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News and Views

On the earliest human occupation in North Africa: a response to Geraads et al.

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Introduction

Geraads et al. (2004) have published a paper on the earliest hominid occupation in North Africa that addresses the previous publication by Sahnouni et al. (2002) of further research at the Oldowan site of Ain Hanech, Algeria. Geraads et al. cast doubt on the suggested age of 1.8 Ma for Ain Hanech. These authors disagree on: 1) the paleomagnetic interpretation; 2) the biochronological interpretation, especially of *Equus* and *Kolpochoerus*; and 3) the Oldowan character of the lithic assemblages. In Geraads et al.'s view, a "best fit" age for Ain Hanech is 1.2 Ma, while they consider the age of Thomas Quarry 1 (Layer L) to be between 1.0 and 1.5 Ma. Thus, if they are correct, this latter site, with a fauna mostly identical to that of the middle Pleistocene site of Tighenif (formerly Ternifine) and associated with a typical Acheulean industry, would be contemporaneous with Ain Hanech, with an early early Pleistocene fauna associated with an Oldowan industry. As outlined below, we disagree not only with this conclusion, but with each of the three major criticisms leveled by Geraads et al. as well.

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Paleomagnetism

Geraads et al. criticized the Ain Hanech paleomagnetic results (Sahnouni et al., 1996) by arguing that: 1) the polarity data have not been published, which is especially a problem since the sediments are detritic; 2) paleomagnetic analyses in continental deposits are a "risky task," and the paleomagnetic interpretation took precedence over the biochronology; and 3) the Jaramillo Normal Subchron has not been considered as a possibility. We respond to these criticisms as follows.

Fraction and mineralogical analyses indicate that Ain Hanech sediments consist of fine silt and clay, and were deposited in a low energy floodplain environment (Sahnouni, 1998: 37–38, Figures 4.3 and 4.4; Sahnouni and de Heinzelin, 1998: 1083–1087, 1089, 1101). Contrary to Geraads et al.'s suggestion, such sediments are well suited for paleomagnetic analysis. In contrast, at Tighenif, Geraads et al. (1986b) carried out a paleomagnetic analysis on sand deposits *disturbed* by ascendant spring water. Furthermore, on the polarity of Level L of Thomas Quarry 1, Geraads (2002: 46) wrote: "Its paleomagnetism is most probably reverse (Sen, personal comm.), suggesting a Lower Pleistocene age."

The *International Stratigraphic Guide* considers paleomagnetism as a line of evidence that should be used in time correlation, and accepts that this has to be done with "assistance from other methods, such as biostratigraphy and isotopic dating" (International Subcommission on Stratigraphic Classification, 1994: 96). The use of paleomagnetism is now widespread in studies of the Quaternary globally despite the fact that sections are often short. Biotic changes in the Pleistocene tend to be rapid, and often biostratigraphy is sufficiently precise to assign a rock unit to a particular paleomagnetic chron or subchron. This is the case at Ain Hanech, where the appropriate combination of methods produced a reliable age estimate.

The Jaramillo Normal Subchron was ruled out because Ain Hanech is clearly much older for biochronological reasons (see next section).

Biochronology

Geraads et al. suggested that Ain Boucherit might be 2.0 Ma or younger. Given the paleomagnetics of the site, this would imply that Ain Hanech should be correlated to the Jaramillo, rather than the Olduvai Event. However, Geraads et al. did not provide any valid arguments in favor of such an age. For example, the question of whether *Equus* entered Africa 2.36 or 2.33 Ma ago is irrelevant here.

In their Figure 2, Geraads et al. presented putative temporal range for some selected large mammalian taxa. However, there are a number of problems with this, including:

1. The temporal ranges of *Sivatherium* and *Elephas recki ileretensis* are so wide that they are irrelevant here for the discussion on the age of Ain Hanech.
2. The temporal range of *Numidocapra* is based on only two occurrences, other than Ain Hanech, and thus is not reliable.
3. Geraads et al. claimed that *Oryx* from Ain Hanech is *Oryx gazella* because of its alleged antero-posteriorly compressed horn cores. This feature is lacking from the Plio-Pleistocene specimens of the Turkana basin (Harris, 1991), which show more transversely flattened horn cores, but it is present in Tighenif and the living species. Figure 1 shows the flattening index of *Oryx* horn cores through time. The higher value of the index indicates the more transversely flattened horn cores; a lower value indicates that they are more antero-posteriorly flattened. Transversely flattened horn cores are common in bovids, and probably represent the primitive state for *Oryx*. There seems to be a tendency in *Oryx* over time towards more antero-posteriorly flattened horn cores. Contrary to Geraads et al.'s statement, however, the Ain Hanech specimen differs from those from Tighenif in having a laterally flattened horn core (index value >100), which clusters better with the sample from the KBS Member of the Koobi Fora Formation. However, although the tendency towards lower values in *Oryx* (Fig. 1) may well be real, one should take into consideration variation. For instance, a sample of 117 specimens of the Miocene bovid *Eotragus clavatus* shows that the range of variation in this species is comparable to that

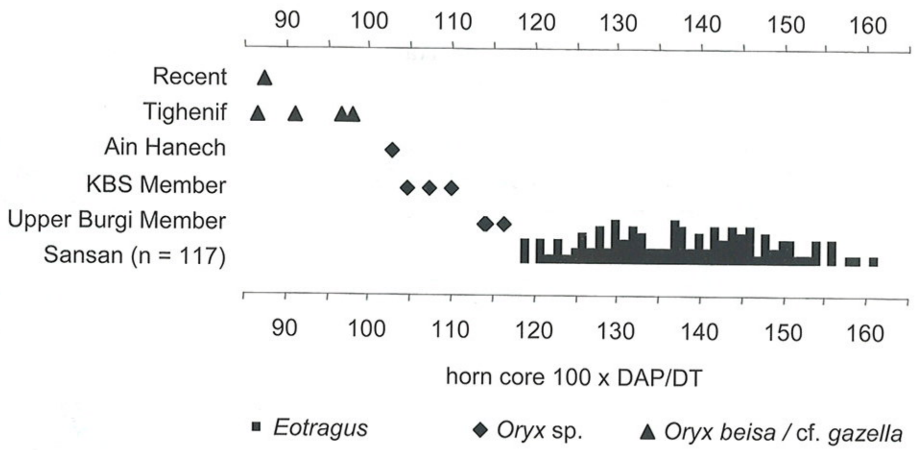


Fig. 1. Flattening index of *Oryx* horn cores through time. The index (100 × DAP/DT) indicates the degree of flattening of the section of the horn core. Higher values indicate a more transversely flattened horn core; lower values indicate that a horn core is more antero-posteriorly flattened. (DAP=antero-posterior diameter; DT=transverse diameter; measurements taken at the base, except for Ain Hanech, where they were taken 5 cm above the base). The *Oryx* samples are ordered in approximate order from oldest (Upper Burgi Member) to youngest (Recent). Data for *Oryx* sp. from the KBS and Upper Burgi Members and Recent *Oryx beisa* are from Harris (1991); data for *Oryx* cf. *gazella* from Tighenif are from Geraads (1981); data for *Oryx* sp. are from Arambourg (1979); measurements for *Eotragus* from Sansan were taken by JvdM on 117 specimens housed in the Muséum National d'Histoire Naturelle (Paris, France), Muséum d'Histoire Naturelle (Toulouse, France), and Naturhistorisches Museum (Basel, Switzerland).

of all *Oryx* material discussed here. Geraads (1981) also stressed the importance of the inclination of the horn cores. However, the specimen from Ain Hanech does not preserve the base and, therefore, its inclination is not known.

4. The temporal range of *Crocuta crocuta* is indicated by Geraads et al. (2004: Figure 2) with a continuous line from about 0.7 Ma to recent and with a dashed line from as early as 1.4 or 1.5 Ma. However, *Crocuta crocuta* has been reported from several late Pliocene localities, including the Upper Burgi Member (Feibel et al., 1991).

Therefore, the arguments on the temporal range of these taxa presented by Geraaads et al. are not relevant to the age of Ain Hanech.

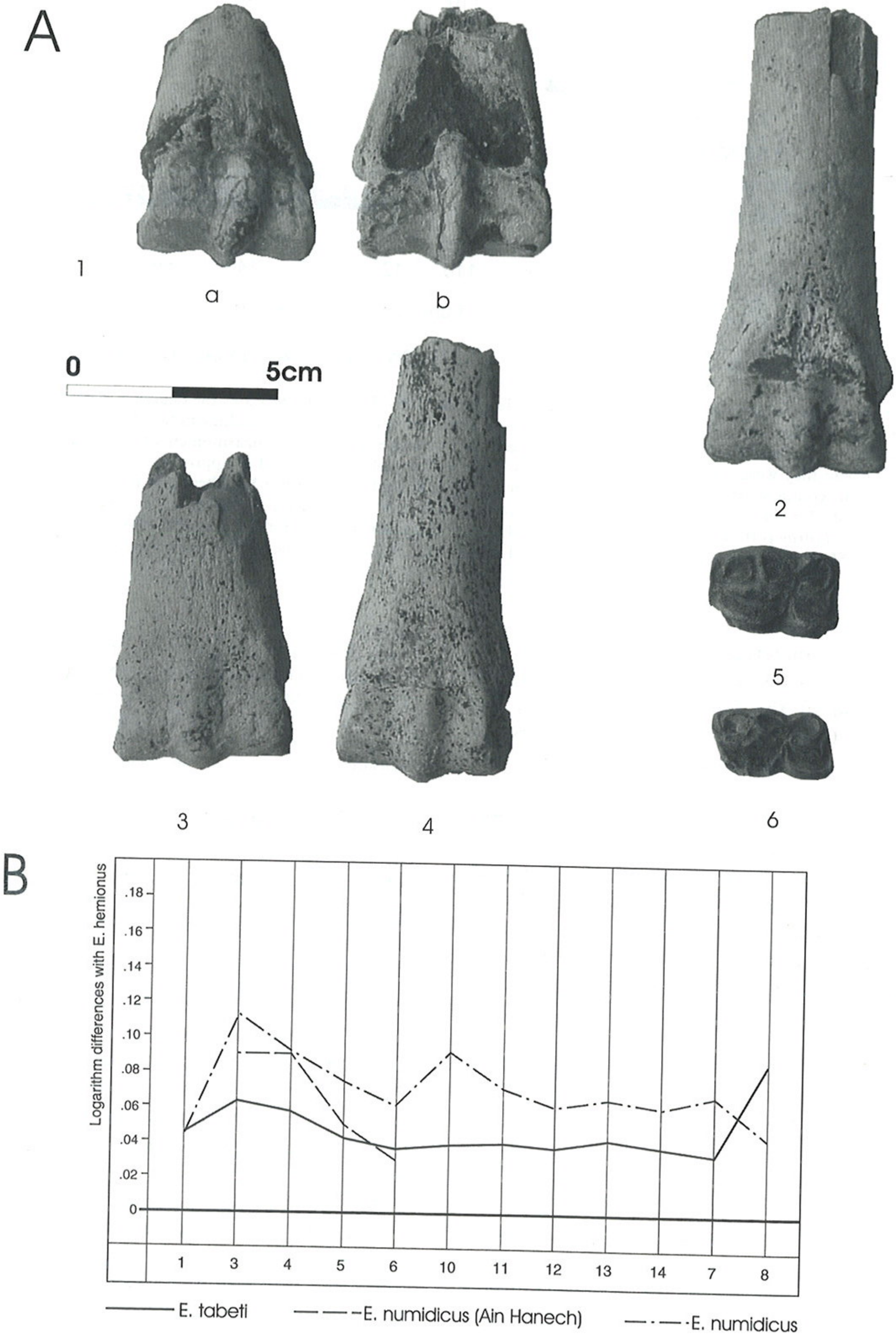
Equus

Sahnouni et al. (2002) referred a P_4 recovered at Ain Hanech to *E. numidicus* (a species known at Ain Boucherit) because of its occlusal surface morphology and large size relative to the other Ain Hanech equid (*E. tabeti*). Geraads et al. disagreed with this, arguing that the resemblance of the characters to those of the Ain Boucherit equid does not demonstrate the presence of *E. numidicus*, and that its relatively large size could be indicative of *E. mauritanicus* or some other large equid species.

Table 1
Lower cheek tooth measurements of *Equus tabeti* and *Equus* cf. *numidicus* (OL=ccclusal length; OW=occlusal width). "P3/P4" and "M1/M2" indicate isolated premolar and molar teeth that cannot be separated morphologically

Measurements	*E. tabeti*		*E.* cf. *numidicus*
	"P3/P4"	"M1/M2"	"P3/P4"
OL	29	26.5–28.6	28.3–31.3
OW	17	14.5–16.7	18.4–18.5
Height	65–68.5	41–65	46–54.5

Sahnouni et al. (2002) figured a single tooth as an example of *E. numidicus*, but actually, there is a sizable sample of equid remains that permits a diagnostic separation between the two Ain Hanech equid species. We select here a few elements that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E. tabeti
E. numidicus (Ain Hanech)
E. numidicus

Table 2
Upper cheek tooth measurements of *Equus tabeti* and *E.* cf. *numidicus* (OL=occlusal length; OW=occlusal width; Prot. L.=protocone length; L+lPm.m/2=protocone length+protocone width of the premolar and molar/2). "P3/P4" and "M1/M2" indicate isolated premolar and molar teeth that cannot be separated morphologically

Measurements	*E. tabeti*			*E.* cf. *numidicus*	
	P2	"P3/P4"	"M1/M2"	"P3/P4"	"M1/M2"
OL	35–37.2	25.5	25–26	28	26
OW	25–26	24.5–25.5	24.5–27.2	28	27.2
Prot. Length	8–9.4	10.3–11.3	8	11.2	9.2
L+l Pm.m/2		25.1–26.3	25.1–25.2	28	26.6
Height	57–58	60.5–66	50–57	52	32

are the best preserved specimens to shed light on this debate, including 7 lower cheek teeth, 9 upper cheek teeth, 9 metacarpals, and 7 metatarsals. The larger of these lower cheek teeth have dimensions within the limits of the *E. numidicus* range of variation, as reported by Eisenmann (1981: Table 26). These teeth are larger than the *E. tabeti* teeth from Ain Hanech (see Table 1 and Fig. 2A: 5–6), within the range of variation for *Equus* from Omo (Eisenmann, 1985: Table 18), and plot near the specimen from Omo Member L (Eisenmann, 1985: Figure 5). The occlusal morphology of these teeth shows double knots of stenonine type, as well as an identical convexity on the entire metastylid-metaconid. The metaconid is the same size as the metastylid, the linguaflexid is deep and pointed, and the vestibular groove is deep given its position in the premolar row.

The upper cheek teeth of *Equus* are generally less characteristic because of the greater uniformity of occlusal characters across this part of the dentition. However, the dimensions permit a distinction. Two teeth of the larger species presented here, an M^1/M^2 and P^3/P^4, are clearly distinguished from the group by their dimensions (Table 2). Furthermore, they are inside the scatter diagram of *E. numidicus* presented by Eisenmann (1985: Figure 4) and close to specimens from Omo Member G and L (OL=28 mm; protocone length=11.2 mm; OL=26 mm; protocone length=9.2 mm). The ratio length+width/2 of the upper cheek teeth relative to the protocone length places three teeth in the Ain Boucherit group (*E. numidicus*).

Although incomplete, the metatarsals and metacarpals illustrate well the difference in size and form between the two Ain Hanech equid species (Fig. 2A: 1–4). The similarity between *E. numidicus* and the Ain Hanech larger species is clear from the similar curves of the metatarsal average dimension ratios (Fig. 2B). These metatarsals display a greater robustness when compared with *E. tabeti*, especially in their diaphyses, which display equivalent antero-posterior (DAP) and transverse (DT) diameters (Table 3: measurements 3–4). They are also larger compared with *E. tabeti*, as evident in both measurement 4 and the proximal diameters. These dimensions plot near the smallest specimens of *E. numidicus* from Ain Boucherit, as well as those from Omo and East Turkana, in the scatter diagram of Eisenmann (1985: Figure 14). As expected in *E. numidicus*, the articular surface of the second species is sharply prominent on both the metacarpal and metatarsal.

Fig. 2. (A) Dental and metapodial morphological features of *Equus* cf. *numidicus* and *Equus tabeti* from Ain Hanech, including: 1a (KH02-236), metacarpal distal end, anterior-inferior face of *E. numidicus*; 1b, same bone, posterior face; 2 (KH02-232), metatarsal distal half, posterior face, *E.* cf. *numidicus*; 3 (KH02-233), metacarpal distal end, posterior face, *E. tabeti*; 4 (KH02-235), metacarpal distal end, anterior face, *E. numidicus*; 5 (KH02-22), P_3–P_4? (or M_1) *E.* cf. *numidicus*; 6 (KH02-28), P_3–P_4, *E. tabeti*. (B) The dimension ratios curve of partial metatarsals of *E.* cf. *numidicus* from Ain Hanech in reference to *E. hemionus*, compared to the *E. tabeti* and *E. numidicus* average curves. Note that the diaphyseal and proximal diameters are close to Ain Boucherit *E. numidicus* (Eisenmann, 1979; Eisenmann and Karchoud, 1982).

Table 3
Metatarsal measurements of *Equus tabeti* (KH02-231; KH02-239, KH02-237, KH02-240) and *Equus* cf. *numidicus* (KH-02-228, KH02-230, KH02-232) specimens housed at the University of Algiers. DAP=antero-posterior diameter; DT=transverse diameter; DAS=articular surface diameter

Measurements	*E. tabeti*			*E.* cf. *numidicus*		
	N	Range	Mean	*N*	Range	Mean
3. Width at mid-diaphysis	3	28.2–30	29.4	2	31.5–31.5	31.5
4. DAP at mid-diaphysis	3	25–28	26.1	2	31.5–31.5	31.5
5. Proximal articular DT	3	43–44	43.7	1	45	
6. Proximal DAP	2	36–36	36	1	38	
7. DAS large cuneiform	1	39.5	39.5	1	40	
8. DAS cuboid	3	10.5–11	10.8			
10. DAP distal sub-articular	2	41.3–41	41.4			
11. DT distal articular	2	40.5–41.3	40.9			
12. DAP articular surface	2	31–31.5	31.3			
13. Minimal DAP internal condyle	2	26–27	26.5			
14. Maximal DAP internal condyle	2	27–28.2	27.6			

Two dental and metapodial morphologies, as well as two distinct sizes, thus occur within the Ain Hanech *Equus* material. The presence of two different species is confirmed in the newly excavated material. A comparison based on more material will be possible when excavations at Ain Boucherit continue. Nevertheless, the features of the large Ain Hanech species already suggest that it is similar to the Ain Boucherit, Omo, and East Turkana equid species.

Kolpochoerus

Geraads et al. disagreed with Sahnouni et al. on the evolutionary stage of Ain Hanech *Kolpochoerus*, arguing that: 1) East African suid biochronology is not directly applicable to North Africa; 2) the Ain Hanech age was estimated using "mainly" the length of the M_3; and 3) a single tooth was used in the study. In contrast:

1. Our use of *Kolpochoerus* in biochronology is consistent with our opinion that the existence of endemic lineages within *Kolpochoerus* has not been proven. In contrast, Geraads has contradicted his own assertion of endemism in *Kolpochoerus* by comparing North African with East African *Kolpochoerus* in estimating the age of the Ahl al Oughlam site: "Assuming an uniform rate of M3 lengthening, the age of Ahl al Oughlam can be estimated at 2.4 m.y." (Geraads, 1993: 731).
2. It is not true that we used mainly the length of M_3 to "date" Ain Hanech. We used primarily the morphology of the posterior lobes. Geraads et al. ignored this and rather restricted their discussion to metrics.
3. We did not present a detailed description of all suid material, but only an illustration of the presence of *Kolpochoerus heseloni*. The Ain Hanech *Kolpochoerus* sample comprises three teeth (two from Ain Hanech and one from the contemporaneous El-Kherba) (Fig. 3: 2, 3, 5). Their morphology is discussed more extensively below. Figure 4 gives data on length changes in M_3 in different *Kolpochoerus* samples. Length is but one of the characters, and below we will discuss in more detail the morphological characters that are of relevance here. The material assigned to *Kolpochoerus heseloni* displays a simple and low crowned M_3 without cementum, with the lower border of the crown parallel to the occlusal surface. The specimens from the *Metridiochoerus andrewsi* zone at Koobi Fora, Shungura J (Cooke, 1985), and Ubeidiya are assigned to *K. olduvaiensis* (Geraads et al., 1986a), and are characterized by M_3 and M^3 that are on average longer, with more complex and higher crowns, presence of cementum, and the lower border of

the crown sloping rather than parallel to the occlusal surface. These characters tend to be more pronounced in the still younger samples.

A comparison with Ubeidiya and the younger site of Evron shows the more primitive character of the Ain Hanech-El Kherba teeth. The cementum is lacking in the teeth from Ain Hanech and El Kherba (Fig. 3: 2, 3, 5), but it is present in the specimens from Ubeidiya and Evron (Fig. 3: 1, 4), save when these are ontogenetically very young (e.g. Fig. 3: 6). The M_3 from Ain Hanech (Fig. 3: 2) has a low crown (the distalmost cusp does not yet show the dentine), the occlusal surface is parallel to the lower border of the crown, and there are only four pairs of main cusps or lobes. A posterior fragment of a tooth from Ubeidiya, probably representing an M_3 (Fig. 3: 6), has at least four pairs of cusps and may well have had six pairs. The cusps are much higher and the lower border of the crown makes an angle with the occlusal surface (i.e., it is not at 90° with the columns). The specimen from Evron (Fig. 3: 1) has five pairs of main cusps and a relatively large terminal cusp, a marked angle between the base of the crown and the occlusal surface, and a high crown. The M^3 from El Kherba (Fig. 3: 5) has a simple distal crown with relatively few cusps, a low crown (the posterior most cusp does not yet show the dentine), and a sharp angle between the occlusal surface and the base of the crown. In Ubeidiya (Fig. 3: 4, 7), there is a proliferation of small distal cusps, the crowns are much higher, and there is a greater angle between the occlusal surfaces and the bases of the crowns.

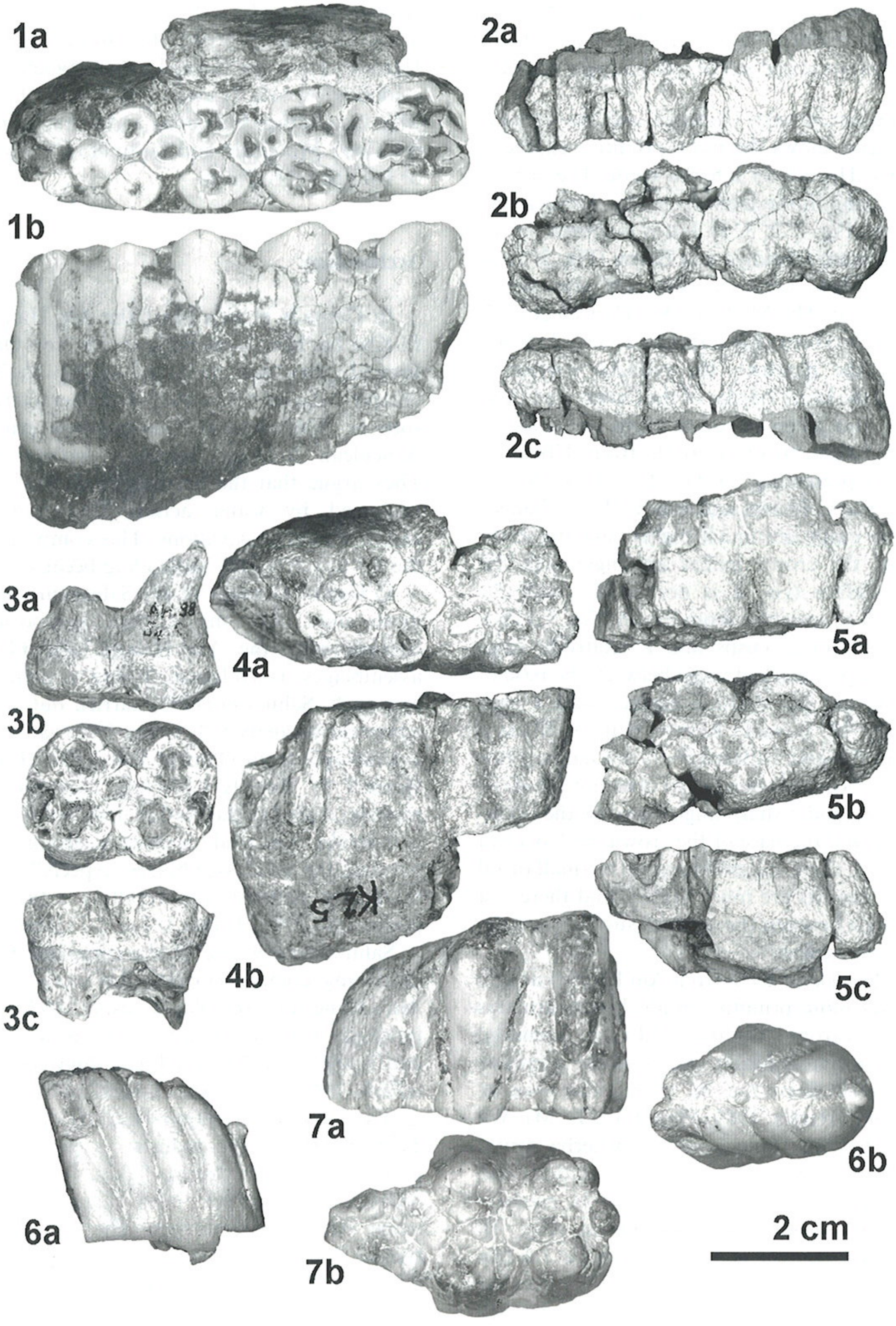
All *Kolpochoerus* teeth from Ain Hanech and El Kherba are more primitive in all these characters than all teeth from Ubeidiya and Evron. Similarly, they are morphologically clearly more primitive than material from the *M. compactus* zone at Koobi Fora (Harris, 1983, Plate 6.12: L, M). We interpret the Ain Hanech and El Kherba dental morphology as an earlier stage of evolution (and older age) compared to Ubeidiya, the *M. compactus* zone at Koobi Fora, and Evron (Fig. 4). The age of Ubeidiya is estimated to be 1.4 Ma (Thernov and Guerin, 1986) and the *M. compactus* zone is below the Chari tuff, also dated to 1.4 Ma (Brown and Feibel, 1991). These data suggest a latest Pliocene or earliest Pleistocene age for Ain Hanech. Thus, the normal paleomagnetic polarity evidenced at Ain Hanech can be correlated only with the Olduvai Subchron and certainly not with the Cobb Mountain and Jaramillo (N) Subchrons or Brunhes (N) Chron.

Archaeology

In Geraads et al.'s view, the Ain Hanech and El-Kherba lithic assemblages are not Oldowan. Instead, they see them as similar to Thomas Quarry 1 Layer L5, which they characterize as a sort of "Oldowan-like" assemblage within the Acheulean Industry, allegedly without bifaces. They argue that the absence of bifaces could be explained by water action, human behavior, and/or limited excavations. This comparison with the L5 unit is totally misleading because:

1) Unlike Geraads et al., Sahnouni considered more than just the artifact composition in characterizing the Ain Hanech and El-Kherba assemblages as Oldowan. Using a technological approach, Sahnouni (1993) carried out a detailed comparative analysis between Oldowan core tool assemblages from Olduvai Bed I and II and Ain Hanech by directly collecting data on Olduvai material stored in the National Museum of Kenya in Nairobi. The study showed a strong similarity between the two assemblages, especially in terms of flaking patterns and resulting artifact forms (Sahnouni, 1993: Tables 1–7 and Figures 2–7).

Sahnouni (1998) devoted a complete chapter to describing comprehensively the newly excavated Ain Hanech assemblages using technological, typological, and quantitative attributes. This study clearly shows the Mode I Technology composition (Clark, 1969) of the Ain Hanech industry, as well as its Oldowan tradition (Leakey, 1971, 1975). Technologically, the industry is primarily composed of core-tools/cores, flakes, fragments, and occasional retouched pieces characterizing early stone artifact assemblages. The cores comprise typical Oldowan artifacts such as unifacial and bifacial choppers, polyhedrons, subspheroids, and spheroids. Moreover, an experimental study on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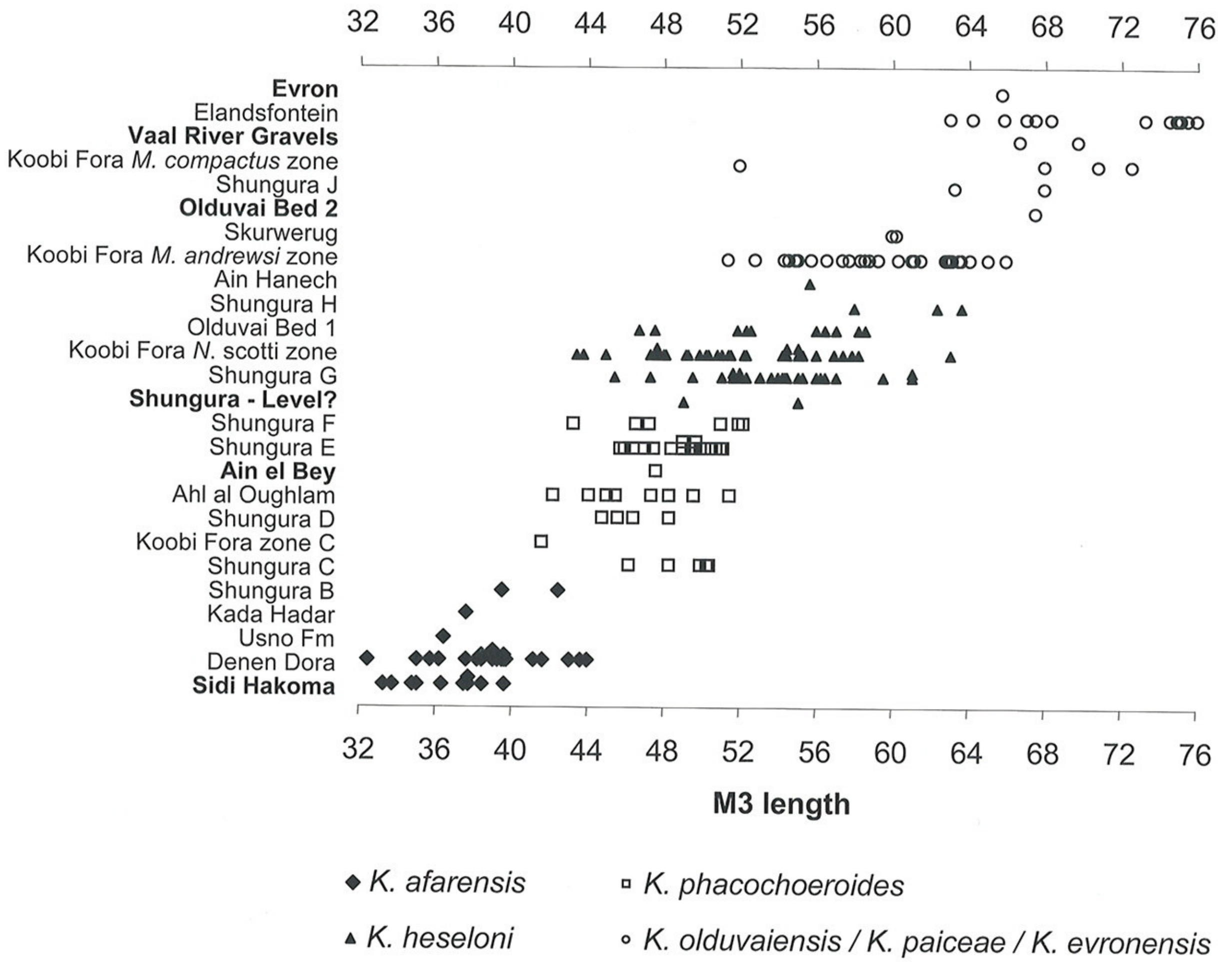

Fig. 4. The length of the *Kolpochoerus* M_3. The samples are arranged in approximate stratigraphical order from oldest (bottom) to more recent (top). Data for Hadar are from Cooke (1978); data for Koobi Fora are from Harris (1983); only complete specimens included); data for Ahl al Oughlam and Ain el Bey are from Geraads (1993); data for Elandsfontein, the Vaal River gravels, Skurwerug, and Olduvai Bed 1 are from Hendey and Cooke (1985); data for the Usno and Shungura formations are from Cooke (1976); data for "Shungura-Level?" and Olduvai Bed 2 from Leakey (1943) and Evron (HUJ). Type localities/levels or type material are indicated in bold. Note that there is a very small specimen in the *M. compactus* zone. This specimen is from area 103, an area that includes material from both *M. compactus* and *M. andrewsi* zones, as well as many specimens of which the stratigraphic provenance is given as unknown (Harris, 1983). It is possible that the specimen was erroneously listed as from the *M. compactus* zone. Nevertheless, it is listed here as indicated by Harris (1983).

Ain Hanech faceted spheroids and other artifact classes corroborated these technological and typological features (Sahnouni et al., 1997).

2) Geraads et al. stated that "In fact these assemblages do not really differ from Oldowan-like assemblages from Thomas Quarry 1 Layer L."

Fig. 3. Morphological features of the *Kolpochoerus* M3: 1) Left M_3, holotype of *Kolpochoerus evronensis* from Evron (Hebrew University of Jerusalem=HUJ); 2) AH99-G2-125, a left M_3 from Ain Hanech; 3) AH98-J4-79, a right M^2 from Ain Hanech; 4) K25, an M3 from Ubeidiya (HUJ); 5) KH 1993, a left M^3 from El Kherba; 6) II-26, an M3 from Ubeidiya (HUJ); 7) I15 LF, a left M^3 from Ubeidiya (HUJ).

This statement is deceptive because Geraads et al. failed to mention here the unambiguous presence of bifaces in Thomas L5 as published by Raynal et al. (2002b). Indeed, the Thomas Quarry Level L assemblages are not Oldowan-like but are *truly Acheulean* as shown by data and drawings of L1 and L5 artifacts. According to these data (Raynal et al., 2002a: Figure 7 and Table 2), L1 contains 41.6% "bifacials" and 6% "pebble tools," and L5 contains 16.4% "bifacials" and 4.8% "pebble tools." Of particular interest, the drawings (Raynal et al., 2002b: Figures 2–6 and 9–11) illustrate typical Acheulean artifacts from L5 unit (see Fig. 5B: 1–4) including bifaces, cleavers, trihedrals, and large flakes almost identical to those of the middle Pleistocene site of Tighenif (Balout et al., 1967: Figures 3, 6–15). In contrast, at Ain Hanech *there is not a single biface* associated with the Oldowan horizons. Acheulean material is found only in the calcrete deposit located higher up in the stratigraphic sequence, and thus, it represents a later phase of human occupation (Sahnouni and de Heinzelin, 1998: 1087). The presence of bifaces at L5 similarly contradicts Geraads et al.'s comparison of this site to the Ugandan site of NY 18 (Nyabusosi), where there is "no evidence at all of handaxes" (Texier, 1995: 652).

3) Unlike Thomas Quarry 1 Level L, the Ain Hanech and El-Kherba lithic assemblages were not heavily disturbed by water action. Three lines of evidence, including the sedimentary matrix containing the archaeological material, taphonomic conditions of fossil bones, and artifact concentrations suggest that the sites experienced minimal disturbance, thus preserving the integrity of the lithic assemblages (Sahnouni and de Heinzelin, 1998: 1088–1094). As a matter of fact, the assemblages, sealed in a very fine grained silty matrix deposited in a low energy setting, are typical of sites showing scant geological disturbance (Schick, 1986), and in which small debitage (<2 cm) predominates: 89.01% for Ain Hanech and 74.9% for El-Kherba (Sahnouni and de Heinzelin, 1998: 1093–1094 and Figures 13–17).

4) The excavated areas at Ain Hanech and El-Kherba are actually not so "limited." The excavated areas total 118 $m^2 \times 1.50$ m depth at Ain Hanech and 80 $m^2 \times 1.40$ m depth at El-Kherba, yielding 1232 and 270 stone artifacts >2 cm, respectively. In spite of these substantial excavated areas, not a single biface or biface fragment was found. However, at Thomas Quarry 1 Layer L, in a comparably sized excavated area of 80 m^2 (Raynal et al., 2002a: 67), a large sample of 185 "bifacials" was found (including 124 in L1 and 61 in L5) (Raynal et al., 2002a: 74, Table 2).

The age of Layer L of Thomas Quarry 1 site

Instead of the previously published ages of 0.7 Ma and 1.0 Ma (Raynal and Texier, 1989; Raynal et al., 2002a), Geraads et al. (2004) suggested an age for Layer L of Thomas Quarry 1 between 1.0 and 1.5 Ma. This age estimate is based on: 1) an admittedly "small faunal assemblage" with "few diagnostic elements," which they nevertheless consider "quite distinct from the fauna of the early middle Pleistocene site of Tighenif"; 2) an early Acheulean industry; and 3) "good agreement with the OSL dating."

We argue that the age of the Thomas Quarry 1 Layer L, as suggested by Geraads et al., is questionable because: 1) all the diagnostic elements of the large mammal fauna (*Loxodonta atlantica*, *Equus mauritanicus*, *Gazella* cf. *atlantica*) are found at Tighenif—the only exception is the presence of a single M^3 of *Kolpochoerus* found outside the archaeological excavations (Geraads, 2002: 46) the presence of an industry does not permit one to date a site; and 3) OSL dating presents huge uncertainties, as is reflected in the error margins on the dates for unit L5: 989 ± 208 ka, 1683 ± 473 ka, and 1037 ± 1204 ka (Raynal et al., 2002a: 68).

Conclusion

Recent multidisciplinary investigations undertaken at Ain Hanech by Sahnouni and colleagues have led to the following results: 1) Ain Hanech is a site with an Oldowan industry contained in fine-grained sediments and in undisturbed context; 2) the fauna, including *Kolpochoerus hesseloni*, two species of *Equus*, elephant, sivatherine, and *Pelorovis* (Hadjouis and Sahnouni, in review), indicates a

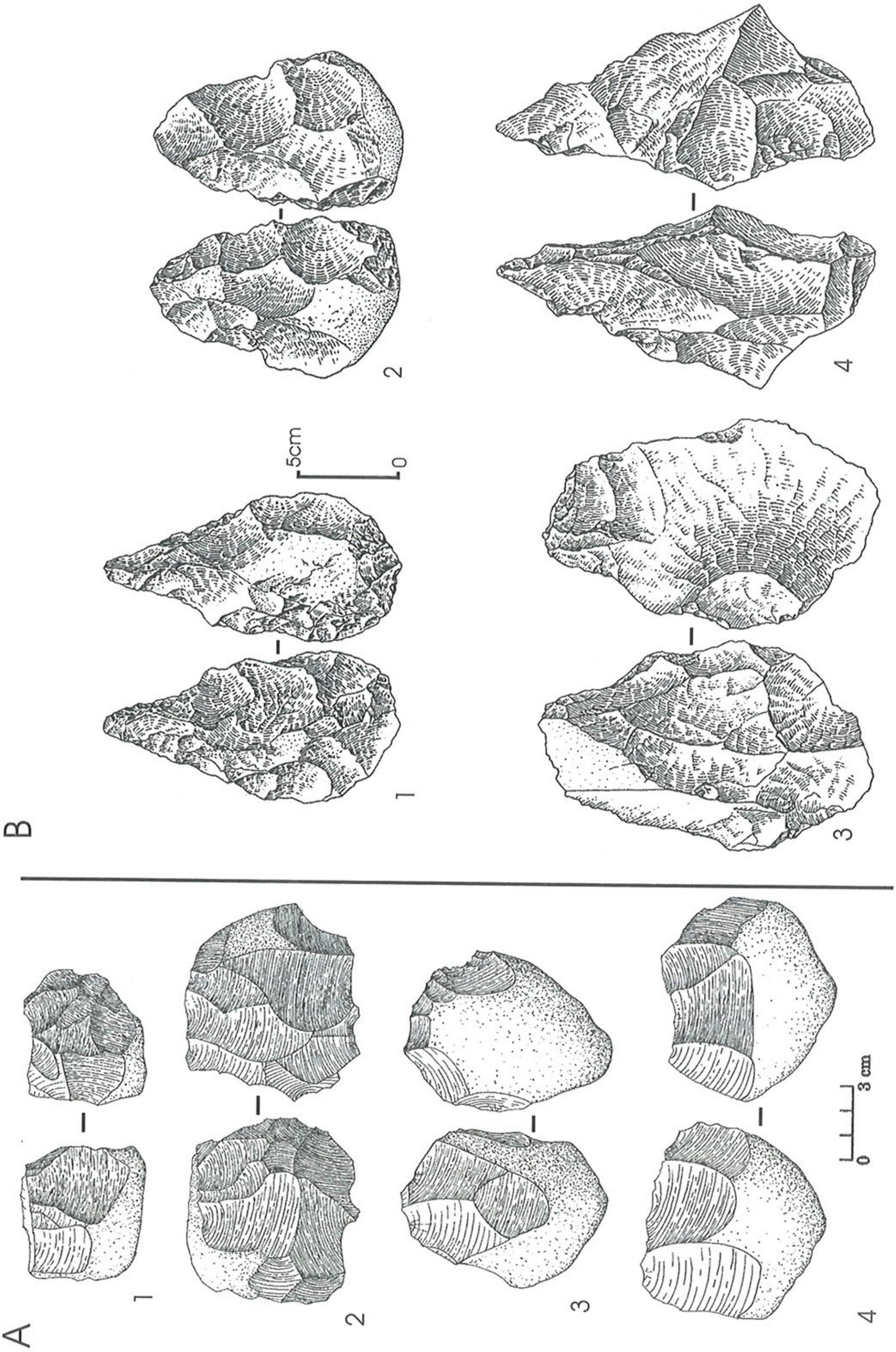

Fig. 5. Examples of (A) Ain Hanech Oldowan artifacts (redrawn after de Heinzelin [Sahnouni and de Heinzelin, 1998]) shown next to (B) examples of typical Acheulean artifacts from Thomas Quarry 1 Layer L5 (redrawn after Raynal et al., 2002b).

latest Pliocene/earliest Pleistocene age and not a late early Pleistocene age; and 3) based on the combination of paleomagnetic and biochronologic data, the estimated age of Ain Hanech site is between 1.77 and 1.95 myrs old. This estimated age is not new, as both Arambourg (1979: 135) and Coppens (1972: 183, and personal communication, 2003) have already proposed such an age for the locality.

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