NEWS

Patterns of technological change at the origin of *Homo sapiens*

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Keywords
Acheulean, Middle Stone Age, Middle Pleistocene, early Homo sapiens, east Africa

Recent papers by White et al (2003) and Clark et al (2003) have raised a number of interesting issues. Fossils of at least three individuals, a juvenile and two adult males, have been recovered from sediments of the Upper Herto Member of the Bouri Formation in the Middle Awash region of Ethiopia. The fossils clearly represent modern *Homo sapiens*, and 40Ar/39Ar dating allows a very precise and reliable age estimate of 160-154 ka. All three crania bear traces of cutmarks, and the juvenile skull also shows traces of polishing to its surfaces and edges. None of the cutmarks resembles those made by defleshing for consumption, and the authors in particular stress the similarity of the polishing to the juvenile cranium to modern ethnographic examples of mortuary practice. The human remains are accompanied by cutmarked animal bone and a suite of stone artefacts that includes handaxes and cleavers.

While a number of African fossils of modern or near-modern aspect are known from the 100-250 ka time range (Omo Kibish, Jebel Irhoud, Ngaloba, Florisbad, Klasies), none of them is as securely dated as the Middle Awash fossils. The Herto hominids thus strengthen the case for an early, African origin for *H sapiens*. What is equally striking from an archaeological perspective, however, is the late persistence of Acheulean technology in the Middle Awash, and its association with tools considered characteristic of the Middle Stone Age (MSA). At 160-154 ka, the Herto handaxes are the latest survivors of Acheulean technology known in Africa. Formerly, the best candidates were those from the site of Rooidam, South Africa, where a U-series date indicated they might date to ~ 170 ka (Szabo & Butzer 1979). K/Ar dates of ~240 ka for Acheulean artefacts from the Kapthurin Formation, Kenya (Leakey et al 1969, Tallon 1978) have frequently been cited as the date for terminal Acheulean in east Africa, but new more precise 40Ar/39Ar dating now shows these to predate 285 ka (Deino & McBrearty 2002).

What does the presence of Acheulean tools at 160 ka signify? The nature of archaeological change in the African Middle Pleistocene is murky, but the most obvious development is the abandonment of Acheulean technology, usually thought to have been made by *H erectus*, and its replacement by implements of MSA traditions, believed to have been produced by *H sapiens*. In a nutshell, this comprises the replacement of handaxes and cleavers by points, signifying a shift from hand-held to hafted tools, and the birth of projectile technology (figure 1). The presence of Levallois technology is usually considered to be a feature of the MSA, but it is present in late Acheulean contexts as well. In fact, the big flakes used to make African late Acheulean handaxes, including some Herto and Kapthurin specimens, may be struck from Levallois cores. Points can also be produced by the Levallois method, or by retouching flakes or blades produced by any method. Levallois points are present among the Herto artefacts, but the sample does not appear to contain any retouched points. The earliest MSA points were once thought to be those from Gademotta, Ethiopia, dated by

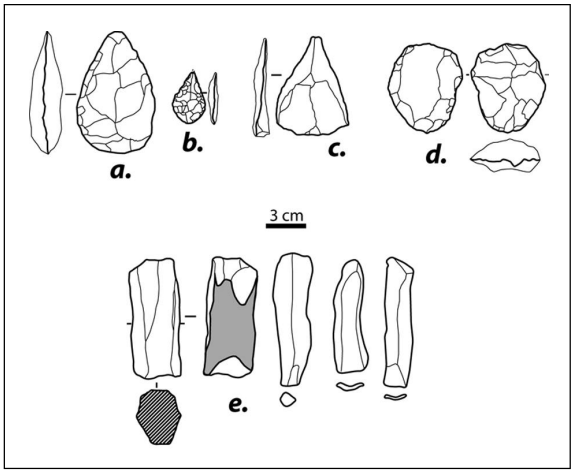

Figure 1 *a Handaxe, Rorop Lingop (GnJi-28), Kapthurin Formation, Kenya; b retouched point, Bed V, Mumba, Tanzania; c Levallois point, Bir Tarfawi, Egypt (Site E-86-3, after Hill 1993:420); d Levallois core, Member 6, Muguruk, Kenya; e blade core and blades, LHA (GnJh-03), Kapthurin Formation, Kenya*

K/Ar to 235 ka (Wendorf et al 1994). Retouched points from the Kapthurin Formation predate those from Gademotta by 50,000 years. Dated by 40Ar/39Ar to > 285 ka (Deino & McBrearty 2002), they are currently the oldest in Africa. A similar date is estimated for the basal MSA at Florisbad, South Africa (Grün et al 1996), though these levels have not yet yielded points (Kuman & Clarke 1986, Kuman et al 1999). Both retouched points and Levallois points have been recovered at Twin Rivers, Zambia, where they are dated by U-series to >265 ka (Barham 2000).

The Herto evidence shows that handaxes and cleavers persist in the record until at least 160 ka. This means that the Acheulean to MSA transition took at least 125,000 years to accomplish. What was the nature of this shift? Early investigators opted for a gradual phasing-in of MSA technology, with the Acheulean replaced by the Sangoan in tropical regions of Africa, and by the Fauresmith elsewhere; both were eventually superseded by the MSA. The Sangoan, characterised by heavy-duty equipment, and the Fauresmith, characterised primarily by small handaxes, were assigned to the 'First Intermediate' Period (Clark 1957). A 'Second Intermediate' was erected to encompass industries that fell technologically and, it was thought, chronologically, between the Middle and Later Stone Ages. When the 'Second Intermediate' industry from Magosi was found to be derived from stratigraphically mixed context (Hole 1959), the entire scheme of Intermediate Periods was abandoned (Bishop & Clark 1967), but no interpretive or explanatory framework has since been erected in its place.

How does the displacement of Acheulean by MSA technology relate to the evolutionary processes leading to *H sapiens*? We might begin by asking exactly who made these artefacts. While an African origin for *H sapiens* has become widely accepted on the grounds of genetic evidence, few have investigated how the speciation event leading to *H sapiens* might have occurred, what might have caused it, or what role technology might have played in the process. Most focus upon the more highly visible events of the later Pleistocene, when the array of behaviours we recognise as 'modern' were fully established. The Herto crania demonstrate that *H sapiens* was present in Africa by ~160 ka, but they did not occupy an empty landscape. Other late Middle Pleistocene fossils can be assigned to *H sapiens* sensu lato or to *H helmei*. The dating of many Middle Pleistocene fossils is uncertain, but it is quite possible that late survivors of the more archaic *H rhodesiensis* or *H heidelbergensis* were present in Africa during this period. Early members of our species likely coexisted with, interacted with, and most probably competed with members of other hominid taxa. All will have left archaeological debris which it is our challenge to interpret.

As Clark et al point out, occupation horizons at a few other east African sites, like Melka Kontouré, Ethiopia (Hours 1976; Chavaillon et al 1978, 1979), and GnJh-17 in the Kapthurin Formation, Kenya (Cornelissen 1992), contain both handaxes and points. Sets of artefacts can accumulate at archaeological sites for a period of time before becoming buried, and thus may represent a series of different activities by a single group, or a succession of visits by members of different social groups. Recent work in the Kapthurin Formation shows that sites containing handaxes are interstratified with those containing points (Tryon & McBrearty 2002). Do these sites represent alternate occupations by different species of hominids? Alas, broad artefact classes like 'handaxe' are poor phenetic characters (cf Otte 2003). Handaxes came into existence during the timespan of *H erectus* in Africa, but have been found in association with fossils of *H rhodesiensis* in the Ndutu Beds at Olduvai Gorge (Mturi 1976), and now with *H sapiens* at Herto. Moreover, handaxes are a component of many Mousterian assemblages, made by Neanderthals. Can the handaxe be viewed instead as a phylogenetic marker, a primitive feature that is retained over the course of evolution but persists through speciation events, as suggested by Foley & Lahr (2003)? Perhaps, but handaxes are made, not born. They were manufactured because they fulfilled some purpose in an ancient subsistence system.

Archaeologists routinely stress the uniformity of the Acheulean tradition, and rarely entertain the possibility that the category 'handaxe' is an artificial construct that we impose upon the material. Experimental work by Jones (1994) shows that the familiar tear-drop shape of the handaxe is a design compromise resulting from attempts to gain the maximum cutting edge from the minimum weight of stone. The same techniques of blank production and bifacial retouch were employed in many cases to make both Acheulean handaxes and MSA points, and in the Kapthurin Formation the two classes of artefacts can grade into each other.

Furthermore the tear drop shape occurs repeatedly in the archaeological record in cases where there is no evidence of 'phylogenetic' relation. Many projectile points from Africa, Europe, the Near East, and even the New World have similar plan forms (McBrearty 2001; Otte 2003), but there is clearly no 'phylogenetic' relationship among them. Rather, the recurrence of this target form demonstrates the design constraints inherent in fractured stone, and it appears to have been rediscovered repeatedly by tool makers in the course of prehistory. If so, handaxes represent homoplasies, and any attempt at phylogeny reconstruction based on them will result in the erection of polyphyletic groups; neither can they be reliable markers of population movements.

We do not know precisely what occurred during the 125,000 years between the appearance of the first point and the disappearance of the last handaxe. What is clear is that the two implements were designed for very different purposes and modes of use. While some investigators see hominid behaviour during the MSA as archaic and somewhat monotonous (eg, Diamond 1992, Tattersall 1995, Mithen 1996, Klein & Edgar 2002), others recognise early signs for imaginative technology and symbolic behaviour in the African record (eg, Barham & Smart 1996; Barham 1998, 2002; Deacon & Deacon 1999; McBrearty & Brooks 2001; Watts 2002; Henshilwood & Marean in press). The polish on the Herto juvenile cranial fragments would seem to support the latter view, but the accompanying handaxes seem an anachronism. Does the interstratification of handaxes and points, and their co-occurrence at some sites, represent the technology of a single evolving population with a flexible strategy, responding to needs of the task at hand? Or can the archaeological record of the African Middle Pleistocene represent the behaviour of several species? Might different tools be the distinctive signatures of different populations or species who are competing with each other for the same territory and resources? A similar scenario of interspecific competition seems to have been played out between *H sapiens* and the Neanderthals in Europe after 40 ka, but there the replacement was complete within 10,000 years or so. Africa is a far more enormous continent than Europe, its Pleistocene population far less dense, and our knowledge of its record less finely resolved. The 125,000 years represented by the Acheulean to Middle Stone Age transition in Africa is more than four times greater than the entire timespan of the residence of *H sapiens* in Europe, but only a handful of African sites from this long time period have yet been explored. The more detailed picture that is now emerging will reveal the population dynamics of this remote period.

Acknowledgments

I would like to thank Larry Barham for his suggestion that I write this paper. Thanks also to Andrew Hill, Erella Hovers, and Christian Tryon for valuable discussion, and to Christian Tryon for producing figure 1.

6 August 2003

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