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Cut Marks on the Bodo Cranium: A Case of Prehistoric Defleshing

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ABSTRACT Cut marks were discovered on the Middle Pleistocene Bodo cranium from Ethiopia. The cut marks most closely resemble experimental damage caused by the application of stone tools to fresh bone. This discovery constitutes the earliest solid evidence for intentional defleshing of a human ancestor and offers new research avenues for the investigation of early hominid mortuary practices.

The original Bodo hominid cranium was found in 1976 by Alemayehu Asfaw on an outcrop of Middle Pleistocene sediments at the site of Bodo in Ethiopia's Middle Awash Valley (Conroy et al., 1978). Nearly 100 fragments of this fossilized cranium were found scattered over 25 m^2. Most of the cranial base was not recovered (Kalb et al., 1980). According to the principal investigators, the specimen "... broke up and was dispersed after weathering whole from the eroding surface of layer B" (Kalb et al., 1980, p.114). Layer B is described as a medium sand with discontinuous coarse lenses, abundant vertebrate fossils, and widely scattered, fresh or slightly weathered artifacts. Stone tools were found in both the conglomerates and sands but only eight of the several hundred artifacts originally found at Bodo were located within 400 m^2 of the hominid discovery (Conroy, 1980). Coarse sand and pebbles removed from the hominid endocranial cavity in 1982 suggest that the cranium derived from one of the coarser, probably fluviatile, lenses and was in reworked association with the artifacts and other faunal remains.

The faunal list compiled from localities within 500 horizontal m and 4.5–7.5 vertical m of the hominid cranium includes aquatic (fish), amphibious (turtle, crocodile, hippopotamus), and terrestrial (bovids, suids, rodents, carnivores, equids, rhinos, elephants, giraffids) species. According to the original description of the Bodo occurrence, "The presence of many hippopotamus remains, including several skeletons, associated with stone tools, suggests that this was a site at which carcasses were butchered by early hominids" (Conroy et al., 1978, p. 68). However, the only evidence besides spatial proximity which has so far been suggested to link the fauna with the hominids and stone tools is a depressed fracture on a suid cranium collected in the Bodo area (Kalb et al., 1984).

The stratigraphic context of the Bodo cranium has recently been formalized by Kalb et al. (1982a,b) as the Bodo Member of the Wehaietu Formation. Chronological placement necessarily relies on paleontological and archeological data until radiometric and paleomagnetic work in progress at the University of Toronto yields results. Archeological assemblages from the Bodo Member are described as middle (Kalb et al., 1984) or middle to late stages of the Acheulian Industrial Complex (Kalb et al., 1982c), or as upper Acheulian and developed Oldowan (possibly representing different cultural activity sets) (Clark et al., 1982). The paleontological evidence confirms this Middle Pleistocene age (Kalb et al., 1982c,d) and placement between 0.5 and 0.2 million years ago is consistent with all estimates for the Bodo Member.

MATERIALS AND METHODS

Initial systematic assessment of the Bodo cranium suggested placement at the *Homo*

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erectus to *Homo sapiens* transition (Conroy et al., 1978; Conroy, 1980). Subsequent publications have placed the specimen in "archaic *Homo sapiens*" (Kalb et al., 1982a) or *Homo sapiens* cf. *rhodesiensis* (Kalb et al., 1982b,c). The 1981 recovery and study of a second hominid individual from equivalent strata in the Bodo area led Asfaw (1983) to identify several characters typical of *H. erectus* on the parietal. The current work of T. Adefris may further clarify the relationships of the specimen. It most closely resembles the Javanese specimen Sangiran 17, the Greek Petralona cranium, the French Arago 21 face, and the Zambian Kabwe cranium.

Between discovery in 1976 and initial description in 1978, the fragmented Bodo cranium was reassembled. Prior to our 1981 reconnaissance of the Middle Awash study area (Clark et al., 1984), Desmond Clark and I asked to examine the specimen at the National Museum of Ethiopia in Addis Ababa. At that time adhering calcareous matrix covered the inner portion of the orbits and the endocranial surfaces of the parietals, frontal, ethmoid, and sphenoid. Cemented sandy conglomerate filled the frontal lobes and nasal aperture. Nevertheless, much bone surface was clean, and Clark and I immediately identified multiple narrow striae on the anterior surface of the left zygomatic bone. Initial visual identification of these marks as cut marks was later confirmed by microscopic analysis.

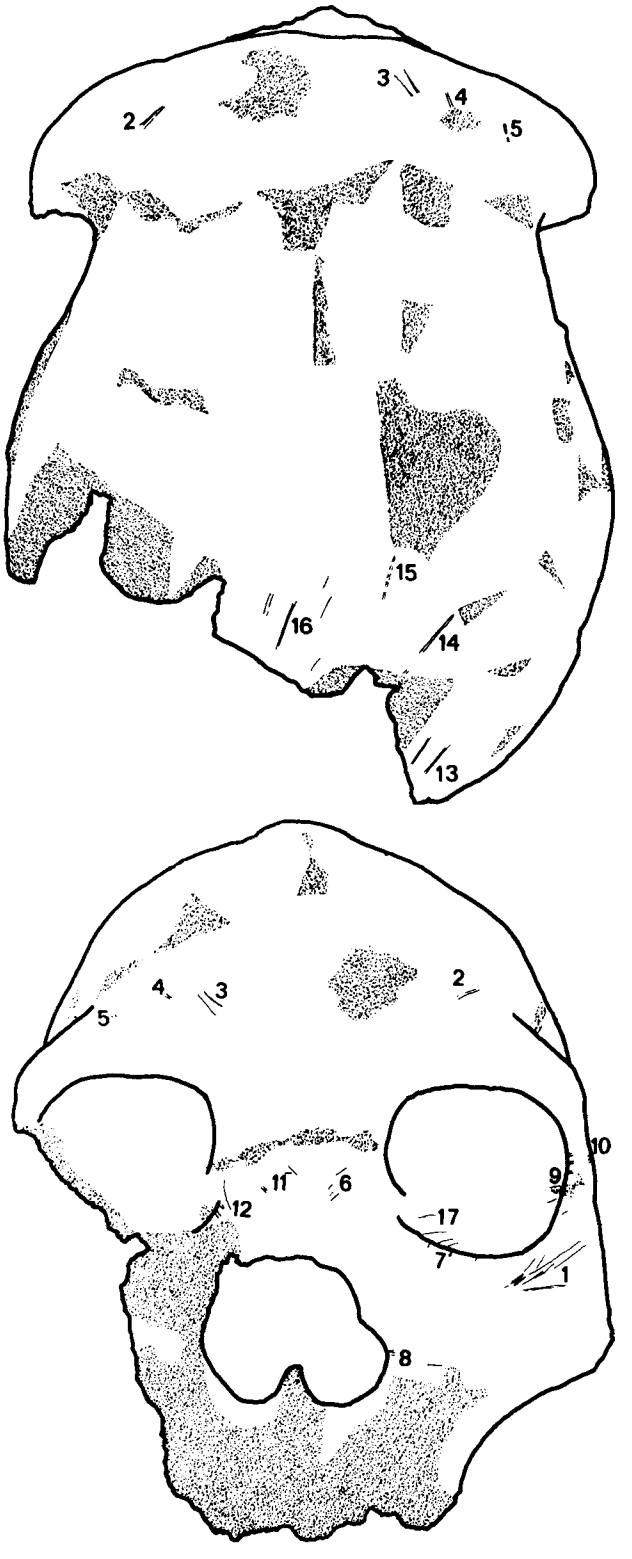
The Bodo specimen was loaned for preparation to our team during a 9-month period in 1982. I was joined by B. Asfaw and G. Suwa in this effort. Each of the individual pieces was unglued, cleaned thoroughly, and refitted in correct alignment. Matrix was removed by an air scribe (Chicago Pneumatic) fitted with a carbide tip. Application of the vibrating scribe tip to the matrix usually resulted in a clean release of matrix from fossil. Fine structures within the orbit as well as the sphenoidal and ethmoidal surfaces in the endocranial cavity were exposed intact. Careful observation of all surfaces revealed additional cut marks (Fig. 1), but only one set of these cut marks (within the left orbit) was obscured by matrix at the time of our 1981 discovery in Addis Ababa. It should be noted that many areas of the cranium show postfossilization weathering (shaded portions of the drawings in Fig. 1). Therefore, any cut marks in these areas have been obliterated. No cut marks were found on those hominid vault fragments still isolated from the main fossil. I have conservatively identified 17 areas with diagnostic cut marks on the Bodo cranium. Figure 1 shows the 17 cut marks areas established. In some of these areas (for example, number 1) multiple stone tool cutting strokes appear to have produced the cut marks. In other areas (for example, number 2) there is evidence for a single stroke. A conservative estimate for the number of slicing strokes required to form the observed cut marks on the specimen is 25.

Observational work on cut marks across archeologically derived faunal remains has recently been augmented by experimental studies on the gross and microscopic levels. Some investigators have suggested that cut marks made by stone tools can be identified by width and/or cross section (Walker and Long, 1977; Bunn, 1981). Others have stressed the consideration of microscopic appearance in identifying cut marks on archeological bone (Shipman, 1981, 1983; Shipman and Rose, 1983a,b; Potts and Shipman, 1981; Shipman et al., 1984). Shipman and Rose have conducted the most thorough experimental studies in this area, proposing a set of criteria said to be diagnostic in identifying marks on fossil bone that reflect hominid cutting activity with stone tools. A slicing mark is defined by Shipman and Rose as "... an elongate groove containing within its edges multiple, fine, parallel striations oriented longitudinally" (1983b, p. 64). Slicing marks were demonstrated to display variable cross-sectional shape and width, depending on the edge characteristics of the tool. Cut marks oriented parallel or subparallel to the main cut mark groove were found to be diagnostic and to also reflect edge characteristics.

RESULTS

Figures 2 and 3 show scanning electron micrographs of selected cut marks observed

Fig. 1. Views of the Bodo cranium to show the placement of cut marks. The 17 cut mark areas (see text for details) are numbered in order of discovery. Shaded portions of the cranium indicate areas of postfossilization damage to the fossil that have obliterated possible cut marks. Approximately half natural size.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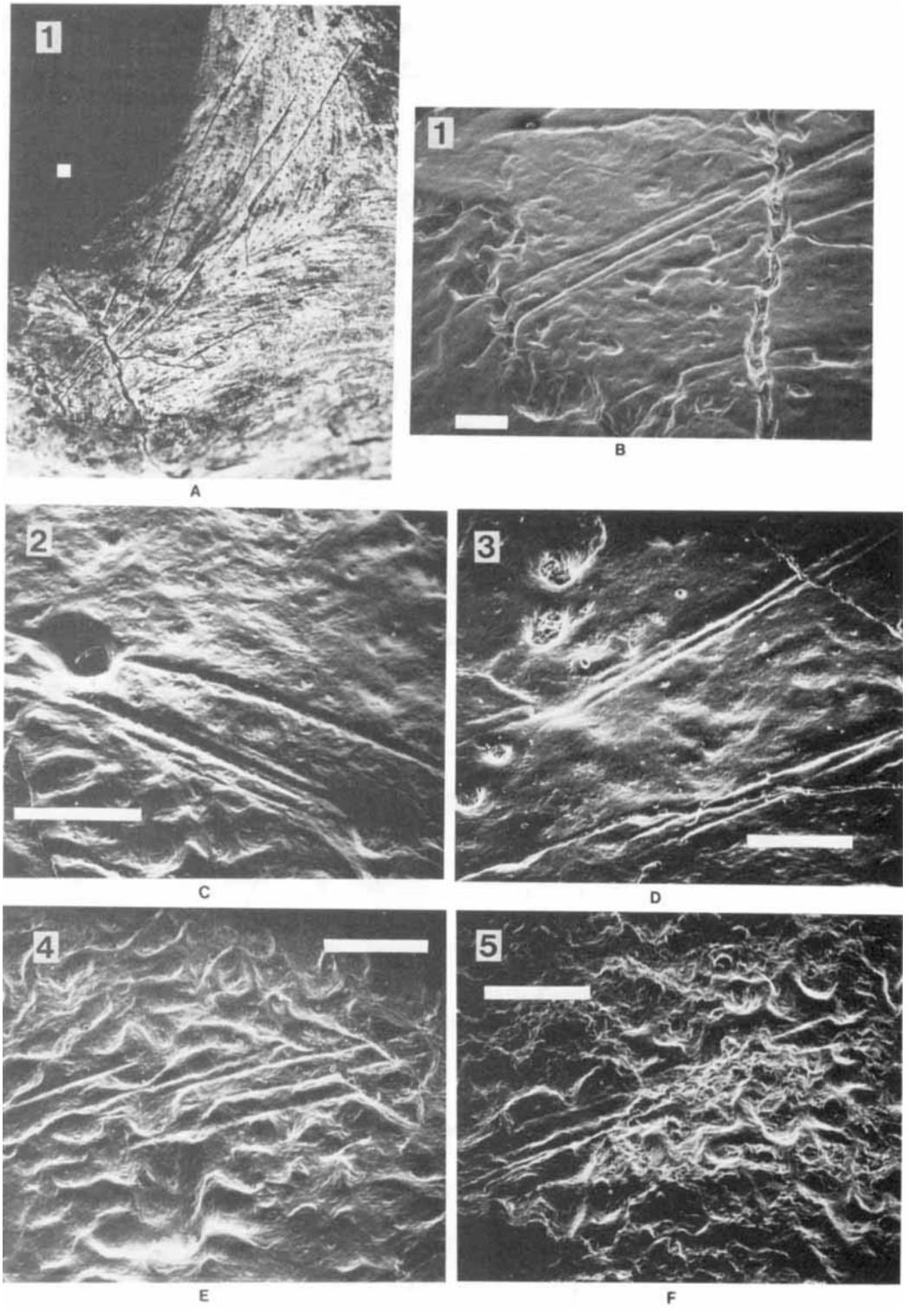

Fig. 2. Close-up views of the Bodo cranium. Numbers on the photograph (A) and the scanning electron micrographs (S.E.M.s; B–F) correspond to cut-mark areas defined by Figure 1. Scale bars represent 1.0 mm. A. Photograph of the left zygomatic. The orbital rim is at the upper left and the zygomaxillary suture is in the left lower corner. B. S.E.M. of the area in the lower left-hand corner of A. C. S.E.M. of cut marks on the left frontal. D. S.E.M. of cut marks on the right frontal. Irregular bone surface is "vermiculate" bone. E. S.E.M. of cut marks on the right frontal. F. S.E.M. of cut marks partly buried by adhering matrix on the right frontal. See text for discussion.

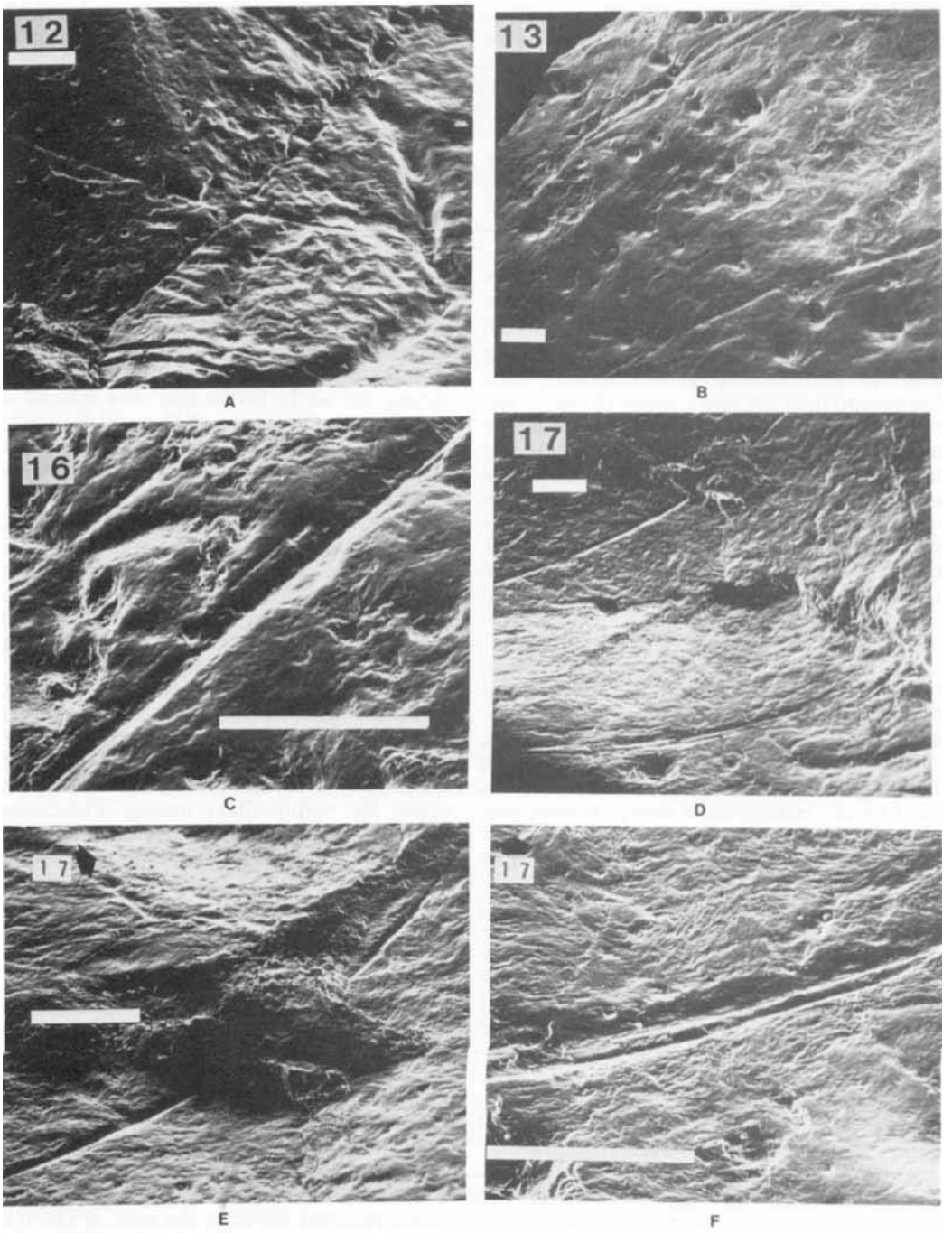

Fig. 3. Close-up views of the Bodo cranium. The numbers on these scanning electron micrographs (S.E.M.'s) correspond to cut-mark areas defined by Figure 1. Scale bars represent 1.0 mm. A. S.E.M. of the right lacrimal crest. Note the cut marks at the base of the image, disappearing under the matrix, which fills the lacrimal canal. B. S.E.M. of cut marks on the right parietal. C. S.E.M. of cut marks near the posterior midline area of the parietals. D. S.E.M. of the floor of the left orbit. View is from the superior orbital fissure. E. S.E.M. of the lower cut mark seen in D. F. S.E.M. close-up of the upper cut mark seen in D. During preparation this matrix was left to show its relationship to the cut mark.

on the Bodo specimen (horizontal bars indicate 1.0 mm). Replication of the fossil surface followed Rose (1983). The micrographs in Figures 2 and 3 illustrate numbered cut mark areas indicated on the drawings in Figure 1. "Shoulder marks" (Shipman and Rose, 1983b) are abundant and the long, fine, parallel-to-subparallel grooves seen in many areas, particularly areas 1 and 13–16, indicate that the implement used was probably a flake. Minor irregularities along the implement's edge scored the bone and formed parallel cuts during a single stroke. The marks in area 17 show that the implement was small enough to reach inside the orbit by 20 mm and then be moved transversely, slicing into the orbital floor. Macroscopically, with the exception of cut mark areas 12 (above the right lacrimal canal) and 17 (four successive strokes on the floor of the left orbit), the cuts are linear. Curvilinear strokes in areas 12 and 17 probably result from implement use in confined spaces. The Bodo specimen shows several healed depressions on the frontal but these are not necessarily related to the cut marks, which show no sign of healing.

INTERPRETATIONS

The surface of the Bodo cranium appears to have been unweathered at the time of fossilization and there is no indication of rodent gnawing or carnivore damage. Abrasion and trauma induced by transport prior to burial is absent—thin, delicate bony features such as the lateral nasal margins were preserved intact. It is possible for dry modern or fossil bones to be scored by agents such as stones or hooves which may, in some instances, mimic stone-tool cut marks (White, 1985). The distribution (patterning and intraorbital placement), morphology, and dimensions of the marks on the Bodo cranium effectively eliminate this possibility as well as the possibility that the marks were made by abrasive particles in the sedimentary matrix prior to fossilization. In addition, none of the hundreds of other fossils from this sedimentary unit examined during the 1981 fieldwork showed such marks. Tightly adhering matrix in the Bodo specimen's right lacrimal canal, right supraorbital area, and left orbit has been left in place to show it infilling and covering the cut marks (see Figs. 2, 3, areas 5, 12, and 17). This weakens the argument that the Bodo striae might represent postfossilization damage. The softly rounded contours of some cut marks probably result from these marks being released from the matrix prior to discovery and subsequently undergoing slight sandblasting abrasion associated with whirlwinds common to the Afar floor. Marks which retained matrix had a more crisp definition, further evidence against preburial abrasion.

The symmetry of the oblique cutmarks on the frontal region (areas 2–5) and the consistent parasagittal directionality and dual-track morphology of cut marks on the posterior parietals (areas 13–16) argue for a patterned intentional defleshing of this specimen by a hominid(s) with a stone tool(s). I studied crania of modern apes (primarily chimpanzee and gorilla from the Cameroons) intentionally defleshed with steel knives during the early 1900s and now housed at the Cleveland Museum of Natural History. I was able to match the placement and orientation of each set of Bodo cutmarks among these apes, despite differences in gross cranial morphology and tool type employed.

The Bodo cranium antedates the Eurasian Neandertals. Evidence for Neandertal defleshing of the dead comes from the Krapina remains (Gorjanovic-Kramberger, 1906; Ullrich, 1978), from the Hortus specimens (DeLumley, 1973), and from the Engis child's cranium (Russell et al., 1983). Weidenreich mentions what he perceived as possible cut marks on the Choukoutien crania of *Homo erectus* (1939). All these fossils and many others (Roper, 1969) have been claimed as evidence for cannibalism among Pleistocene hominids. Binford (1981) has commented on the suspect nature of many such claims. We have recently initiated a comprehensive review and survey of the fossil evidence for early hominid violence and trauma. Dr. Nick Toth and I will perform a worldwide survey of the hominid fossil record to observe, record, and compare the macroscopic and microscopic patterns of osteological damage to fossil remains of Neandertals, *H. erectus, H. habilis*, and *Australopithecus*.

In the case of the Bodo cranium, it is already evident that intentional postmortem defleshing of some kind occurred. It is particularly unfortunate that the base is missing so that little evidence bearing on the issue of brain removal through the area of the foramen magnum is available. Alternative hypotheses concerning the hominid behaviors that resulted in the observed pattern of cut marks on the cranium are available. It is impossible to falsify hypotheses of cannibal-

ism, cannibalism combined with curation, simple curation, mutilation, or decoration with the evidence at hand. A choice between these and other plausible alternatives may be possible upon completion of comparative work now underway on experimental, ethnographic, and recent archeological materials. The recovery of more skeletal elements, including postcrania and cranial remains differentiated by age and sex, will be important in elucidating mortuary practices during the Pleistocene. It is likely that future discoveries in the Middle Pleistocene beds at Bodo and Dawaitoli in Ethiopia's Middle Awash Valley will serve to clarify these matters.

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