Technological Strategies in the Lower Pleistocene at Olduvai Beds I and II

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When one takes a survey of the really grand sites of prehistoric research, none compares to Olduvai Gorge. Only a handful of sites rival Olduvai in generating lively and productive debates, and precious few contain the endless riches of data waiting to be unearthed. The grandeur of the site was matched by that of its excavator, Mary Leakey, who recognized and fulfilled its potential, and by doing so set the methodological and research paradigms for a whole generation of workers. Leakey's (1971) authoritative monograph has served as the basis for all subsequent discussions of the Oldowan and as the key work in understanding the evolution of lithic artifacts. It was the basis for successive prolific research that addressed issues of cultural taxonomy and change, biostratigraphy, site formation processes, and land use patterns. All these studies relied to variable degrees on Leakey's original analyses. In this volume, de la Torre and Mora take it upon themselves to re-assess Leakey's original observations and interpretations of early stone tool manufacture through time through their own first-hand analyses of selected lithic assemblages from Beds I and II. In other words, they question whether the "bible" of Early Paleolithic lithic artifacts is, in fact, writ in stone.

The volume is skimpy on theory and revolves entirely around the empirical data amassed by the authors. The first and last of its nine chapters are an introduction and synthesis, respectively, the other seven being descriptions of selected lithic assemblages. Chapter 1, which presents the chronological and contextual background for the sequence of the lower beds of Olduvai, provides the rationale for the study and the criteria according to which assemblages were included in the study. While acknowledging the contributions of earlier workers, the authors state that "[a]ll these authors have based themselves on the data provided by Leakey (1971) and have used it for conducting statistical analyses. By not examining the artifacts themselves, these scholars have attributed cultural connotations to questionable objects…" (p. 10). To remedy this situation, de la Torre and Mora opted to study assemblages in Bed I and II that Leakey herself considered to be in "primary position." This is of utmost importance for the purposes of their study, since they perceive the significance of the work in its focus on "synchronic reconstruction of the technology and operational sequences employed in each site."

This goal sets the format for the volume. Each of the data chapters presents a detailed, monographic description of a lithic assemblage from one of seven sites (and 14 stratigraphic horizons), starting with the earliest (DK, FLK Zinj and FLK North Levels 1–6 in Bed I) through the mid-section occurrences (FLK North *Deinotherium* in Lower Bed II, FLK North Sandy Conglomerate, EF-HR and FC West in "Middle" Bed II) to the latest cases included in the study (the lower and upper floors of TK and BK in Upper Bed II). Although they berate the "diachronic fixation" (p. 10) of earlier workers, the authors are not free of it themselves (as amply demonstrated by their discussion in Chapter 9). This is not really surprising because, after all, one would not seriously expect any archaeologist, regardless of specific research interests, to remain impervious to temporal patterning when studying a stratified sequence.

The structure of the data chapters is standardized, facilitating comparisons between the assemblages. After an introduction presenting each site's context as described by Leakey and the significance of each assemblage as perceived by earlier workers, there follows a general characterization of the assemblage in terms of artifact categories (cores, test cores, broken or complete flakes, small flakes, angular fragments, various hammerstones, etc.). Then raw materials, knapping products (i.e., the detached pieces), retouched artifacts, and cores are presented with useful graphic aids showing distribution curves and statistical tests as well as drawings of artifacts.

A major goal of the research was to derive applicable broad categories of knapping systems from the highly variable modes and methods of exploitation. These generalizations are based first on designation of cores according to the number of exploitation surfaces (unifacial, bifacial, and multifacial/polyhedron), and a further sub-division according to the geometric relationship between detachments on the observed surfaces, such that one can distinguish between unidirectional abrupt unifacial strategy (Figure 2.18, p. 26), a "core with unifacial abrupt exploitation in independent planes" (Figure 2.19, p. 27) or "unifacial cores with peripheral exploitation of the horizontal plane" (Figure 2.20, p. 27), as opposed to "bifacial abrupt" and "bifacial peripheral" (Figures 2.221-2.22, pp. 28-29), and so on. The majority of technological processes employed throughout the sequence are discussed earlier, in the first data chapter describing the DK assemblage, because they were identified in this earliest assemblage. There is however an incremental increase in the importance of specific strategies through time, and particular knapping processes are described in minute technological details when discussing those assemblages in which they attain quantitative importance. Finally, based on metric and qualitative characterization of the artifacts, the technological systems that were identified are reconstructed through looking mostly at cores and are based on the principles of the *chaîne opératoire* approach.

The choice of this worldview to deal with lithic assemblages in general, and with Oldowan ones in particular, is not unproblematic. Analyzing lithics from a *chaîne*

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opératoire approach often is based on strong beliefs of the analyst, anchored in what he/she perceives as an intimate familiarity with the subject assemblage; but the principles according to which lithic exploitation strategies are reconstructed are not always necessarily clear to an outsider. The use of cores as the main source for reconstructing lithic strategies also is dubious because cores only reflect the last stages of reduction and may not depict the core's use life prior to these stages (e.g., Braun et al. 2005 with regards the Oldowan; Bar-Yosef 1998 regarding later periods). Arguably this is less of an issue in simple reduction procedures than it might be studying technological processes involving pre-planned flakes, but herein lies also the logical hurdle. To reconstruct technological systems from core data, one has to have some previous knowledge about the studied technological system and, possibly, one has to assume with some certainty that the technological systems are simple and rigid, but, to obtain such knowledge, one has to first reconstruct the technological process.

De la Torre and Mora circumvent this difficulty in two ways. First, their descriptions of the technological systems are well illustrated. The schematic graphics describing the geometric principles of various knapping strategies are shown in tandem with drawings or photographs of actual artifacts on which the pattern can be observed, clarifying for the reader how such products look like in "real life" and why they were associated with the particular technological strategy. Second, after statistical analyses, the characteristics of detached items are brought into the discussion as auxiliary data. These characteristics often reveal the existence in an assemblage of flaking systems that are not necessarily or easily recognized on the cores themselves. De la Torre and Mora argue convincingly that higher degrees of technological variability and complexity are revealed by this procedure. Flake characteristics can be used to actively *test* the reconstructions of the technological system as derived from the cores (e.g., Hovers 1997, in preparation), but it is not entirely clear whether the data had been applied in this manner to the Oldowan assemblages discussed in the volume.

Another problem with the application of *chaîne opératoire* is specific to the Oldowan. The high-level theory of *chaîne opératoir*e is consistent with the notion that technologies are systemic behaviors. Following the writings of Mauss, Leroi-Gourhan, and Levi-Strauss, c*haîne opératoire* makes *a priori* assumptions about societal/cultural infrastructures that underlie and shape the technological system. Ethnological case studies document the diversity and complexity of the interactions between cultural/societal infra-structures and technological systems (e.g., Gosselain 1998; Lemonnier 1993; Roux 2003; Stout 2002, to name but a few examples). In short, *chaîne opératoir*e is an anthropological rather than archaeological concept, and a complex one at that (Hovers 2004; Tostevin 2006). Can we claim sufficient knowledge of Oldowan lifeways that would justify investing Oldowan lithic technology with the manifold implications of the concept?

Probably a more acceptable term to use here is "reduction sequence." Contrary to some recently voiced opinions (e.g., Shott 2003), this is not a synonym or equivalent to *chaîne opératoire* (Hovers 2004). The term can be applied to only a restricted set of technological behaviors (for example, bone working, wood cutting, and knapping stone) that consist of *reducing* the volume/mass of an initial raw material package in an *irreversible* sequence. These properties of the reduction sequence are the key elements that allow prehistorians to replay (mentally but sometimes also physically through refitting studies) the course of prehistoric actions. In the parlance of *chaîne opératoire*, reduction sequence is that part of the technological process that consists of a set of cognitive and physical processes and skills resulting in the lithic assemblages we observe archaeologically.

The analysis of reduction sequences is informative of some broader behaviors. Here De la Torre and Mora show clearly how the study of reduction sequence meshes with and complements the study of early hominin raw material acquisition. They note that two main types of raw materials—lavas and quartz—were utilized throughout the sequence of Beds I and II, and support Hay's (1976) conclusions that raw materials were obtained from a catchment area of no more than 4 km, and, in most cases, probably as little as 2 km from the Gorge. As a rule, lavas derive from cobbles from streams near the sites, whereas the majority of quartz originates from tabular blocks transported from the source at Naibor Soit, a distance of 2–4 km from any one of the sites under discussion. This pattern holds through times of changes in the paleo-landscape that might have restricted access to the Naibor Soit inselberg (e.g., Blumenschine and Peters 1998), when quartz too would be obtained from secondary deposits; or when a new, highly valued raw material such as chert was exposed due to lake regression (Hay 1976; Kimura 2002; Stiles 1998; Stiles et al. 1974). A notable exception to this rule is the use of small quantities of gneisses in FC West and TK, which, based on the technological analysis, would have been transported from sources as far away as 8 km (p. 206).

Because de la Torre and Mora quantified and compared the amounts of raw materials according to both raw frequencies (as is the common habit) and to weight distribution, they were able to demonstrate that different reduction processes were applied to similar—even identical—raw materials throughout the Beds I and II sequence. Examples of this include DK, where technological categories are distributed similarly within the each raw material type but the utilization of quartz is statistically more intensive than that of lava. At FLK Zinj quartz items are more numerous but lava occurs in much higher mass, represented mainly by "heavy duty" elements (hammerstones and cores). This is interpreted as intensive flaking of quartz, whereas lava was utilized more extensively. This quantitative relationship between raw materials is repeated in EF-HR, but here technological observations indicate a completely different reduction process: whereas in the older site the basalts came in the form of small pebbles, in the younger occupation they occurred also in the form of huge flakes of excellent flaking quality, derived from giant cores not found on site. Hominins at the two sites selected for raw material with very different flaking qualities.

Thus, site-specific data indicate that lithic production and transport distances did not vary much from the Oldowan to the Acheulian but Acheulian groups appear to have moved much larger amounts of raw material over the landscape, and did so in a more complex manner than the Oldowan: large flakes were produced off-site from giant cores, modified into a pre-conceived shape, and transported over the landscape into sites in the Gorge where they served as blanks for large cutting tools (including handaxes). This suggests to de la Torre and Mora that Acheulian hominins were behaviorally (mentally? physically? the specifics are moot) better equipped than Oldowan ones to deal with considerable ecological variability over the small distances that they had to travel to obtain raw material. They were able to move large amounts of raw materials over the landscape which were then used only extensively:

> "…given the extensive use of [quartz]…. it seems that these Acheulean craftsmen dominated the landscape well enough to embark on repeated journeys to accumulate a large amount of lithic resources in specific points of the territory ……This does not apply to Oldowan sites, where quartz is reduced intensively… but where the total volumes of transported raw material never achieve the importance of subsequent assemblages. The difference… is linked to technological processes. A TK hominid needed two kilograms of quartz to make a single large cutting tool whilst any of the craftsmen from Bed I could have used those two kilograms to knap 5-10 cores. The technological purpose obviously conditioned the contribution of raw materials" (p. 235).

And yet, these behaviors do not pertain necessarily to the social and cultural realms of either Oldowan or Acheulian groups, as is implied by the statement that the authors use a *chaîne opératoire* perspective.

Some patterns discussed in the volume are in fact a reiteration of observations made by Leakey and her co-workers in the 1970s. The use of the same raw material sources through the time span of Bed I and Bed II is one such pattern, as is the renewed recognition that the Oldowan and the Acheulian technocomplexes are distinguished from one another by the appearance in the latter of strategies for detaching of large flakes for making Large Cutting Tools. Leakey (1975:485) claimed that Oldowan knappers were not able to detach large flakes. This statement (cited on p. 227) is an oversimplification—Oldowan stone tool makers could detach large flakes (Delagnes and Roche 2005; Hovers n.d.). The crucial point is that the pre-planned reduction sequences of the Acheulian led to the systematic detachments of such flakes whereas large flakes in the Oldowan were of a more incidental nature.

With regards to some major issues, the interpretations offered by de la Torre and Mora differ fundamentally from Leakey's. Lithic classification—of retouched tools, manuports and some core forms—is one such issue. In the majority of Oldowan assemblages, de la Torre and Mora recognize considerably fewer retouched pieces than Leakey did, explaining the discrepancy by the misleading effects of post-depositional processes (e.g., Leakey's "burins" are in their view split flakes, and many "retouched" pieces bear in fact nothing more than trampling or rolling damage). Yet they recognize a temporal increase in the frequencies of retouched pieces from the earliest to the latest assemblages examined in this monograph.

The notion of manuports as unmodified cobbles brought into sites by hominins to serve as future lithic raw material stock similarly is not supported by the detailed technological analyses. Many of the pieces thus classified by Leakey are arguably geofacts derived from the natural depositional background of the sites (especially in DK; de la Torre and Mora 2005) and should be excluded from studies of the lithic assemblages. Likewise polyhedrons, which Leakey identified as a form of cores, are identified here in many cases as unmodified natural pieces (p. 213). Like a number of previous researchers, de la Torre and Mora disagree with Leakey's identification of spheroids and subspheroids as tools. Their data suggest that Leakey's classification conflates into a single category naturally rounded quartz cobbles that are not artifacts, some such cobbles that had been used in percussion activities and bear traces of battering, and fragments of tabular quartz blocks that had been transformed into rounded shapes *through* pounding and percussion activities. Like Schick and Toth (1994) and Jones (1994), de la Torre and Mora infer from the technological analyses that spheroids attained their rounded shapes through continuous utilization rather than through knapping procedures or intentional modification of the original shapes.

The deviation from Leakey's original classification impacts directly two broader issues. What was the importance of pounding activities in Olduvai? The technological procedures for producing passive percussion elements (i.e., anvils) were first encountered in Upper Bed I (FLK North level 6; Chapter 4) and are remarkably similar throughout the sequence of Beds I and II. The identifiable technological characteristics of passive percussion elements led the authors to hypothesize that those were used for purposes other than stone tool knapping—bone fragmentation or nut cracking such as is observed among present-day chimpanzees are discussed in this context (pp. 215-216). These are interesting hypotheses that touch on the fundamental issue of the uses of stone tools as the means of ecological adaptation of early stone tool makers, especially given some recent development in research on the Oldowan. Dominguez-Rodrigo et al. (in press) have argued that FLK Zinj is the only Oldowan site in which an anthropogenic, causal relationship between lithics and faunal remains can be established unequivocally. If that is the case, there should not occur any clear correlations between lithic percussion and bone fragmentation/ marrow acquisition.

The hypothesis linking percussive technologies with nut cracking is even more difficult to test, not the least so because the antiquity of this behavior among chimps may not go back to the late Pliocene and thus may not represent an ancestral adaptation (Boesch et al. 1994; Mercader et al.

2007). Interestingly, frequencies of hammerstones and of other percussion/pounding tools in the very early Oldowan sites are extremely low (Delagnes and Roche 2005; Hovers n.d.; Kibunjia 1994; Roche et al. 1999; Semaw 2000). This may reflect ecological differences between Olduvai and sites in Gona, West Turkana, or Hadar, as the majority of the early sites are located in relatively open habitats where nut-bearing trees may not have been part of the vegetation. But it could also be that pounding activities documented in Olduvai do not represent the retention of an early behavior and may have been 're-invented' in the course of technological evolution.

Another important point in which the current analysis deviates from that of Leakey's is that of cultural taxonomy. Leakey's "Developed Oldowan" as an entity that co-existed in the sequence of Olduvai with the Acheulian is rejected in favor of a simpler scenario of an Oldowan (a technical sequence that consists of flake detachment and its immediate use) and an Acheulian, identified from the time of EF-HR onwards through its increased level of technological complexity (i.e., at least three stages of flake detachment, secondary modification and imposition of specific morphology, and subsequent use).

Due to the importance of the site and of Leakey's work, the points in which the new analysis deviates from the old ones pose the most interesting questions for future Oldowan studies, although the monograph does not dwell on such far-reaching implications. If a pre-Oldowan has been distinguished from the Oldowan by the lower frequencies of retouched elements (de Lumley and Beyene 2004; de Lumley et al. 2005), is this still a valid taxon in view of the much lower frequencies now identified in the type assemblages? Do all the assemblages currently classified as Oldowan indeed fall within the parameters of the new classification? In view of the new analysis, how do the older and younger Oldowan assemblages compare?

This volume is not for everyone. It is highly technical in many sections, and will most probably be best appreciated, pondered, and understood by lithic analysts. Some of the points raised and the conclusions reached may not be acceptable to all of us who are interested in the very Early Paleolithic, but the strength of the volume is in the detailed presentation that allows an examination of the data and enables an informed consideration of the points raised.

Unfortunately, the volume suffers from poor editing. There are too many instances when the reader gets bogged down in convoluted, poorly structured sentences and lengthy repetitions, which sometimes make it difficult to figure out what the sentences (or whole paragraphs) are all about. Not being a native English speaker myself, I can only imagine how this may raise the hackles of Anglophones.

Still, this is an important contribution to the ongoing process of understanding the Oldowan. As the number of excavated and studied Oldowan assemblages increases, they are evaluated against the magnificent record of Olduvai as published by the original excavator as well as the numerous subsequent teams that have toiled at the site and over the finds. The overall impact of this surge of research thus far has been a more nuanced understanding of the complexities of early tool production strategies, how they served early hominins in varied ecological settings, and what they tell us about what hominins could and could not achieve. This volume is an example of the type of analyses that help reveal the fine-grained patterns that make the Oldowan. It definitely should be a companion to researchers who struggle to make sense out of the earliest lithic technologies.

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