Handaxe-Hurling Hominids: An Unlikely Story

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In archaeology as in all sciences, a poorly conceived but attractive idea often takes on a life of its own, especially if it appears to be backed by some evidence and is further elaborated to provide theoretical insights into larger issues. Such a case is the idea that Acheulean handaxes were throwing weapons.

Ideas about the functions of handaxes have a long and varied history that reflects trends in archaeological thinking. The term appears to have originated with Smith (1911) and mirrors other early names for large bifacial tools: *haches* (Boucher de Perthes 1847), *coup de poings* (de Mortillet 1883), and "hatchets" (Evans 1897). While most early artifact names reflect no more than a guess at function, heavy-duty cutting is indeed the most generally accepted notion, and handaxes are most often described as general-purpose tools usable for cutting and shaping wood, digging, and skinning and butchering (Bordaz 1970:21; Knowles 1953:18; Leakey 1960:58; Oakley 1961:72; 1972:42; Ohel 1987). Most suggestions of handaxe function have been based on common sense and analogy with modern tools, with a few relatively unsystematic experiments (e.g., Leakey 1960, Howell 1965). Other arguments have proposed that many handaxes were primarily cores (Jelinek 1977) and that some were hafted rather than hand-held (Clark 1975, Howell 1965, Leakey 1960) or that they were sunk in the ground as stationary tools (Kleindienst and Keller 1976). More systematic experimentation in recent years has demonstrated their usefulness as hand-held tools for the kind of general-purpose cutting originally proposed (Keeley 1980) but emphasized their effectiveness as butchery tools (Jones 1980, 1981; Schick and Toth 1993:260). The few use-wear studies of bifaces so far have suggested butchering use (Keeley 1977, 1980). Keeley (1980:160–70) also discusses the contextual evidence for handaxes as general-purpose tools often used for butchery, and recent finds of bifaces associated with butchered faunal remains support this functional interpretation (Villa 1990, Roberts 1986). In recent years, emphasis has fallen upon the cognitive nature of artifacts, and handaxes have been seen as evidence of mental development and social organization (Wynn 1989, 1995; Gowlett 1984; Isaac 1978; McNabb and Ashton 1995; Mithen 1994; Steele, Quinlan, and Wenban-Smith 1995). Although the evidence is perilously weak, two recent studies even consider handaxes as artifacts with primarily social functions: facilitating communication (Byers 1999) and impressing potential mates (Kohn and Mithen 1999). The idea that handaxes may incorporate aesthetic or social elements beyond their utilitarian functions is itself not new (Clark 1975:190).

Suggestions that handaxes could have been thrown at game and enemies also have a long history (Jeffreys 1965: 153; Kleindeinst and Keller 1976:184; Leakey 1961:8; Watson and Sieveking 1968:46). Fittingly, the earliest published reference seems to be in a prehistoric fantasy story by the science fiction writer H. G. Wells (1899), in which his cavemen hurl "smiting stones" in combat. To be fair, the throwing theory at this point was no more speculative than most other early archaeological statements about handaxe function. Decades later, as archaeologists became more intent on examining the functions of tools, Jeffreys (1965) seems to have been the first to discuss throwing handaxes in detail. Jeffreys envisioned some handaxes, specifically the narrowly pointed African forms, as "hand bolts" held by the narrow end and thrown end over end like a knife. His main arguments are notable because we will see them again: (1) Sharp margins all the way around make a good throwing weapon but would injure the hand if the handaxe was used as a hand tool. (2) Specimen edges show no "wear and tear." (3) These handaxes are often found around rivers and lakes. Pointing out that handaxes are easy to make and therefore expendable, Jeffreys argued that they were probably thrown at flocks of waterfowl and enlivened his paper with a cartoon showing a hominid (watched by an envious saber-toothed cat) hurling a "hand bolt," which plunges point-first into a flying bird. He made no mention of actually attempting this improbable feat, and a brief comment by Seddon (1966) quickly pointed out the inadequacy of Jeffreys's arguments about lack of wear, sharp margins, and riverine contexts.

In the 1980s, Eileen O'Brien took up the handaxe projectile idea, and some serious experiments were finally performed (O'Brien 1981, 1984). O'Brien used a fiberglass cast of a large handaxe from Olorgesailie, an Acheulean site in Kenya (Isaac 1977). The handaxe was 29 cm by 14 cm by 4 cm, "edged all around." The original weighed 1,949.35 g and the cast 1,914.6 g (O'Brien 1981:76). After preliminary experiments, a simple side-arm "discus"-throwing motion was favored, and two experimenters performed 25 and 20 throws respectively in that manner. One experimenter also threw the handaxe 6 times overhand as for a knife throw. The two throwers were both athletes with discus experience. The mean throwing distances were all very similar, between 30 and 32 m. Extrapolating from her experimental distances with a 2-kg handaxe, O'Brien suggested that a half-kilogram handaxe could be thrown 60 m. She reported that the handaxe, when thrown like a discus, rose lying horizontally but then turned edge-on for its descent. Thus, whether thrown discus-style or overhand knife-style, it almost always (average of the two throwers 93.3%) struck with the sharp edge or the point. In fact, when thrown like a discus, it struck point-on far more often than one would expect: 84% of one thrower's trials and 50% of the other's. This makes it seem much more convincing as a throwing weapon (O'Brien 1984:24). The mean accuracy to right or left of the line of trajectory was 1.77 m. O'Brien considered the accuracy observed in these experiments "sufficient to assume even greater accuracy with lifelong practice, training, and skill."

As supporting archaeological evidence for the throwing theory, O'Brien (1981:78) argued that the abundance of handaxes suggested an expendable tool. "Abundantly and predominantly" recovered "from within or near paleowatercourses" and sometimes found standing on edge, they might, she suggested, have been thrown at concentrations of game coming to water and lost in the water or vegetation. Although O'Brien (1984:20) admitted that handaxes have been shown to be suitable for butchering, digging, and other functions, she pointed out that "*Homo erectus* possessed other tools suitable for these purposes" that were easier and less costly to produce and suggested that the sharp edges all around a handaxe made it "capable of inflicting as much damage on the user as on the material being worked."

O'Brien's experiment has been used as support for further theorizing by Calvin (1983, 1990, 1993) that, in turn, has affected others (e.g., Gibson 1996:37). To be brief, Calvin argues that the ability to throw was critical in human evolution not merely for defense and subsistence but for social and neurological development. In Calvin's model (see esp. 1993), language, tool use, and many other manifestations of human intelligence are based on the ability to sequence things mentally, stringing together sets of separate elements to form plans or schemas that then act as programs controlling a sequence of actions, especially complex actions like throwing and hitting, which occur so fast that control by feedback during the action is impossible. This "neural sequencing machinery" could have evolved from the evolutionary advantage of language or problem-solving or other mental activities, but the first and fastest of these, Calvin proposes, was throwing. Early hominids would have had the throwing capabilities at least of modern apes and would soon have converted chimpanzee-type threat throwing to "predatory" throwing by heaving branches into herds of animals clustered around waterholes. A branch thrown into a herd might not have done much damage but might have confused and tripped an animal, which might then have been hindered in its escape by the rush of the herd. If branches had been depleted, the hominids might have turned to stones. As the dietary advantages of this kind of hunting were learned and as the evolutionary advantages were selected for, improvements could have given additional impetus. For instance (Calvin 1993:243), "A flat rock may spin in flight like a frisbee. If thrown in the plane of spin, air resistance is minimized and distance increased. If it hits an animal this way, it may also do more damage, as all of the impact is concentrated in a narrow edge; the sharper the edge, the more damage to the skin . . . This seems to describe the enigmatic Acheulean handaxe in several respects: nice spin symmetry, and sharpened edges all around."

Citing O'Brien's experiments, Calvin claims to have repeated them with similar results: even experienced discus throwers cannot keep thrown handaxes from landing on their edges (Calvin 1990:181–85). He additionally observes that a pointed handaxe, when striking the ground (or in theory an animal) edge-on, will spin forward and embed its tip, transferring most of its energy in a way damaging to the target. Expanding theoretically, he argues that it is not really necessary to do much damage to an animal when ambushing a herd at a waterhole. Small injuries to the skin on the back might cause withdrawal reflexes that interfere with the victim's stabilizing itself after the blow, and again the target is knocked down by the herd, making easy meat for the hominid.

The other and more important improvement in this system would have been increased throwing accuracy. Calvin argues that increasing accuracy, distance, and force requires much greater precision in timing, which in turn requires exponential increases in the number of neurons involved. This could have been attained by increasing brain size and either specializing neurological circuits or, more likely, "borrowing" from more general capacity. The evolutionary advantages of throwing, in the form of defense and more important, meat, would thus have led to selective forces promoting all aspects of intelligence. Calvin considers greater accuracy a later development. In Acheulean times, "lobbing" a "spinning-snagging axe" or "killer Frisbee" (Calvin's terms [1990:186]) "was a major step in food acquisition . . . probably of 'new niche' proportions, the sort of thing that can create a new species and spread them around the continents."

We do not wish to dismiss the idea of throwing as an important part of human adaptations, and others have considered this (most recently Bingham [2000], who suggests a quite different model). We are also not in a position to judge the neurological aspects of Calvin's model. However, confining our remarks to handaxe use, Calvin's scenario of waterhole hunting still seems immediately questionable. How many handaxes do you have to lob with low accuracy into a herd before you hit an animal? How big a wound would a 2-kg handaxe make? What about the more normal half-kilogram handaxe? For that matter, would the normal small handaxe make an effective weapon of any kind? Does a large animal really fall down from a small wound on the skin of the back? The stampeding herd might keep the victim from escaping efficiently, but would it not equally hinder the hominid in getting to the victim? No one seems likely to do hunting trials with handaxes, nor do we recommend them, but hunters we know are skeptical about all of these issues.[1]

Turning to the handaxes themselves, both O'Brien and Calvin depend, as did Jeffreys before them, on an excessively stereotypical view of morphology and context. In the first place, handaxes are not just found along rivers and lakes where they might have been thrown at game (Ohel 1987, Seddon 1966). At Olorgesailie, for example, the sites occur in diverse sedimentary and topographical circumstances. Isaac (1977:83) even goes so far as to say, "Most sites appear to have been remote from the lake waters." He believes the hominids there favored dry sandy channel beds of ephemeral streams as camp areas, and taphonomic processes have also affected the concentrations of tools. Many sites elsewhere are interpreted

1. Barbara Isaac (1987) collected ethnographic and historical accounts of extraordinarily accurate and effective stone throwing among various aboriginal people. She too points out the adaptive advantages of defensive and predatory throwing but emphasizes (correctly in our opinion) that the ethnographic weapons and probably their Paleolithic predecessors were rounded, not edged, and that forceful and accurate throwing is done overhand, not by clumsy lobbing. Paul Bingham (2000), who sees throwing as a "novel remote-killing capability" key to the development of human cooperative society, also emphasizes accurate throwing, probably with cobbles as early missiles, and on the basis of his own trials (personal communication) considers handaxes unlikely projectile weapons.

as camps or butchery locations, including the sites at Isimila (Howell 1961), which are also mentioned by O'Brien. Of course, handaxes are also plentiful in some cave sites in Europe and southwestern Asia. Even in putatively waterside assemblages with many handaxes, as at Olorgesailie and Isimila, handaxes are almost always associated with numerous other tools (Isaac 1977:103, 211; Howell 1961). Are we to assume that flakes, scrapers, and denticulates were also being thrown at game?

Calvin (1993:245) suggests that "the handaxe's characteristic features (flattened spin symmetry, all edges sharpened, and something of a point) make it an excellent projectile for waterhole predation." Handaxes actually come in a great variety of forms, from ovate to cordiform, triangular to teardrop (see Bordes 1961, Debenath and Dibble 1994, Isaac 1977). Most are thick and irregular, many are blunt or rounded while others have chisel ends, and some have only part of the perimeter sharpened. Calvin tries to get around this by claiming that "the Acheulean cleavers, and the handaxes without all-round edging, may be damaged versions of the classic design; if they were thought to be less effective in downing herd animals, they might well have been 'retired' and converted to less demanding secondary uses such as chopping or fleshing." This cleverly attempts to explain variant forms and use-wear or other evidence of nonthrowing uses but fails because the majority of handaxes never were "of the classic design." The artifacts classified as "cleavers" are certainly not broken handaxes—they are intentionally made with a sharp flake edge, which is not the result of damage. If we confine ourselves to the African Acheulean, which seems to be primary in Calvin's thinking, we do find numbers of ovate or pointed handaxes that could be considered "classic," but Isaac (1977:117–25) notes that handaxe forms grade into other classifications of artifacts at Olorgesailie. Ashton and McNabb (1994) make much the same point for British bifaces. Isaac's idea of the classic form is not much different from Calvin's: "1. A variable amygdaloid or oval plan form. 2. Lenticular sections. 3. Trimming scars penetrating most of both faces. 4. A sharp edge running all around or almost all around the perimeter." Isaac analyzed a sample of 666 handaxes and says that "about 28% are classic forms displaying the definitive characters, and 72% represent a more variable fringe of subclassic forms."

And how about the experiment on which this is based? O'Brien's handaxe, at 29 cm long and weighing 1.949 kg (4 lb. 3 oz.), was not a typical specimen. Perhaps because she wanted a handaxe close in weight to a modern discus (2 kg), O'Brien (1984:22) chose the largest specimen she could find from Olorgesailie. At this site, the normal biface length was about 15–20 cm (Isaac 1977:108); the mean length of over 350 handaxes was 17.9 cm (Isaac 1977:121), and the maximum mean for some levels in the site was less than 23 cm. Roe (1994:174) measured the length of 904 handaxes from Olduvai sites and found only two longer than 29 cm. Of 766 handaxes weighed, 9 weighed 1.9 kg or more. Isaac's data comparing Olorgesailie with other Acheulean handaxe assemblages shows that the Olorgesailie tools are on the large end of the range (Isaac 1977:135–39), the average handaxe length for all of the 61 European and African assemblages listed being about 14.5 cm. O'Brien's specimen is an outlier, too large to represent the average handaxe even at Olorgesailie and far beyond the norm for other handaxes.

The supposed failings of handaxes for nonthrowing functions are also exaggerated. The sharp edges all around are not necessarily dangerous to the hand. Even without a wrapping of hide or plant material, a biface used with care is no more likely to cut one's hand than a flake (Jones 1980; 1994:294). While flakes and other tools are easier to make than handaxes and can perform many of the same functions, handaxes are in fact more efficient for some aspects of butchery and other work because they have more durable edges, are easier to hold and sometimes easier to use with precision, and can be resharpened repeatedly (Jones 1980, 1981; Whittaker 1994:246). As for the claim that many handaxes lack apparent damage or use-wear, we simply do not have the evidence to say that. Very few sites have had any systematic examination for such evidence, and in many the depositional circumstances have left the tools unsuitable for use-wear studies.

NEW EXPERIMENT

Although there were good a priori reasons to wonder about the applicability of O'Brien's experiment, it seemed sound practice to repeat the experiment ourselves before dismissing her ideas entirely. We used two different handaxes, a large ovate basalt specimen made by Whittaker to approximate O'Brien's handaxe and a smaller, more triangular chert handaxe made by Harold Dibble (table 1). We attempted to test both overhand and discus-style side-arm throwing. After preliminary experiments, McCall, a baseball pitcher in high school and college, made the overhand throws. Joe Pipkins, a student with discus experience on the track team, performed the discus-style throws. He threw the smaller handaxe 15 times and the larger 10 times for the record. McCall performed 15 overhand throws with the smaller axe and found the large one impossible to throw overhand. Whittaker (a competitive atlatlist) and McCall then threw both the large and small handaxes discus-style 12 times each, with remarkably consistent results.

The two different throwing styles are significant. It is hard to throw a heavy object any distance overhand, and

TABLE 1
Comparative Handaxe Data

Handaxe	Length (cm)	Width (cm)	Thickness (cm)	Weight (kg)
O'Brien	29	14	4	1.915
Whittaker and McCall				
Large	24	14	4	1.457
Small	17	11	4	0.620

TABLE 2
Handaxe Throwing Data: Discus-Style

Thrower and Handaxe	Number of Throws	Mean Distance (m)	Landing (%)					
			Edge	Point	Butt	Point/Edge	Butt/Edge	Flat Face
O'Brien	45	31.9	2.2	68.9	6.7	8.8	6.7	6.7
Pipkins								
Large	10	30.2	0	0	0	0	0	100.0
Small	15	41.7	6.7	0	0	0	0	93.3
Whittaker and McCall								
Large	24	18.0	0	0	0	0	4.0	96.0
Small	24	25.9	16.0	4.0	0	0	12.5	66.0

TABLE 3
Handaxe Throwing Data: Overhand

Thrower and Handaxe	Number of Throws	Mean Distance (m)	Landing (%)					
			Edge	Point	Butt	Point/Edge	Butt/Edge	Flat Face
O'Brien	6	30.2	50.0	33.3	0	16.7	0	0
McCall (small)	15	29.3	13.3	26.7	0	26.7	33.3	0

therefore a large flat handaxe is best thrown side-arm. As did O'Brien, we used not the elaborate running and turning throw of discus competition but a much simpler side-arm motion. Nevertheless, it took a great deal of effort to throw the large handaxe this way. Given our lack of experience, we did not attempt to measure accuracy, but we ended unconvinced that anyone would be likely to attain any level of marksmanship with a discus throw of a heavy handaxe. Throwing overhand is far more forceful and accurate.[2]

Another thing we learned right away is that throwing a heavy discus with a knife-sharp and jagged edge all around is not a good idea. O'Brien's use of a fiberglass cast may not have revealed this. When one tries to throw a heavy handaxe any distance, a lot of gripping force must be applied, and the handaxe rotates as it leaves the hand. After several bloody slashed fingers, including some cuts through a leather glove, we dulled the base of the large handaxe. A supporter of the throwing theory could point out that the many handaxes with dull bases, some even left cortical, which are contrary to Calvin's stereotype of handaxes now seem more acceptable. Of course, that makes them less effective weapons, and there does not seem to be any documented pattern of intentionally dulled edges.

While the large handaxe was impossible to throw overhand, Pipkins found the small one uncomfortable to throw like a discus. McCall and Whittaker did not. The distances obtained by Pipkins were broadly comparable to those reported by O'Brien (table 2). Ten discus throws with the large handaxe averaged 30.2 m compared with O'Brien's 31.9 m and with the smaller handaxe averaged 41.7 m. The smaller handaxe weighed .62 kg, and O'Brien had predicted throws of 60 m for a half-kilogram handaxe. Whittaker and McCall, strong throwers but without discus experience, averaged only 18 m with the large handaxe and 26 m with the small one.

Although O'Brien's thrower managed to average 30.2 m with her fiberglass handaxe thrown overhand, McCall averaged 29.27 m over 15 overhand throws with our much smaller axe (table 3), leaving us to wonder how exactly O'Brien's thrower managed to throw her specimen even the 6 times reported.

An important part of the throwing-weapon theory is O'Brien's finding that her handaxe, thrown like a discus, rose flat like a discus but then turned and descended edge-on. We were completely unable to replicate this, and we wonder if the weighting of O'Brien's fiberglass replica affected her results. She feels (1984:24) that it is probably a matter of the release and therefore under control by the thrower. Pipkins agreed that a bad release sometimes resulted in a discus's landing on its edge, but although he tried, he could not get the handaxe to turn consistently.

Thrown overhand, our small handaxe always struck edge-on, but thrown side-arm, both large and small handaxes almost always landed with a thump like a pancake. Combining all the discus-throw data for both axes, we registered only 14% edge-on landings, and only one throw struck point first. The small handaxe was noticeably less stable. O'Brien claimed that her discus throws landed on edge 93% of the time and on the point 68%.

2. At what point did hominids develop this skill? Chimpanzees throw sticks and stones, but poorly and usually underarm (Goodall 1964). Marzke (1983) suggests that *Australopithecus afarensis* hands and other anatomy would have permitted forceful overhand throwing of small objects, and Isaac (1987) discusses the adaptive advantages and possible evidence in the form of spheroids and unshaped rocks at Oldowan sites.

As our field was soft and wet, we had ample opportunity to observe the landings, and in a couple of cases overhand throws actually stuck in the ground. However, even in the soggy turf, handaxes mostly bounced freely without much penetration, and they did not show any tendency, as is claimed by Calvin, to rotate and sink their points into the ground.

CONCLUSIONS

The handaxe-hurling hypothesis is based on exaggeration and stereotyping of the archaeological record: most handaxes are not the "classic" form envisioned, and few would throw as well as the nicer specimens with which both O'Brien and we experimented. Handaxes are not confined to river and lakeside contexts. No characteristic throwing wear or impact damage has been proposed or identified for handaxes; what use-wear information is available supports interpretations of handaxes as multipurpose tools often used for butchering. The original experiment as reported was flawed in its use of a fiberglass replica—a sharp-edged handaxe is quite unpleasant to throw. We were unable to replicate the reported edge-on landing of handaxes, so it is at least not the consistent pattern assumed by O'Brien and Calvin. The side-arm discus throw is an unnatural and inaccurate way to throw things, although necessary if one envisions large, heavy projectiles. Calvin's elaborate scenario is based on further dubious assumptions as well as those embodied in O'Brien's experiment. Cutting functions, especially butchery, are more plausible than throwing and have better evidence in the form of use-wear and context. We cannot, of course, rule out the possibility that some handaxes were occasionally thrown, but we can say pretty confidently that the handaxe as a class of artifact was not ordinarily intended as a projectile weapon.

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