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A Middle Stone Age Worked Bone Industry from Katanda, Upper Semliki Valley, Zaire

John E. Yellen, Alison S. Brooks, Els Cornelissen, Michael J. Mehlan, Kathryn Stewart

Three archaeological sites at Katanda on the Upper Semliki River in the Western Rift Valley of Zaire have provided evidence for a well-developed bone industry in a Middle Stone Age context. Artifacts include both barbed and unbarbed points as well as a daggerlike object. Dating by both direct and indirect means indicate an age of ~90,000 years or older. Together with abundant fish (primarily catfish) remains, the bone technology indicates that a complex subsistence specialization had developed in Africa by this time. The level of behavioral competence required is consistent with that of upper Paleolithic Homo sapiens sapiens. These data support an African origin of behaviorally as well as biologically modern humans.

Anatomically modern humans (Homo sapiens sapiens) appeared in Africa and the Levant before 90,000 years ago (ka) (1). By 50 ka, they had colonized Australia (2) and possibly east Asia (3). In the colder climates of Europe, central Asia, and Siberia, however, Neandertals (Homo sapiens neandertalensis) continued to predominate until as late as 35 ka. The middle to upper Paleolithic behavioral transition in Europe, central Asia, Siberia, and the Near East also occurred between 40 and 30 ka and is marked by the appearance of (i) new technologies, such as prismatic blade cores, specialized bone and antler tools, burins, and sophisticated hearths, (ii) more complex economic strategies, involving seasonally specific activities, storage, and long-distance procurement, (iii) larger scale social networks, reflected not only in the long-distance trade in raw materials but also in the use of personal ornaments, and (iv) an expanded use of symbols in art and daily life. Regionally specific styles of artifice manufacture in the early upper Paleolithic reflect this greater social complexity. In Europe, with a few exceptions from the transitional period (4), the evolutionary shifts in human morphology and behavior coincide; anatomically modern humans are associated with upper Paleolithic industries, whereas Neandertals are associated with middle Paleolithic or Mousterian industries.

In Africa, however, fossils of anatomically modern humans from between 130 and ~60 ka are associated with industries grouped as Middle Stone Age (MSA), which share broad technological parallels with the Mousterian or middle Paleolithic of western Eurasia (5). By ~40 ka, these flake and prepared-core industries begin to be replaced, at least in some areas, by Later Stone Age (LSA) industries based primarily on microlithic technology rather than on blades (6). This new technology is associated with other indicators of greater behavioral complexity such as bone tools, ostrich eggshell beads, and transport of raw materials over long distances. The extent to which the MSA differs from the Mousterian is in shadowing this complexity is uncertain (7).

We have recently recovered evidence for early complex behavior in the MSA from three sites at Katanda (Kt2, Kt9, and Kt16), a multisite locality in the Upper Semliki Valley of eastern Zaire, ~6 km north of Ishango, where the Semliki River exits from Lake Rutanzige (formerly Lake Edward) (8). The Katanda materials include a formal (9) bone industry, consisting of barbed bone points, unbarbed points, and a flat dagger. Bone industries from other African sites are considerably younger. Upstream at Ishango, uniserial and biserial barbed points have been dated to ~25 ka (10, 11). Outside Africa, formal bone points with finished bases suggestive of hafting first appear in the European Aurignacian as early as 38 to 40 ka (12); barbed points, however, do not occur before ~14 to 12 ka (13) at sites throughout Eurasia. Here we describe the artifact horizon at Kt9 with occasional reference to materials from Kt2 and Kt16. Paleoenvironmental data (8) suggest that all three Katanda sites were located along the valley of a southward-flowing proto-Semliki River, fringed with relatively dense gallery forest in proximity to open savannas. Sediment analyses at Kt9 were located closer of the three to the proto-Semliki channel (14).

Excavation at Kt2 began in 1986 and continued through 1990, exposing 21 m² in the MSA levels. Three horizons of MSA were distinguished. The lowest, resti on the ASB paleosol, is the most comparable stratigraphically to the MSA horizons at Kt9 and Kt16. Over 2700 lithics in quartz, quartzite, and chert and 1100 faunal remains of fish and mammals were recovered from this lower horizon. The upper two MSA horizons yielded a total of 3700 lithics, predominantly in quartz, and some 75 poorly preserved faunal remains of which only 10 fragments were identifiable. Disoidal cores were the most distinctive aspect of the lithic material; formal tools were rare. In 1990, a single large fusiform bone point was recovered from the lowest MSA horizon in contact with the paleosol.

At Kt9, the MSA horizon crops out on a steep cliff face below ~8 m of horizontally
stratified sand and silt, carbonate paleosols, and volcanic deposits. This overburden was intact over all but the extreme northwest and southwest corners of the excavated area at the cliff face. Removal of the overburden over an area of 35.2 m² revealed a dense concentration of artifacts and faunal remains (15).

The artifact concentration stopped abruptly on the north, east, and southeast. To the west and southwest, the original distribution had been truncated by erosion of the cliff face. The artifact horizon rested on a surface that sloped up 3° to the southeast. The thickness of the concentration averaged 5.5 cm but increased downslope to a maximum of 16 cm. The abundance of artifacts (up to 289 pieces per 400 cm²), the abrupt edges of the concentration, and the dominance of chipped pieces over manos, retouched pieces, and other formal artifacts in the analyzed sample of 7366 pieces is a low 8.2%. Core types were primarily discoidal but included examples with single and multiple platforms. Bipolar specimens are rare. Scrapers on retouched flakes are uncommon and do not conform to highly formalized patterns. Occasional spheroids and rubbing or grinding stones with intentionally ground flat faces are also present. The assemblage lacks formal bifacial or unifacial points or daggers, as well as hand axes, large core tools, blades, or microliths. Presence of the latter would have suggested inclusion within the LSA.

Highly formalized worked bone tools constitute the most remarkable aspect of the assemblage. These include seven well-made uniserial barbed bone points, two unbarred points, and a large dagger-shaped object of unknown function (Table 1). All are made from rib fragments or long bone splinters of large mammals.Replication experiments and low-power microscopic examination (20) indicate that the shape was obtained by grinding the bone on a stone anvil or with a stone grinder. The method for barb construction on all pieces was the same: The edge was first shaped and smoothed before parallel notches, all at the same oblique angle to the long axis of the point, were cut into it. Specialized lithic artifacts such as burins were unnecessary, as the barbs could have been cut with an unmodified quartz flake. The resultant barbs are shaped like a parallelogram with three distinct edges (Fig. 1). This shape clearly distinguishes the Katanda points from later Ishangian counterparts (21), all of which have a triangular shape formed by the intersection of two edges.

Pieces where the butt end is preserved suggest that two hafting methods were used. Either several shallow grooves were incised around the circumference of the shaft or a series of closely spaced notches were cut into the barbed and nonbarbed edges. It is possible that the points served as harpoons, which, by definition, detach from the shaft after contact with prey, but this is unlikely because it is difficult for this grooved butt shape to hold a line against pressure from the harpooned animal. It is more likely that they were permanently fixed to a shaft.

The blunt rounded point and edges of the daggerlike object suggest that it served neither to cut nor pierce; its function is unknown. Although the two nonbarred points probably served as weapons, their use is also uncertain. The number of clearly distinct artifact classes demonstrates that the Katanda people recognized that bone could serve as a workable plastic medium and be used for different purposes.

The barbed bone points are spatially associated with both fish and mammal remains.
mains, which are present in abundance at Kt9 as well as Kt2 and Ktl6. Species captured by Katanda people (8) include Clarias and Synodontis, both catfish, which constitute the majority of the assemblage. Because of Clarias’s much larger size (some specimens exceeded 2 m in length), this species could have provided the major meat input. Clarias is a bottom dweller that spawns in shallow water. The taxa represented in the samples from all three Katanda sites and the absence of individuals in juvenile size ranges are consistent with predation during spawning and suggest that the Katanda people visited the area repeatedly during limited seasons. Clarias and Synodontis spawn chiefly on floodplains in the rainy season, when they are easiest to catch (22).

The distribution of materials within the pavement suggests several inferences regarding behavior. Artifacts and fauna are particularly concentrated in two distinct clusters on the up-slope portion of the pavement (23). These clusters cannot be attributed to materials settling into low points on the surface. Size sorting is evident (24) both overall and within each cluster, and larger pieces are located further downslope. Although the extent of abrasion on some of the bone and lithic pieces attests to extended exposure on the surface, the strong sorting by size over a short distance suggests that the deposits were redistributed slightly by low-energy transport. The effect of this was to blur the cluster edges. Although one or more edges of each cluster have been truncated by erosion of the cliff face, analysis of the remainder suggests that each exhibits bilateral symmetry and that material is concentrated in the center. On this basis, it is possible to reconstruct the original shapes and sizes of the clusters. One cluster is somewhat larger than the other (4 and 3.4 m in maximum diameter). The two clusters contain similar proportions of artifacts and faunal remains. Neither the contemporaneity nor original causality of the clusters can be proven. In terms of cluster size, distance between clusters, and similarity in both faunal and lithic remains, the pattern conforms to that of ethnographically observed debris produced by hunter-gatherer nuclear families in which production tasks are replicated by each nuclear unit (25).

The Kt9 site, 400 m to the north of Kt9, was discovered and excavated in 1990. From 11 m² of a buried MSA horizon, we recovered ~1500 lithics, 650 mammalian faunal elements, and 9700 fish remains, together with a large barbed bone point. As at Kt9 and Kt2, the assemblage consisted largely of flakes and radial cores, with rare formal tools. In contrast to the other two sites, however, Kt16 also contained several large bifacial pieces, a few blades, and two large, carefully made grindstones on doricritic, gabbroic, or amphibole rocks. Microliths and microcores such as those associated with the late Paleolithic Ishango horizons (8) are absent at all three sites.

The Katanda sites indicate that a complex bone industry and seasonal use of aquatic resources had developed by ~90 ka. The absence of known parallels within Africa may indicate the existence at this time of a geographically limited cultural tradition, with little contact between central and southern Africa, or it may reflect inadequate exposure or exploration of the ancient margins of large tropical rivers and lakes. The presence of other, geographically limited hafted projectile traditions within the MSA, such as the Lupemban or Bambata (26), reflects that African hominids not only possessed considerable technological capabilities at this time but also incorporated symbolic or stylistic content into their projectile forms. The fact that other early barbed bone points, although ~55,000 to 60,000 years younger, occur only 6 km away suggests the long-term continuity of regional adaptations (11). The Katanda people may have been living in nuclear family units that following a specialized subsistence pattern most often associated with a terminal Pleistocene to Holocene adaptation. Their archaeological traces suggest the early presence of modern behavioral capabilities in Africa along with the evidence for anatomically modern humans.

REFERENCES AND NOTES


Crystal Structure of DCoH, a Bifunctional, Protein-Binding Transcriptional Coactivator

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DCoH, the dimerization cofactor of hepatocyte nuclear factor-1, stimulates gene expression by associating with specific DNA binding proteins and also catalyzes the dehydration of the biotinier cofactor of phenylalanine hydroxylase. The x-ray crystal structure determined at 3 angstrom resolution reveals that DCoH forms a tetramer containing two saddle-shaped grooves that comprise likely macromolecule binding sites. Two equivalent enzyme active sites flank each saddle, suggesting that there is a spatial connection between the catalytic and binding activities. Structural similarities between the DCoH fold and nucleic acid–binding proteins argue that the saddle motif has evolved to bind diverse ligands or that DCoH unexpectedly may bind nucleic acids.

Transcription depends on interactions among numerous proteins, including regulatory proteins bound at specific DNA sites. Homeodomain transcription factors, for example, are recognized by protein-binding coactivators (1, 2). Little is known, however, about the molecular nature of the activation signals or the structure of the interacting protein motifs. One such coactivator is DCoH, the dimerization cofactor of hepatocyte nuclear factor–1 (HNF-1) (1). In vertebrates, DCoH presumably binds other ligands, or that DCoH unexpectedly may bind nucleic acids.

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