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Theoretical Issues in the Interpretation of Microartifacts

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Archaeology is increasingly partitioned into specialities. While this practice is not universally deleterious, frequently it limits the impact of novel concepts to small segments of the discipline. Such is the case with the idea of microartifacts, now treated by only a handful of specialists. After linking the definition of microartifact to techniques of sampling and identification, the unique and valuable information of small artifacts is obvious. Microartifacts, by virtue of their unique transport and deposition properties, compliment the information contained in macroartifacts. Thus, they should be a routine concern in all archaeological research. This implies a stronger integration of geoarchaeology and archaeology.

INTRODUCTION

Although archaeologists may occasionally emphasize other subjects in accord with contemporary fads, most archaeologists would agree that at the most fundamental level, they study artifacts (Clarke, 1968; Dunnell, 1971; Spaulding, 1960). Archaeologists are also aware that these artifacts are found in various sizes from the very small to the very large, even if only a fraction of that range is used in most research. Until quite recently small artifacts (microartifacts) have not attracted much attention. The increased interest in small artifacts is directly traceable to Fladmark's (1982) landmark paper on microdebitage. Significantly, Fladmark's investigation was not an analysis of small artifacts generally, but specifically framed around lithic technology. Even so, Fladmark recognized a larger potential of microdebitage study. Perhaps even more remarkable, given the original insights of Fladmark and the relatively modest equipment required of the technique, is that so few investigators pursue the analysis of small artifacts. Microartifact analysis appears to be regarded as an optional speciality, not essential to archaeological investigations.

This paper delineates the role of microartifacts in the discipline as a whole, first by taking a theoretical perspective that integrates microartifacts with the general notion of artifact, and second by examining the kinds of information that microartifacts contain as they contrast with the larger artifacts of traditional focus. This discussion leads to the conclusion that while microartifacts supplement some information obtained from larger artifacts (and this is the dimension along which their utility has been judged thus far), most of the information they contain complements that obtained from larger objects.

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ARTIFACTS

From a theoretical perspective, an artifact is anything that displays one or more attributes as a consequence of human activity, i.e., possesses one or more artificial attributes (Dunnell, 1971:117, Spaulding, 1960:438). This is the sense in which all archaeologists study artifacts. A number of properties of this definition need to be remarked. First, artifacts are objects without scale specification. Secondly, an attribute of the object may be a physical property, such as color or shape, or it may be locational. Objects become artifacts when their properties are altered by human actions and when their location is a consequence of human agents. Many artifacts entail both kinds of artificial attributes.

Defining Artifacts

The definition of artifacts has attracted little theoretical attention, in spite of the demonstrably central role of the notion in archaeology and the debates over the artificiality of purportedly early artifacts that have been with archaeology since its inception (Grayson, 1983). The emergence of archaeology as a distinct field in the 19th century was predicated on the recognition, in the two preceding centuries, of ancient artifacts as the work of people. Unfamiliar forms (objects unlike those manufactured by living populations) had traditionally been explained as natural phenomena, fossils, geological structures, or mythical creations. Particular forms were successively identified as having a human origin by analogy, association, or circumstance, so that by the mid-19th century a wide variety of prehistoric objects were regarded as artifacts. Their associations with extinct animals played a crucial role in the establishment of human antiquity (Grayson, 1983).

This process of artifact recognition (through analogy and association) has continued, expanding the range of things regarded as artifacts. Prehistorians began to recognize more primitive tools such as choppers and more elaborate structures such as mounds as creations of prehistoric people. To appreciate the currency of this phenomenon in the development of the notion of artifact, one need look no further than the arguments concerning a particular kind of fracture in bone that may be uniquely attributable to human beings (e.g., Bonnichson, 1979; Morlan, 1980).

Partitioning Artifacts by Kind

Paralleling this gradual expansion of the list of things that are regarded as artifacts, has been a partitioning of the concept of artifact by kind and size. While these partitions are created by analysts for particular research questions, they have been reified and affect data collection and interpretation.

The term "artifact" is frequently reserved for the products of human technology. Other objects, which may or may not display physical modification, are defined as ecofacts (e.g., Sharer and Ashmore, 1987). In part, this restriction reflects the history of archaeological interests. For example, an interest in chronology requires artifacts with a significant amount of style (Dunnell, 1986). Thus, even though in an abstract sense a larger range of objects might be acknowledged as artifacts, in practical terms "artifact" was often interpreted as only decorated pottery or rim sherds, or finished lithic bifaces (e.g., Heizer and Graham, 1967). Undecorated ceramics and debitage were not only neglected during tabulation and analysis, but often were not even collected. Objects not manufactured by people (e.g., botanical material, sediments, and faunal remains) were seen as "non-artifactual archaeological materials" (e.g., Taylor, 1957), relevant to archaeological pursuits but not artifacts.

The broader range of interpretative interests of the new archaeology did much to widen the pragmatic range of objects treated as artifacts (e.g., Schiffer, 1972, 1976, 1983, 1987). Still, current research proposals display obvious partitioning of specialists for identification of these non-artifactual materials. In consequence, these "non-artifactual" materials are examined by non-archaeologists and are used to address non-human research questions.

Partitioning Artifacts by Size

Partitioning of the concept of artifact along the lines of scale has followed pragmatic lines. Artifacts too large and/or incoherent to be transported from the field have become "features" or "structures." Very large artifacts remain vaguely and arbitrarily delineated as "sites" or similar constructions (Dunnell and Dancey, 1983; Dunnell, 1988). Artifacts too small to be recovered individually have been ignored regularly and their recovery limited to "samples" of the "matrix" (often called soil samples; Stein and Farrand, 1985; Stein, 1987). Along the dimension of size, "artifact" has become, largely by default, coterminous with objects that can be picked up with the hand and identified without magnification.

All of these partitions rest upon important, usually empirical properties of artifacts that have resulted in divisions of the discipline into a variety of specialities, each tracing its own trajectory. Integration of the discipline of archaeology requires a theoretical notion of artifact that can relate the various pragmatic usages that partition the discipline. Two approaches, appropriate to different research contexts, are possible. A robust definition of artifact, which interprets "artificial attribute" as any attribute *not known* to be a consequence of natural processes, minimizes Type I identification errors and is appropriate to CRM and destructive contexts. A weak definition, which interprets "artificial attribute" as any attribute *known* to be a consequence of human activity, minimizes Type II identification errors and is appropriate in nondestructive contexts (Dunnell, 1984).

MICROARTIFACTS

Microartifacts denote all objects smaller than a given size that otherwise qualify as artifacts. As intuition suggests and recent studies demonstrate

(Bullard, 1970; Butzer, 1978, 1982; Fladmark, 1982; Hassan, 1975, 1978; Hull, 1987; Madsen, 1988; Rapp, 1975; Rosen, 1986; Stein and Teltser, 1989; Vance, 1985), there are many kinds of small artifacts and many kinds of interpretations that they provide. Not all objects recovered as microartifacts enter the archaeological record as microartifacts. Microdebitage usually enters the record as small objects, shatter or micro-flakes produced during percussion and pressure flaking. But most other artifact types enter the record as larger objects and become smaller while resident in the archaeological context. Smaller sizes are the result of chemical and physical weathering that takes place after deposition. Microartifacts that become small after deposition inform not only about cultural properties that persist, but also about transformations of the archaeological deposit since deposition. Microartifacts that entered the record already small inform about cultural properties primarily.

Scale Specification

The upward boundary of microartifact size is obviously an arbitrary decision, but there are sound, empirical reasons for making the distinction at a certain size. The most important consideration lies in the interaction of size and recovery. There is a size beyond which aggregate (bulk) sediment samples become a more practical means of collection. Screens and fingers place a practical lower limit on the efficiency with which discrete items can be recovered. Further, for small objects, samples are adequate estimators of frequencies (e.g., Casteel, 1970, 1976).

As Fladmark noted (1982:205), in addition to the problems of convenient sizes for our hands, techniques of observation and identification shift from the naked eye to instruments as objects become smaller than our fingertips. Fladmark suggested an upper limit for microdebitage of 1.0 mm, basing the selection of this boundary on the ability to distinguish flakes from other lithic particles without instrumentation. This boundary was based on his experience in the laboratory.

Considering field conditions and the full range of artifacts beyond lithic debitage, we suggest an upper limit for microartifacts at 2.0 mm. Both recovery and identification constraints suggest that Fladmark's original 1.0 mm limit is too small. Surface collecting and excavation sieving are practical in most field situations only for objects greater than 2.0 mm. Field identification of material that is 1.0 mm produces unreliable recovery results (e.g., results are heavily influenced by the obtrusiveness of particular shapes and materials). Also, reasonable estimates of densities of objects up to 2.0 mm in size can be obtained from bulk samples, while unbiased identification is facilitated by microscopic examination. In short, rather than defining the upper limit of microartifacts in a capricious fashion, we suggest that it be tied to the size at which a change in collection and identification techniques is necessary. This same size is the sedimentological boundary between sand and gravel particle sizes (Folk, 1980), a fact that strongly influences this recommendation.

Stipulating a lower boundary is more complex but conditioned by similar considerations. Theoretically, artifacts are detectable to ionic sizes, as in concentrations of phosphorus. Detection of artifacts shifts from identifying individuals (deterministic) to detecting artificial concentrations (probabilistic) as artifact sizes become smaller and individual items lack distinctive physical properties. This shift occurs at different sizes for different compositional artifacts. A ceramic that is tempered with 0.5 mm sand will break into its constituent elements, sand and aggregated clay, at a relatively large size, whereas bone and lithics will retain their distinctive structure to much smaller sizes. Because the point at which identification shifts from probabilistic to deterministic varies considerably, we suggest that the lower boundary be arbitrarily placed at 0.25 mm. Objects larger than 0.25 mm can be reliably identified under stereomicroscope (Stein and Teltser, 1989; Vance, 1985), while objects smaller than 0.25 mm typically require a chemical approach and probabilistic identification. This size corresponds to the boundary between medium and fine sand in sedimentological nomenclature (Folk, 1980). Lastly, when considering this decision of lower boundary placement, the method of data collection is not relevant (as it was when considering the upper boundary of microartifacts). Because a bulk sample, which is adequate to characterize the frequencies of large microartifacts, is also adequate to characterize smaller microartifacts, a shift in sampling strategy is not required.

In sum, to distinguish microartifacts from other size artifacts, the boundaries should reflect changes in techniques required by sampling and identification. Because the archaeological information contained in artifacts varies clinally with their size and materials, distinguishing microartifacts as a group is warranted *not* by the nature of the individual artifacts, but rather by our ability to sample and identify them. That ability shifts at 2.0 mm and again at 0.25 mm. Thus, these sizes are proposed for the boundaries of microartifact.

MICROARTIFACTS AS ARCHAEOLOGICAL DATA

Information Content and Size

Even though size limits are conditioned by practical considerations, the amount of information contained in an object is systematically related to its size (Figure 1). In general, the smaller the object is, the less information it contains. A small object has fewer parts and thus fewer potential attributes. A 1.0 mm potsherd cannot be identified with a culture historical type that requires observations of surface treatments and paste characteristics. A larger sherd cannot be identified with a ceramic type that requires observations of vessel characteristics. Yet the location of the sherd, either as a ceramic or a ceramic with a particular paste, is an attribute that is informative regardless of sherd size. Microceramics may not be assignable to historical ceramic types,

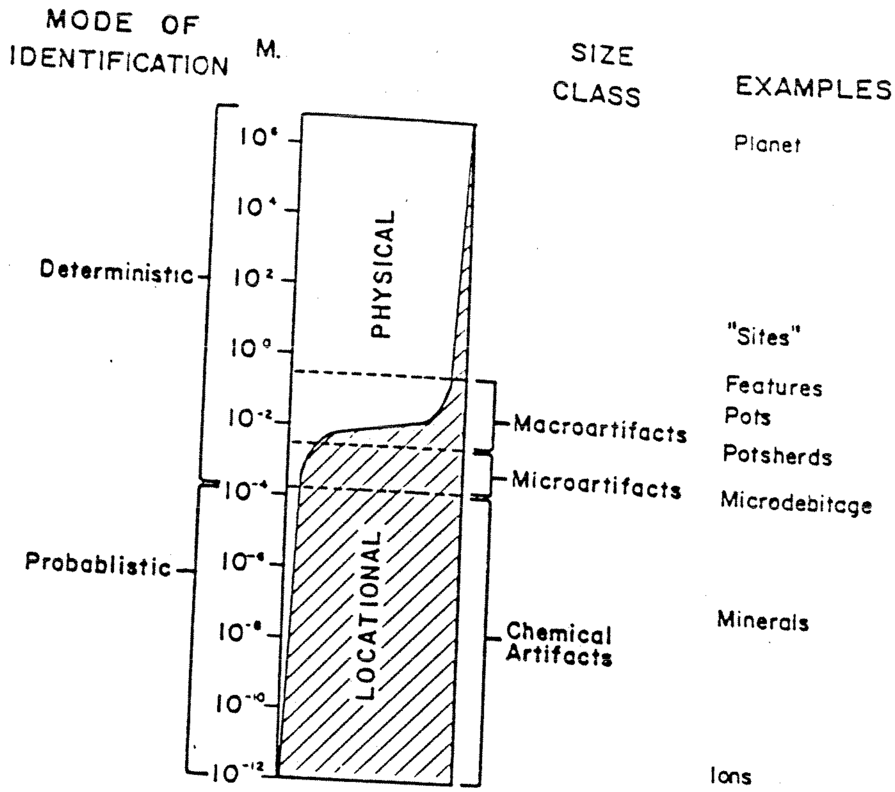

Figure 1. Relative importance of physical and locational attributes in relation to artifact size. Horizontal dashed lines indicate the boundaries of the size classes proposed in this paper.

but they can be used as evidence that ceramic deposition (and thus cultural activity) took place at that location. Location can be ascertained for all artifacts, regardless of size. As the size of the artifact decreases, locational attributes become an increasingly dominant source of information, until (when combined with a single physical attribute) they represent the minimal attributes necessary to identify cultural activity.

The lower per-unit information content of microartifacts is compensated by other characteristics in important ways. The fact that whole pots have more information than sherds and assemblages of pots have more information than single pots has not led to the rejection of sherds or pots as sources of archaeological data. The fact that microartifacts typically contain less information than the larger artifacts of traditional focus should not preclude obtaining the information that they do contain.

Informational Content and Abundance

Microartifacts are typically more numerous than their larger counterparts and thus have many advantages. As Fladmark notes with microdebitage (1982:218), large numbers of small objects allow detection of occupation and human activities in small samples. The abundance of microartifacts makes them especially valuable in circumstances such as coring sites that are deeply buried (Stein, 1986) (i.e., only a small amount of the site is available for examination). Even in situations where large concentrations of artifacts are easily accessible, large numbers of microartifacts permit more precise and cost-effective estimates of artifact abundance. The combination of greater abundance and small size provides high quality quantitative data, which covers a great range of archaeological situations.

As Evidence for Transportation

Because of their size, the transportation and deposition of microartifacts is controlled by physical processes that differ from their larger analogs. Macroartifacts are sufficiently large that size alone serves to identify them as artifacts in many depositional situations (e.g., alluvial, lacustrine, aeolian). They are so large that no transport agent, other than a solid or highly viscous one, would have the competency to entrain them (Stein, 1987; Stein and Teltser, 1989). On the other hand, microartifacts can be transported by water and wind under a wide range of conditions. Thus to ascertain the significance of the location of the microartifacts, knowledge of the kind and competency of transport agents operative since the deposition of the artifacts is required.

On the other hand, some transport agents, such as people (including both prehistoric occupants and artifact collectors) and some other animals, selectively move macroartifacts, while they are incompetent to move microartifacts. On those occasions when these transport agents move both large and small objects (e.g., burrows and pits) the signature in the archaeological record is readily detectable using standard archaeological techniques. The immunity of microartifacts to transport by agents that selectively move only large objects makes microartifacts prime candidates for detecting what Schiffer (1972, 1976, 1987) has termed *de facto* refuse. For example, Vance (1982, 1986) has argued that concentrations of macroflakes in an early Historic-period settlement in Washington, which were interpreted as "lithic workshops," lack the high levels of microflakes expected. Similarly, Dunnell (1985) uses the presence of microflakes to ascertain whether single artifacts encountered in plowed fields represent isolated objects lost in use or samples of low density artifact clusters.

The point is not that microartifacts are better or worse in some absolute sense than macroartifacts in terms of their transportation histories. They are transported differently, by different agents of different competencies. Because of these differences, they supply unique information on archaeological deposits. The distribution of microartifacts may frequently supply information crucial to interpret the distribution of macroartifacts, and vice versa.

As Evidence of Post-Depositional Disturbance

Archaeologists frequently lament the effects of predation on the surficial archaeological record by artifact collectors. While this effect is probably much overestimated, at least on plowed surfaces, some distortion of frequencies and perhaps even distribution does occur in macroartifacts from this source. As just noted, microartifacts are immune to such predation and can provide better estimates of density, size, and distribution than can collections of macroartifacts across localities subject to differential predation.

Inasmuch as a large proportion of the surficial archaeological record has been subjected to plowing for variable periods of time, the different transport properties of microartifacts and macroartifacts are important. Plowing can move tiny particles only short distances, whereas larger objects can be transported laterally over considerable distances (Lewarch and O'Brien, 1981). This notion of little movement by the plow is more dramatically illustrated by the stability of boundaries of different soil types and archaeological sites under centuries of cultivation (Hampton, 1975). The spatial stability of microartifacts on plowed surfaces means that microartifacts may typically be the best means by which artifact clusters and their boundaries are mapped.

Although microartifacts are found on plowed surfaces in association with macroartifacts, in areas where surfaces are subjected to aeolian transport, fluvial transport, or illuviation, small-sized artifacts can be removed selectively from the archaeological record. On surfaces devoid of vegetation and subject to high winds, microartifacts may be dispersed at the time of occupation or at some later date. On surfaces subjected to sheet wash, microartifacts will be entrained in the flow and removed as suspension or saltation load, the size of the microartifacts so affected being a function of the agent's competency. In archaeological deposits where pore spaces are sufficiently large (such as shell middens), microartifacts may be illuviated from the surface into subsurface horizons. In these cases, the absence of microartifacts of particular sizes provides information crucial to interpreting macroartifact distributions; i.e., the transport history, both the agents and their competencies.

Artifacts of all sizes are affected by exposure to weathering processes, especially mechanical and chemical weathering that occurs on or near the surface. By virtue of the size of microartifacts, they have larger ratios of surface area/volume. This ratio dictates that more reactive substances are reduced in size until they fall into the class of artifacts that can only be detected chemically. By the same token, weathering can reduce macroartifacts to the point that only microartifacts and chemical traces remain. Elevated concentrations of phosphorus marking the former location of bone (Eidt 1984, 1985) exemplify this process. Only by the examination of the full range of artifact sizes can any particular segment of that range be interpreted securely.

CONCLUSIONS

Although the information content of individual artifacts varies continuously with size, there are practical reasons, both in terms of data collection and artifact identification, to segregate the range between 2.0 mm and 0.25 mm as a special class of artifact, microartifacts. Indeed, the difficulties of collection and identification have been the reasons for excluding microartifacts from the traditional view of what contitutes archaeological data.

Microartifacts, as a class, should not be ignored, nor their collection and analysis relegated to an optional geoarchaeological speciality. They are an important, and in some respects, a more robust source of information than the traditional macroartifacts. Microartifacts are not simply smaller versions of the larger artifacts. They contain different information about the archaeological record than do macroartifacts. Microartifacts (and by extension, chemical artifacts) are complimentary, not supplementary data and should be a routine concern of all archaeological investigations. To ignore them not only omits information about small artifacts *per se* but it imperils the interpretation of macroartifacts and their distributions by omiting crucial data on the history of the deposit.

The complimentary nature of different sizes of artifacts has an important implication for the so-called "tests" of the validity of microartifacts, which have compared the distribution of microartifacts with that of macroartifacts (Nicholson, 1983). A correlation between the two might intuitively seem to validate the utility of microartifacts (or vice-versa, though that outcome is not entertained), but this reasoning is defective. The real value of microartifacts, as in other novel data sources, lies not in reinforcing what is already known or believed but in their contribution of different information. As should be clear from our brief survey, only under the most unusual formation conditions would different size classes of artifacts be expected to display identical distributions. Microartifacts, by virtue of their size, their transport characteristics, and their abundance, provide information that is not otherwise obtainable.

In closing, there is one additional implication that warrants attention. Micro- and chemical artifacts are best acquired by bulk samples of sediment. When the objectives of such sampling are limited to geological and pedological issues, the acquisition of samples is conditioned by those research needs. To exploit the *archaeological* value of microartifacts, new sampling designs for bulk samples will be required in order to compare frequencies, kinds, and distributions of macro-, micro-, and chemical artifacts. Collecting bulk samples using the vertical sampling profile (designed by soil scientists to study soil formation) must be supplemented by extensive horizontal sampling comparable to what is now used for macroartifacts.

Small artifacts represent the single largest untapped data source available to archaeologists. This potential cannot be realized as long as microartifacts are treated as the concern of specialists. The lack of interest in microartifacts is partly a consequence of the narrow interests of earlier generations of archaeologists, but also stems from the difficulties associated with the recovery and identification of small objects. The incorporation of sedimentological training in graduate programs and the availability of modern analytical equipment should remove the last barriers to what promises to be a major breakthrough in archaeological research.

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