

An Archaic Character in the Broken Hill Innominate E. 719

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ABSTRACT The additional hominid material from Broken Hill, Kabwe, Zambia, is only dubiously associated with the hominid cranium from the site and is often considered to be anatomically modern in morphology. This study identifies an archaic feature, previously recognised in Pliocene and earlier Pleistocene innominates, in the Broken Hill innominate E. 719. An acetabulo-cristal buttress of cortical bone 10 mm thick is present, and this can be clearly distinguished from the morphology present in a comparative sample of large recent *Homo sapiens* innominates. This observation increases the likelihood that some of the additional specimens from Broken Hill are indeed of comparable antiquity to the hominid cranium and extends the range of hominids in which the feature has been recognised.

From 1921 to 1925 a number of hominid fossils were recovered from a cave (subsequently destroyed) at the Broken Hill mine, Kabwe, Zambia (Oakley et al., 1977). The most important specimen, a well-preserved cranium (BM[NH] registration No. E. 686), became the holotype of *Homo rhodesiensis* Woodward 1921. It was subsequently referred to the new genus *Cyphanthropus* by Pycraft, in Pycraft et al. (1928), based on an erroneous assessment of the Broken Hill pelvic remains, and to *Homo erectus* by Coon (1962). However, it is generally regarded as representing an archaic form of our own species and is often referred to the subspecies *H. sapiens rhodesiensis* (Campbell, 1964; Rightmire, 1984). This cranium is now believed to date from the later part of the middle Pleistocene (ca. 250-130 kyr) (Klein, 1973; Partridge, 1982; Vrba, 1982).

Other material recovered from the site includes cranial and postcranial bones of at least three individuals. However, of this additional material, only the left tibia (E.691) and perhaps a fragment of femoral shaft (E.M. 793) appear to have been found in close proximity to the cranium. The other remains, consisting of a cranial fragment (E. 897), right maxilla (E. 687), distal right humerus (E. 898), right innominate (E. 719), left innominate (E. 720), sacrum (E. 688), proximal right femur (E. 907), proximal left femur

(E. 689), distal left femur (E. 689), and left femoral diaphysis (E. 690), were recovered in various circumstances and must be considered unprovenanced (Hrdlička, 1930; Clark et al., 1968). Reconstructions of the stratigraphy of the Broken Hill cave and chemical analyses of the human bones suggested to Clark et al. (1950) that the material was probably all of upper Pleistocene age, but other workers have regarded most or all of the other human material as unassociated with the cranium and of essentially modern character (Hrdlička, 1930; Leakey, 1935; Partridge, 1982). Some workers who accepted the contemporaneity of all the hominid specimens from Broken Hill have nevertheless remarked on the lack of archaic characters in the postcranial material (e.g., Coon, 1962; Howells, 1973; Howell, 1978), although a minority of workers have claimed that such features are present (e.g., Wolpoff, 1980; Kennedy, 1984).

INNOMINATE E. 719

The Broken Hill fossil that is the main subject of this article is a right innominate (E. 719), probably of a female, represented by part of the ilium (including the greater sciatic notch), acetabulum, and ischium (including

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most of the ischial tuberosity) (Figs. 1-3). Comparable pelvic material from the lower and middle Pleistocene is rare, but three fairly complete innominates from Olduvai (O.H. 28), Koobi Fora (KNM-ER-3228), and Arago (Tautavel - Arago 44) have been reported as sharing distinctive morphological characters. Day (1971) described a left innominate and femur from Bed IV at Olduvai (O.H. 28) and identified a unique combination of features that differentiated the material from Plio-Pleistocene (australopithecine) and late Pleistocene (Neanderthal, anatomically modern) specimens. In the pelvis these features include a very robust acetabulocrystal buttress, a relatively large acetabulum, a small oblique auricular surface, an ischial tuberosity which faces more laterally, a forwardly raked anterior superior spine, a stout horizontal buttress, and a poor demarcation between the true pelvis and the iliac fossa. Features of the associated femoral shaft were very like those described by Weidenreich (1941) in the Zhoukoudian *H. erectus* material, and the O.H. 28 specimens were therefore attributed to that taxon. Subsequently,



Fig. 1. Superior view of Broken Hill right innominate E. 719 (left) and a damaged Romano-British left innominate from York (right). The external cortical thickness of the damaged ilium in E. 719 is more than twice that of the York specimen in the area above the acetabulum (10 mm compared to 4.1 mm). $\times 0.45$.

Day (1982, 1984), Sigmon (1982), and Rose (1984) recognised the same distinctive suite of characters in the Pliocene right innominate from Koobi Fora (KNM-ER-3228), assignable to either *H. habilis* or *H. erectus*, and in the middle Pleistocene left innominate from Arago (Arago 44), assignable to either *H. erectus* or "archaic" *H. sapiens*. The strong acetabulocrystal buttress, rising vertically above the acetabulum, is perhaps the most impressive single feature of these innominates (Day, 1984), although details of the internal anatomy of this structure are only available from radiographs of O.H. 28 taken by A. Walker, where the heavy density of cortical bone in the buttress is clearly apparent (Day, 1971; Stringer, personal observation).

Most workers since Pycraft et al. (1928) have regarded the Broken Hill innominate E. 719 as essentially modern in morphology, albeit larger and more robust than the modern average. It was therefore with some surprise that I noted, during a casual examination of the fossil in 1983, that where the ilium was broken, about 21 mm vertically above the acetabulum, there appeared to be the origin of an acetabulocrystal buttress like that found in the O.H. 28 innominate. Externally (laterally or gluteally) the cortical bone reaches a maximum thickness of 10 mm in this area, while internally (medially) the cortical bone is only 2.5 mm thick, out of a total minimum iliac thickness at this point of 22.0 mm. In cross section (Fig. 1) the enhanced cortical thickness coincides with the development of a triangular prominence of bone corresponding closely to the form of the O.H. 28 innominate at a comparable position (Figs. 2, 3).

It was decided to gather data about the internal anatomy of modern innominates in the area of the ilium directly above the acetabulum to ascertain how distinctive E. 719 was with respect to cortical thickness in this area. It was decided to sample a number of large innominates from a recent population, using a power drill to remove cores of bone from a small area of the ilium. First, from a large sample of Romano-British skeletons from York, England, 23 of the largest innominates that preserved comparable areas to E. 719 were selected, using acetabular height and iliac thickness as a guide to overall size (right innominates were selected where possible). A standardised sampling point was identified by first orienting the surface of the ischial tuberosity toward the observer. A tan-



Fig. 2. Gluteal view of Broken Hill right innominate E. 719 (left) and a cast of Olduvai hominid 28 left innominate (right) to show similarity in overall size. The sampling position used for the comparative specimens has been added to the photograph of E. 719, marked as X. $\times 0.47$.

gent from the posterior acetabular rim, parallel to the line of the adjoining posterior iliac-ischial border, was projected superiorly toward the appropriate area of the ilium. The sampling point was marked 21 mm above the intersection of this line, with the tangent perpendicular to it projected from the superior acetabular rim (see Fig. 2). The minimum iliac thickness at this point was measured, using spreading calipers, and the equivalent sampling point on the internal (medial) iliac surface was also marked. Using a power drill, two roundels of bone 20 mm in diameter were then cut out around the external and internal sampling points, and they were detached when cortical bone clearly gave way to trabecular bone. The two roundels were then measured for their maximum cortical thickness at any point to allow for any slight variation in the sampling positions or in morphology, and the data were recorded and tabulated for the entire sample of 23 innominates (Table 1).

Table 1 compares the data on the York innominates with measurements taken on E. 719. While the Broken Hill fossil is comparable with the York sample in acetabular height and internal cortical thickness, and is only slightly outside the York range in iliac thickness, the value for external cortical thickness is considerably larger in E. 719 than in the York sample (more than nine standard deviations distant from the mean). Given that the selected York sample itself is large and robust by modern standards (for example, the *mean* acetabular height of the York sample used is outside the *range* for 40 specimens from various areas measured by Rose [1984]), it seems probable that the Broken Hill cortical thickness reported here would be extremely difficult to match in a normal population of modern *H. sapiens*, and, from personal observation of specimens, casts and radiographs would also be unexpected in Neanderthals.

Given that E. 719 shows not only an eleva-

tion of the iliac surface above the acetabulum but also a cortical thickening of bone demonstrating the presence of a true acetabulocrystal buttress, it is worthwhile examining the preserved innominate for signs of other characters recognised by Day (1971, 1982, 1984), Sigmon (1982), and Rose (1984) in the O.H. 28, Arago 44 and KNM-ER-3228 innominates. There is certainly an overall similarity in size between E. 719 and the other specimens, two of which (O.H. 28 and Arago 44) are probably also attributable to female individuals. But of the other expected *H. erectus*-like characters, only a large acetabu-

lum, a moderate degree of iliac flare, and the roofing of the acetabulum (mentioned by Sigmon, 1982) can certainly be recognised in E. 719. Less certainly, the preserved posterior gluteal surface of the ilium is also fairly concave, and there is a hint of the sigmoid curvature in superior view described by Rose (1984) for KNM-ER-3228. Because of damage it is impossible to assess acetabular and iliac breadth and the form and orientation of the auricular surface and iliac spines. The preserved ischial region is orientated normally and the true pelvis of E. 719 is certainly well demarcated from the deep iliac fossa by a transverse ridge, as in modern humans.

The identification of at least one archaic character in one of the unprovenanced Broken Hill specimens suggests that the material found close to the cranium (E. 691 and E.M. 793) can also be attributed to a nonmodern hominid group (although not necessarily to the E. 686 cranium) with greater confidence. This would allow confirmation that African hominids of the late middle Pleistocene or early upper Pleistocene probably differed in limb proportions and overall robusticity from the Eurasian postcranial pattern evident in the Neanderthals, since, for example, the single Broken Hill tibia E. 691 is considerably longer than any known Neanderthal specimen (Trinkaus, 1981, 1983; Kennedy, 1984). Also, the Broken Hill evidence suggests that the thick cortex of the long bones was still allied to one aspect of a pelvic pattern lost in Neanderthal and anatomically modern humans (Sigmon, 1982; Kennedy, 1984). The presence of an archaic acetabulocrystal buttress in E. 719 furthers the concept of a long period of stasis in this feature (Day, 1982; Rose, 1984) stretching at least from the end of the Pliocene to the late middle Pleistocene in Africa. However, it raises further doubt about the exclusive association of this character with *H. erectus*, since the character may predate, and does



Fig. 3. Anterior view of Broken Hill E. 719 (left) and a cast of Olduvai hominid 28 innominate (right) to show similarity in overall size and degree of iliac flare, particularly noticeable in O.H. 28. $\times 0.40$.

TABLE 1. Comparison of York Romano-British innominate sample ($N = 23$) with Broken Hill innominate E. 719

	Thickness			Acetab. height
	Ext. cort.	Int. cort.	Min. iliac	
York				
mean	3.90	2.41	17.70	60.80
SD	0.63	0.45	1.84	3.19
Range	3.0-5.7	1.6-3.3	15.0-20.0	54.2-67.5
E. 719	10.0	2.5	22.0	60.5

All measurements are in millimeters.

postdate, the range of *H. erectus* as known from cranial remains in Africa. This is also arguably the case at Arago, since the cranial material is classified as an archaic form of *H. sapiens* rather than as *H. erectus* by some workers (Wolpoff, 1980; Stringer, 1984).

Rose (1984) believes that the lateral flaring of the ilium in archaic *Homo* innominates cannot in itself be responsible for the degree of development of the acetabulocrystal buttress in these specimens. But in combination with powerful lesser gluteal muscles used in abduction, forces generated in the ilium might require such a vertical pillar. This would certainly appear to be the case in Broken Hill innominate E. 719. However, sometime during the late middle Pleistocene or early upper Pleistocene the long-lasting functional requirement for such a buttress was apparently removed, and in Neanderthal and early anatomically modern innominates from Europe and South West Asia the morphology of this area of the ilium is essentially modern.

STATUS OF ADDITIONAL REMAINS

Not all of the Broken Hill material can be clearly associated with the archaic morphology represented by the cranium and E. 719, and their status remains uncertain. The male left innominate (E. 720) and the sacrum (E. 688) show no obvious archaic characters, and the right distal humerus (E. 898) is gracile. However, the femoral remains are robust (Kennedy, 1984). The right maxilla (E. 687) may also represent a nonmodern hominid, since it bears a close resemblance to the comparable part of the Laetoli (Ngaloba) L.H. 18 cranium, dated to ca. 120 kyr (Day et al., 1980). The Laetoli fossil represents a more modern-looking hominid than the E. 686 cranium, but it is archaic rather than anatomically modern in overall morphology and dates from the middle-upper Pleistocene transition (Bräuer, 1984). The only teeth preserved on E. 687 are a damaged M^2 and an M^3 , but the M^3 is certainly larger than those of the Broken Hill cranium (E. 686) and L.H. 18. Although E. 687 is smaller than the maxillae of E. 686 in subnasal height and displays an apparent canine fossa, it is very comparable in external palate breadth (estimated at 80 mm as in E. 686) and is larger in nasal breadth (estimated at 33 mm compared to 31 mm). Comparing E. 687 and L.H. 18, E. 687 is larger in palate breadth (77.5 mm in L.H. 18) and nasal breadth (28 mm in L.H. 18), while they are similar in canine fossa morphology, subnasal dimensions, and prognath-

ism. Therefore E. 687, through its similarity to L.H. 18, probably falls within the range of late middle-early upper Pleistocene African hominids. Thus there is no longer any reason to assume that the Broken Hill maxilla (E. 687) and innominate (E. 719) represent anatomically modern hominids from the site. Both specimens, like the cranium E. 686, femora, and tibia E. 691, probably derive from an archaic late middle Pleistocene population. Judgement on the remaining unprovenanced material (E. 897, E. 898, E. 720, E. 688) must be reserved until further morphological studies or discoveries reveal new information or until their age can be determined more accurately.

CONCLUSIONS

These new data about the presence of archaic features in the Broken Hill postcranial remains assist in considerations of phylogenetic problems in the evolution of the genus *Homo* (Delson, 1985). An additional (postcranial) link can be provided between specimens generally assigned to *H. erectus* and early *H. sapiens*. However, the possibility remains that the presence of a vertical iliac buttress is only a primitive feature for *Homo* (present in *H. habilis*, *H. erectus*, and early *H. sapiens*) and therefore cannot provide an exclusive synapomorphy between *H. erectus* and (early) *H. sapiens*. This question is further complicated by the absence of this character (claimed to be ontogenetic) in the WT 15000 pelvis, which is assigned to early African *H. erectus* (Brown et al., 1985). Nevertheless, this structure was present in middle Pleistocene African and European hominids and therefore, whichever phylogenetic scheme is favoured, was likely to have been present in the ancestors of Neanderthal and anatomically modern humans. However, given the morphology of the other Broken Hill specimens, it may be that a divergence was developing between African and European hominids in postcranial as well as cranial morphology by the end of the middle Pleistocene.

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