plain pattern. Clearly, other explanations are possible.

As to the specific questions concerning bladelet industries, and backing retouch, for what it is worth, it has been my experience that:

- modes of backing retouch are universal: there are only a few ways to back a bladelet, all of them immediately apparent to even an exceptionally stupid rock-knocker;
- backing modes show up in various combinations wherever bladelet assemblages are found: e.g. Helwan retouch occurs in the Azilian of northern Spain;
- backing modes exhibit no 'diagnostic' properties whatsoever — except, perhaps, for tendencies related to handedness;
- it is unwarranted to conclude that backing modes can only reflect the presence of identity-conscious social units when their time–space distributions happen to coincide with those known to us from ethnography.

What we think of as Palaeolithic technologies almost certainly constituted a range of options very broadly distributed in space and time, held in common by all circum-Mediterranean hominids, and invoked differentially according to context. The challenge of future work is to determine what general contextual factors constrained choice amongst these options. Such factors probably included the range and size of, and distance to, raw material; forager mobility strategies, anticipated tasks, group size and composition, structural pose of site occupants in an annual round and, more generally, duration of site occupation (see, e.g., Kuhn 1995).

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Phantom cultures of the Levantine Epipaleolithic

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We thank those whose interest in the Levantine Epipalaeolithic has led them to comment on our research. Such public discussion of differing interpretations is vital to understanding the past. In this article, we briefly respond to some of the points raised by those writing in this issue (G.A. Clark, N. Goring-Morris, D.O. Henry and J.L. Phillips) and in a previous issue (Fellner 1995; Kaufman 1995) of ANTIQUITY.

Regardless of their perspective, these commentators would likely agree with us that the Levant was inhabited by a number of forager groups during the late Pleistocene. Each group probably ranged over a defined spatial territory and maintained relationships with neighbouring (and possibly distant) groups. Each had a social self-identity, and varying social affinity with other groups. Although they employed a diverse material culture, discarded chipped stone artefacts are the most common behavioural residue that remains. It is in the causes of variability in these lithic artefacts and its interpretation that we strongly differ — both in our theoretical approach to the data and our results.

Theoretical perspective

In studying lithic artefacts, we consider typologies to be arbitrary, often convenient, systems *devised by archaeologists* to measure morphological variability (just as millimetres or colour charts measure other aspects). Those criticizing our study envisage Epipalaeolithic indus-

1 Barton has studied Palaeolithic and Epipalaeolithic assemblages and their contexts from Europe and SW Asia for two decades. He also teaches lithic technology and lithic theory. Neeley has studied Epipalaeolithic and Neolithic assemblages from SW Asia for nearly a decade. We assume that our commentators are equally experienced and dedicated professionals.

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tries as comprising a finite set of discrete types, *discovered* by archaeologists, whose frequencies vary in time and space. While variation, from this perspective, represents deviation from these types — noise that can obscure meaningful pattern — we see variation as meaningful and expected. This theoretical dichotomy pervades the natural sciences. Our perspective has been characterized as 'materialist' or 'population thinking'; the alternative approach is termed 'essentialist' or 'typological thinking' (Dunnell 1986; 1989; Mayr 1976; see also Clark this issue, and 1991a). These differences in theoretical approach extend beyond the individual lithic forms to the interpretation of larger-scale patterns.

While neither of these approaches is inherently right or wrong, each may be more or less parsimonious for a given data-set and research objectives. Lithic assemblages have long been analysed from an essentialist/typological point of view, but numerous recent studies support the employment of a materialist/population paradigm. Examples include analyses of Middle Palaeolithic assemblages from Europe and SW Asia (Barton 1988; 1990; 1991; Dibble 1987; 1988; Kuhn 1994; Rolland 1981; Rolland & Dibble 1990), Upper Palaeolithic and Epipalaeolithic assemblages from SW Asia (Barton *et al.* 1996), and North American Archaic and later prehistoric assemblages (Flenniken & Raymond 1986; Flenniken & Wilke 1989; Hoffman 1985). These studies show that macroscopic morphology is largely continuous in sets of lithic artefacts and truly discrete types are few; common archaeological classifications are arbitrary divisions of this continuous variability. This accords well with ethnographic accounts of lithic technology among recent foragers (e.g. Gould *et al.* 1971). Given these studies, we feel that the materialist/population approach we advocate better fits the lithic data in question here, and has a greater potential for understanding behavior in the Levantine Epipalaeolithic.

The need for portability and functional versatility in forager equipment, and spatial/temporal variation in the quality and abundance of suitable raw materials, strongly influence lithic artefact design, manufacture, use and discard (Barton 1991; Nelson 1991). Coupled with the reductive nature of lithic technology and the tendency for foragers to invest little energy in making artefacts, such as lithics, with short use-life expectancies (Bamforth 1986; Nelson 1991), this leaves scant room for function-specific design or for imbuing artefacts with active style (*sensu* Clark 1989). Further, as essential elements of forager economic systems, lithics are likely to be under strong selective control; the effects of drift — producing isochrestic variation (Sacket 1982; 1985) or passive style (Clark 1989) that might allow for tracing of social descent lines — are likely minimal. These constraints, which pervade lithic technology, place severe limits on potential form and impart a large amount of equifinality to the morphologies of the scattered discard assemblages that comprise the Pleistocene archaeological record. For example, forms such as the microburins and microliths discussed here recur over much of temperate Eurasia.

Finally, the morphological features used to construct regional typologies were not created to distinguish the cultural groups they are claimed to identify, or to answer any specific research question (except perhaps to sort assemblages chronologically). In fact, they commonly conflate multiple, different causes of morphological variability. Microlithic systematics, for example, mix at least size and shape, production stages, and hafting modification.

Data considerations

Several of the authors (especially Goring-Morris and Phillips) criticize the quality of the data and the analyses we used in our original study. We are painfully aware of the shortcomings of published data on the Levantine Epipalaeolithic (see Olszewski & Barton 1990). While we would prefer to utilize raw counts and measurements, or at least to integrate basic summary statistics (count, range, standard deviation, mode, median, mean, etc.), we were lucky to find mean size data for even a limited number of forms. Counts of most classes, and especially unretouched forms, often are unreported and measurements are rare indeed. Notably our primary sources of data — with their admitted shortcomings — were published by those individuals most critical of our study.

Compounding these limitations, the data are very coarse-grained. Even doubling the size of our original sample (from 130 to 260 assemblages, to account for those lacking usable data and unpublished ones alluded to by our critics) over the course of 4500 years (14,500–10,000

b.p.) or 225 generations, gives a sample averaging 1·2 assemblages per generation across the entire 100,000 sq. km of the Levant. We have tried to scale both our analyses and interpretations to take into account the uneven and coarse-grained nature of the data. Our critics, on the other hand, claim to recognize distinct ethnic groups among mobile and socially fluid Levantine foragers using the *same data*.

Microburin technique

We suggested that the frequency of microburin debitage is largely a function of the sizes of microliths relative to the bladelets from which they were made. In support of our model, Kaufman notes that two geometric microliths often could have been made from a single bladelet in assemblages with few to no microburins ('Geometric Kebaran'), and both Goring-Morris and Phillips note that blanks are shorter in assemblages with considerable microburin debitage (i.e. 'Mushabian') than in those with little or no such debitage.

All commentators, with the exception of Clark, provide examples of other attributes that we did not examine in our original study. Most seem worth pursuing, but there is little or (more often) no consistent, quantitative data published for the features mentioned.[2] While we do not doubt the observational powers of our colleagues, the significance of variability cannot be evaluated on the basis of subjective assessments alone.

Kaufman's valid comment about the increased variability in microburin frequency among Natufian assemblages (also see Henry 1989) is one of the few that could be evaluated with published data.[3] This seems related to the fact that, unlike the preceding temporal interval, the final Epipalaeolithic is represented by the Natufian and not further subdivided into contemporaneous industrial complexes (except for the later Harifian). In fact, published variability in microburin frequency within the monolithic Natufian 'culture' is greater than among all the preceding 'cultures' combined (i.e. Geometric Kebaran, Madamaghan, Mushabian, Qerenian, Ramonian), in spite of a much smaller sample of Natufian assemblages (mean, $\bar{x} = 49$, s.d., $\sigma = 29$, range = 1–85, N = 27 for the Natufian *vs* $\bar{x} = 25$, $\sigma = 22$, range = 0–76, N = 78 for the preceding 'cultural mix'). While microburin frequency is used to differentiate Geometric Kebaran and Mushabian 'cultures', it is not used to subdivide the Natufian, in spite of increased variability.

Microlith typologies

Our model explains much of the variability in the frequency of those microliths most commonly used to distinguish Epipalaeolithic 'cultures' as discard residues from different stages of microlith manufacture and compound tool maintenance. Because compound tool maintenance involves periodic replacement of some of the microlithic components, a new microlith would need to fit into the space left by one being replaced. We showed how slight modifications of a replacement's hafting portion (i.e. its backing) to fit a pre-existing space would alter a geometric shape from one type to another.

Both Kaufman (1995) and Fellner (1995) mistakenly equate our explanations of variability with edge rejuvenation models proposed for the Middle Palaeolithic (e.g. Barton 1988; 1990; Dibble 1987; 1988; Dibble & Rolland 1990; Rolland 1981). However, most of our discussion centres on the *production* of microlithic artefacts; maintaining compound tools involves hafting *new* microliths, not resharpening old ones.

All the authors critical of our study maintain the essential distinctiveness of microlith types, although they disagree about which are distinct. (For example, Goring-Morris recognizes continuity between lunates and triangles, but Henry feels that these two classes are clearly distinguishable by any 'experienced typologist'.) Kaufman and Henry further charge that no transitional forms exist among microliths. By definition, there can be no transformation between types in an essentialist paradigm, only deviation from 'typical' forms or additional types. Our microlith production model (Neeley & Barton 1994: figure 6) shows a clearly transitional sequence — using the most common microlith types. For even more finely transitional forms, we refer the reader to Goring-

2 For example, Henry provides no citations for his assertions about flexion scars, and there is no mention of residual microburin scars in the 1987 citation Goring-Morris provides; Goring-Morris' 1991 reference was not in the bibliography of the draft provided to ANTIQUITY, and, in turn, sent to us for comment.

3 Using the data-set from our original study.

Morris' (1987) detailed account of the Negev Epipalaeolithic. Every conceivable intermediate form is illustrated and tabulated, including examples of the 'Helwan trapeze/rectangle[s]' that Kaufman claims do not exist. With individual type names of 'double truncated helwan bladelet' and 'atypical helwan lunate' (Goring-Morris 1987: 458–9), they are invisible from an essentialist viewpoint, however.

Added evidence for the compound tool maintenance we postulated is provided in Goring-Morris' study of Negev assemblages (whose conscientious publishing of information left out of many other reports is commendable). Many microliths in Epipalaeolithic assemblages are broken ($\bar{x} = 26\%$, $\sigma = 17\%$, range = 0–87%, N = 81), raising another disturbing question. Broken microliths are usually excluded from typological assessments of industrial affiliation, for good reason: many broken pieces cannot assigned be accurately to a type category. This means that assemblage classification normally is based on a variable fraction of the total microlith population used by a group of foragers, with no assurance that this fraction is representative of the larger population. To our knowledge, there has been no investigation of this phenomenon. It is plausible that this fraction includes an unknown (and possibly large) proportion of microliths that were rejected for use for one reason or another (see also Goring-Morris' thoughts on blanks in this issue). This would make the samples used for assemblage classification rather *unrepresentative* of the populations actually used. Added to this is the problem of biased collections from older excavations (Olszewski & Barton 1990) and still used for assemblage classification (*cf.* Henry 1989: appendix c). Even if different ethnic groups created microliths with slightly different backing shapes, such subtle differences would be difficult or impossible to recognize in the discard assemblages recovered by archaeologists and analysed by means of the current systematics (see also Clark 1989).

Stone tools and settlement systems

Previously, we suggested that a complex interplay of mobility, resource availability, tool production, tool maintenance, tool use and discard behaviour — along with ethnically distinct idiosyncracies in tool manufacture — produce observed assemblage diversity. While admitting that all are possible, our critics see culture as making the greatest contribution.

If prehistoric ethnic divisions (or 'cultures') *can* be equated to typological variability, we can make some predictions as to its nature. Because the majority of activities for all known historic forager groups with an ethnic self-identity take place within a spatially defined piece of the landscape, assemblage variability due to ethnic differences should show similarly discrete, or possibly clinal geographic distributions (e.g. see Savage 1990). Also, there should be spatial co-occurrence between different aspects of variability that result from the same ethnic divisions. In FIGURES 1 and 2, we examine relevant available data for 'Mushabian' and 'Geometric Kebaran' assemblages.

FIGURE 1 shows that there is no geographic patterning — either discrete divisions or clinal distributions — for the critical artefact classes examined.

FIGURE 2 assesses the co-occurrence of microlith forms and microburins. No clearly discrete groups are revealed, but rather constrained, continuous variability. This is typical for inherent technological constraints on morphological variability (see Barton 1988; 1991). Differential discard of residues deriving from microlith manufacture and compound tool maintenance seems the most parsimonious explanation for this distribution.

Our critics take the lack of spatial patterning for 'Mushabian' and 'Geometric Kebaran' industries to mean that both 'cultures' 'occupied the same area, under the same paleoenvironmental conditions and had access to the same . . . resources' (Kaufman 1995: 378). In spite of close cultural contact (even occupying the same territory), each group maintained 'their own traditional tool forms and techniques of manufacture' (Kaufman 1995: 378). However, Epipalaeolithic populations comprised fully modern humans, whose modern representatives do *not* behave in this way. Among mobile foragers, the composition of any one assemblage is composed of: discarded artefacts exhausted *en route* from the previous campsite; those made, used and discarded at the site in question; and the production residues from making artefacts to be carried to the next campsite. These, in turn, are affected by activities performed or planned, and by available and anticipated lithic and other resources *en route* and at the vari-

ous localities. Hence, some degree of assemblage diversity is to be expected, even in sites close to one another. The overlapping distributions of 'Mushabian' and 'Geometric Kebaran' industries says more about such diversity and the conflated nature of typological systematics than anything meaningful about the distributions of social groups.

In support for our settlement model, Kaufman (1995: table 1) indicates that cores were more intensively reduced (higher debitage:core ratio), fewer cores were produced on the sites at which they were discarded (lower primary element:core ratio), and artefacts were used more intensively (higher tool:core ratio and lower debitage:tool ratio) in assemblages classified as Geometric Kebaran compared with those classified as Mushabian. These characteristics suggest the former assemblages represent higher mobility and conditions encouraging material conservation — the very explanation we proposed as responsible for the most obvious differences between the Geometric Kebaran and Mushabian. The lack of statistical significance at an $\alpha = 0{\cdot}05$ level clearly is due to the wide range of variability within the Mushabian and Geometric Kebaran industries, indicating that these classes, as currently conceptualized, are not very useful entities for evaluating this kind of variability in the Levantine Epipalaeolithic — a point we made before and reiterate now.

Similarly, Goring-Morris notes for a group of sites in the western Negev that assemblages classified as Mushabian were produced from 'immediately available' flint, those classified as Ramonian and Natufian were produced from flint sources 'at least 6–8 km distant', and those classified as Geometric Kebaran vary in being produced from distant and local raw material sources. Although Goring-Morris attributes this to cultural preferences, it accords well with our previous predictions about mobility and raw material access (Neeley & Barton 1994: 287). In spite of assertions to the contrary, both Goring-Morris' and Henry's responses reveal spatial variation in the quality and quantity of raw material in the modern Levantine landscape — cultivated, overgrazed and eroded for millennia in many areas. Raw material would have had an even more patchy distribution in the much less eroded and more vegetated terminal Pleistocene landscape.

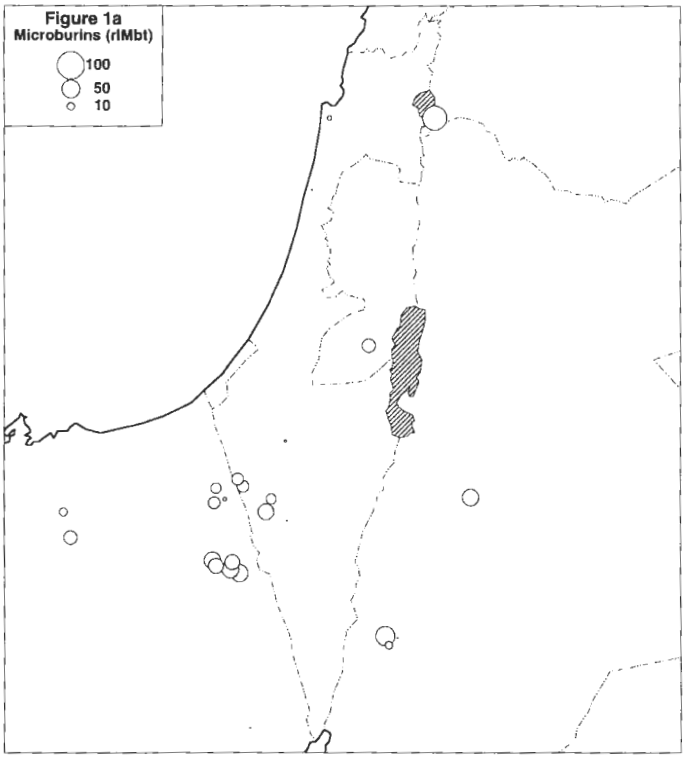
Microliths and 'culture'

That much of the variability expressed in Epipalaeolithic typologies is a result of the processes of microlith production and use in compound tools, and associated constraints, should come as no surprise. We do not think that *all* Geometric Kebaran assemblages derive from highly mobile foragers suffering from raw material shortage nor that *all* Mushabian assemblages represent the opposite extreme. However, such processes seem to underlie much of the morphological variability that has been pigeon-holed into such industries — and obscured by them to a considerable extent.

Our critics go to considerable lengths to point out differences among assemblages that we did not address in our study. We do not purport to have explained all aspects of lithic variability in the Levantine Epipalaeolithic. We have attempted to disentangle some elements of the common Epipalaeolithic systematics in SW Asia, focusing on a few aspects of microlith form — albeit critical ones for typologies. We feel that our proposed explanations do this scientifically, sufficiently and more parsimoniously than others now current. Other aspects indeed should be investigated — objectively, systematically and quantitatively. The implication of our critics is that assemblage difference equals ethnic difference. While we agree with Kaufman (1995: 377) that 'technology and typology do co-vary' — the major point of our original paper — this does not lead us inescapably to the conclusion that this 'variability represents cultural and temporal markers' (Kaufman 1995: 375–6).

Do any aspects of microlith morphology reflect ethnic divisions? Possibly. But we maintain that this has yet to be seriously investigated, much less demonstrated. Beyond showing how microliths were made, there has been little attempt to explain the behavioural causes of formal variability in microlithic artefacts. 'Culture' is a weak explanation when it is simply a catch-all category for unexplained variability (*cf.* Henry, this issue). There is no inherent reason why hafting modifications, in the form of backing, or any other aspect of current typologies have anything to do with ethnic identity (see Sinopoli 1991).

The same is true of the named industrial complexes. The standard approach has been to classify assemblages into timeless and spaceless 'industries' on the basis of similarity and



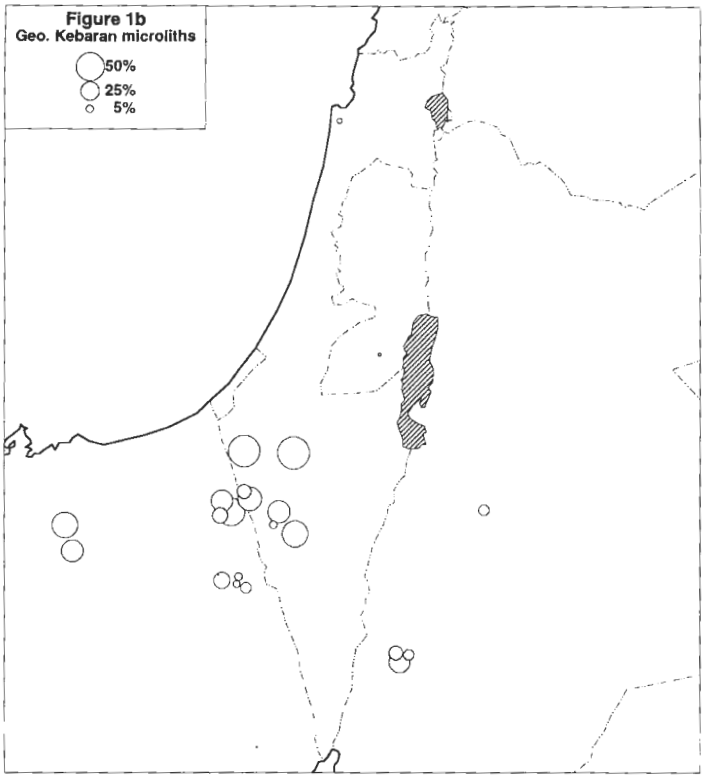
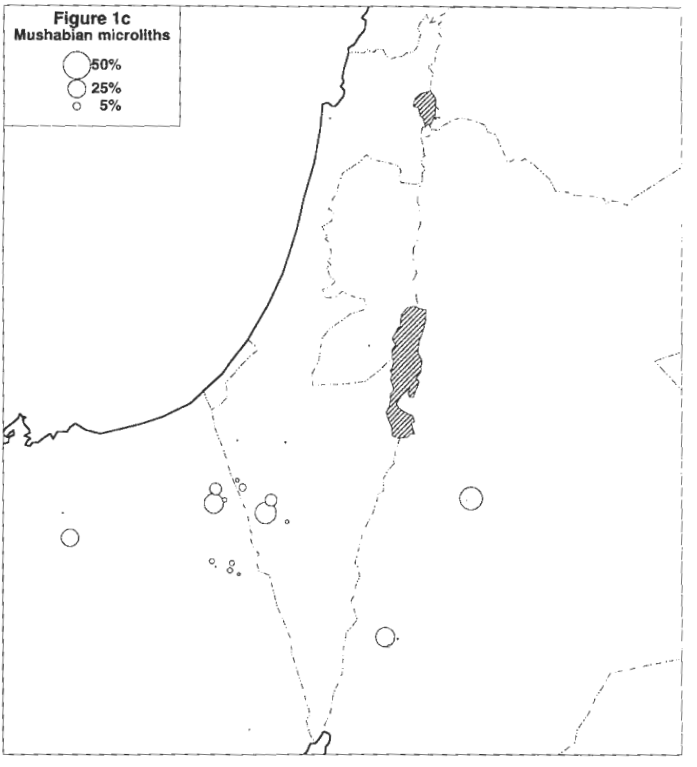


FIGURE 1. *Distribution of:*
a *microburins,*
b *typical 'Geometric Kebaran' type microliths (straight backed bladelets and trapeze/rectangles), and*
c *typical 'Mushabian' type microliths (arched backed and scalene bladelets, and La Mouillah Points).*

Assemblages are displayed according to relevant artefact frequency, irrespective of the industry to which they have been assigned. Symbol size is proportional to relative frequency. Microburin frequency is represented by the restricted microburin index (rIMbt); microlith frequencies are shown as percent of total retouched assemblage.

Data from Henry (1989); Goring-Morris (1987); and Olszewski et al. *(1994).*

For situations of more than one assemblage at a locality on the map (usually from several sites in close proximity to one another), a mean value was used. The range of values at such localities with multiple assemblages is strongly correlated with the number of assemblages analysed ($r = 0{\cdot}79$ for microburins, $r = 0{\cdot}86$ for Geometric Kebaran type microliths, and $r = 0{\cdot}63$ for Mushabian type microliths), indicating that the archaeological recovery of diversity is largely a function of sample size.



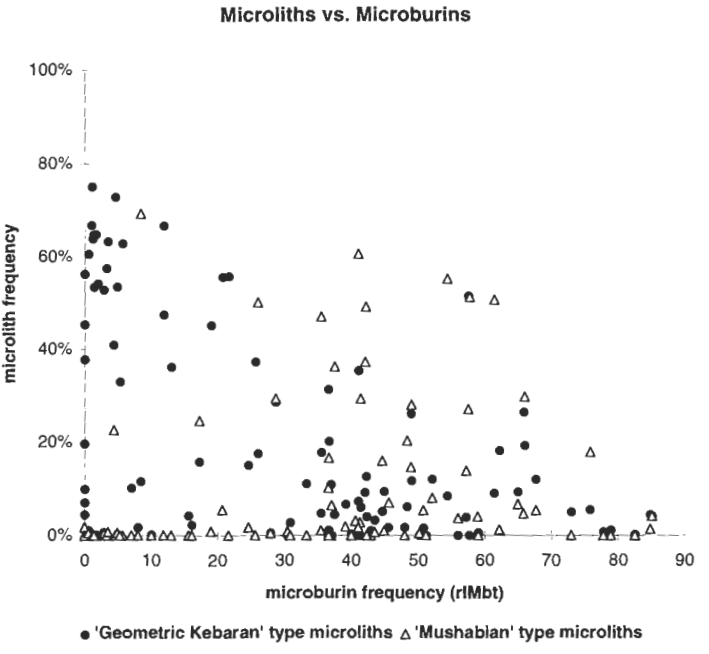


FIGURE 2. *Scatterplot of microburin frequency (rIMbt) versus relative frequencies of 'Geometric Kebaran' type and 'Mushabian' type microliths (see* FIGURE 1*) (N = 99).*

Along the left side of the graph are assemblages derived primarily from maintenance of compound tools: numerous discarded geometrics, with rare initial (microburins) and intermediate (various backed bladelets) stage production residues.

Assemblages near the centre of the graph represent geometric production from intermediate elements and compound tool manufacture: discarded geometrics in variable proportions, common (but still variable) intermediate stage production residues, and modest frequencies of initial stage production residues. Along the right edge of the graph are assemblages from bladelet and microlith 'preform' production: initial production residues are frequent and all microliths are rare or absent.

Data from Henry (1989); Goring-Morris (1987); Olszewski et al. *(1994).*

dissimilarity in assemblage composition, as measured by the frequencies of morphological types. These industries are considered, *a priori*, to represent social entities, for which temporal and spatial distributions, and the environmental contexts are assessed *post facto* (e.g. 'what is the age and geographic extent of the Mushabian?'). This approach is most likely to reveal timeless and spaceless patterning inherent in lithic reduction technology. Social groups are not timeless and spaceless. For foragers, especially, they occupy a discrete, contiguous piece of landscape — to the exclusion of other such groups — and exist in recognizable form for a limited time-span (Palmer *et al.* 1995). If one hopes to identify such groups in the prehistoric record, a better approach would be first to identify the closely contemporaneous assemblages in a restricted, spatial context, with the working hypothesis that they represent residues of closely related social groups. Then, one can evaluate assemblage variability within this dataset to distinguish it from other, spatially and temporally defined, groups of assemblages.

It is unlikely that the Mushabian and Geometric Kebaran complexes represent different social groups, but probably cross-cut whatever ethnic divisions existed in the region. Neither do they seem very useful for exploring the types of processes we have addressed, representing a diverse mix of sites and associated behaviours, with only general statistical tendencies in the direction of the models we proposed. Because of the way they have been created by archaeologists, the same is very likely true of *all* other industrial complexes in the Levantine Epipaleolithic.

Without an understanding of the underlying causes of variability that differentiate these complexes, they are simply phantom cultures — archaeological constructs that have no reality in Epipalaeolithic activities or social organization. Grouping assemblages by the compass orientation of the microliths in the ground would be as valid and as useful. Certainly there were real people in the Levant during the Epipalaeolithic. They made real artefacts, performed real behaviours and had real social organizations. The material residues of these behaviours are indeed our key to their interpretation. However, because of the way archaeologists have approached the available data, these prehistoric people are largely invisible to us. While we disagree with Fellner's charge that our study 'undermine[s] the validity of much of the research in this field carried out during the last 30 years' (1995: 381), a fundamental change in archaeological approaches to Levantine prehistory is warranted. Another 30 years of chasing phantoms will do little to advance our understanding of the past.

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