Mohamed Sahnouni
CRAFT Research Center, Indiana University, 419 North Indiana Avenue, Bloomington, IN 47405, U.S.A., Email: msahnoun@indiana.edu

Djillali Hadjouis
Laboratoire Départemental d'Archéologie du Val de Marne, 7–9 rue Guy Moquet, 94800, Villejuif, France, Email: Djillali.Hadjouis@wanadoo.fr

Jan van der Made
Departamento de Paleobiologia, Museo Nacional de Ciencias Naturales (CSIC), José Gutierrez Abascal, 2, 28006 Madrid, Spain, Email: mcnjv538@mncn.csic.es

Abd-el-Kader Derradji
Department of Archaeology, University of Algiers, 2 rue Didouche Mourad, 16000 Algiers, Algeria, Email: derradji_kader@hotmail.com

Antoni Canals
Area de Prehistoria, Universitat Rovira I Virgili, 1 Placa Imperial Tarraco, 43005 Tarragona, Spain, Email: ancls@fll.urv.es

Mohamed Médig
Department of Archaeology, University of Algiers, 2 rue Didouche Mourad, 16000 Algiers, Algeria, Email: Mohamed.medig@yahoo.com

Hocine Belahrech
National Museum of Sétif, Sétif, Algeria, Email: hbelahreche@yahoo.com

Further research at the Oldowan site of Ain Hanech, North-eastern Algeria

Further investigations were carried out at Ain Hanech, Algeria in 1998 and 1999 to explore its potential for investigating early hominid behavioral patterns and adaptation. Research concentrated on the stratigraphy and dating, identifying new archaeological deposits, and excavating the Ain Hanech and El-Kherba localities. To enhance the chronological control within a biostratigraphic framework, the Ain Boucherit fossil-bearing stratum, yielding a Plio-Pleistocene fauna, is correlated with the regional stratigraphy. In the stratigraphic sequence, the Ain Boucherit stratum, located 13 m below the Ain Hanech Oldowan occurrences, is found in Unit Q of the Ain Hanech Formation. Unit Q shows a paleomagnetically reversed polarity, which may be correlated with an age earlier than the Olduvai normal subchron (1·95–1·77 Ma). Based on test trenches and stratigraphic analyses, additional Oldowan deposits A, B, and C are identified at Ain Hanech. All three deposits and the El-Kherba site contain Mode I technology artefacts associated with an Early Pleistocene fauna. El-Kherba is stratigraphically equivalent to Ain Hanech. These two archaeological sites are estimated to be dated to about 1·8 Ma.

0047–2484/02/120925+13 $35.00/0

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Zoheir Harichane
Agence Nationale d'Archéologie et des Monuments Historiques, Algiers, Algeria, Email: harichane@excite.com

Merouane Rabhi
Agence Nationale d'Archéologie et des Monuments Historiques, Algiers, Algeria, Email: mrabehi@yahoo.com

Received 24 August 2002
Revision received 13 September 2002 and accepted 17 September 2002

Keywords: Algeria, Ain Hanech, Ain Boucherit, Early Paleolithic, Oldowan, fauna, Plio-Pleistocene.

Journal of Human Evolution (2002) **43**, 925–937
doi:10.1006/jhev.2002.0608
Available online at http://www.idealibrary.com on IDEAL®

Introduction

Discovered by Arambourg (1947) in the course of his paleontological survey in northeastern Algeria, the site of Ain Hanech yielded an Early Pleistocene fauna associated with Mode I technology artefacts (Arambourg, 1949*a*,*b*). Renewed archaeological investigations were initiated in 1992 and 1993 (Sahnouni, 1998; Sahnouni & de Heinzelin, 1998). The research involved studying the stratigraphy and dating, conducting archaeological excavations at areas adjacent to the original site and at newly discovered localities nearby, assessing formation processes of the occurrences, and analyzing the archaeological material. The major conclusions drawn from previous investigations are: (1) the site of Ain Hanech is the oldest archaeological occurrence in North Africa (ca. 1·8 Ma), and suggests an earlier spread of hominids into the region than commonly assumed; (2) the occurrences are not from a secondary depositional or disturbed context and are, therefore, appropriate for behavioral studies of early hominid occupations; (3) Ain Hanech yielded, for the first time in the Maghreb, a Mode I Technology artefact assemblage similar to those recovered from East African Plio-Pleistocene sites (e.g., Olduvai Bed I and Lower Bed II and Koobi Fora). The Ain Hanech assemblage is characterized by a low degree of standardization, and may be considered a North African variant of the Oldowan Industrial Complex. Acheulean occurrences were not associated with Oldowan materials. Bifaces derive from calcretes higher up in the stratigraphic sequence; and (4) preliminary evidence indicates that animals likely constituted some part of Ain Hanech hominid subsistence. Artefacts were used for processing animal carcasses.

Further investigations were carried out in 1998 and 1999, focusing on studying the Ain Boucherit fossil-bearing stratum and its regional biostratigraphic

context, identifying additional archaeological deposits, and expanding excavations at two major archaeological localities. This paper outlines the major results of these recent investigations.

Dating Ain Boucherit and Ain Hanech sites

Between 1931 and 1948 Arambourg explored the Ain Boucherit and Ain Hanech area in the course of his paleontological survey of the fluvio-lacustrine deposits around the town of Sétif (Arambourg, 1970). The faunal assemblage from Ain Boucherit comprised: *Anancus osiris*, *Mammuthus africanavus*, *Hipparion libycum*, *Equus numidicus*, *Kolpochoerus phacochoeroides*, *Sivatherium maurusium*, *Hippopotamus*, bovids, and carnivores. Based on proboscideans and equids, Arambourg (1970, 1979) assigned the occurrences to the Lower Villafranchian.

In the course of investigating the stratigraphy of the Ain Hanech Formation, we were able to relocate the Ain Boucherit fossil-bearing stratum using Arambourg's published information. We collected fossil invertebrates (well-preserved molluscs and ostracods), and identifiable vertebrate bones ($n=21$), including *A. osiris*, *E. numidicus*, *S. maurusium*, *Gazella sitifensis*, *Parantidorcas latifrons*, *Oreonagor tounoueri*, and *Canis anthus primaevus*. In addition, taxonomically indeterminate remains include vertebral fragments of a medium-sized Alcelaphini (probably *Oreonagor* ?), and a rodent long bone fragment. Of interest, among these newly recovered remains is an *E. numidicus* P^2 (mesiodistal diameter=41·3 mm; vestibule–lingual diameter=2·8 mm; protoconid length=7·2 mm; protoconid index=17·43), metrically close to *Equus* from Shungura Member G (G4-13) (Eisenmann, 1985) dated to 2·32–1·88 Ma (Brown *et al.*, 1985; Brown, 1994).

Stratigraphically, the Ain Boucherit fossil-bearing stratum is contained in Unit Q of the newly defined Ain Hanech Formation, 13 m below the Ain Hanech Oldowan layer (Unit T) (Figure 1). Chronologically, based upon the association of *H. lybicum* with *E. numidicus* (the oldest North African *Equus*) and *A. osiris* with *M. africanavus*, Arambourg (1970) assigned the Ain Boucherit fauna to the Lower Villafranchian. He also correlated it with Shungura Members A, B, C, and D. Coppens (1972) placed Ain Boucherit in his biozone V, arguing that it dated between 3·4 and 2·7 Ma.

However, the magneto-stratigraphic study of the Ain Hanech Formation indicates that the Ain Boucherit fossil-bearing stratum may be somewhat younger than suggested by Coppens. The paleomagnetic analysis indicates a shift from reversed polarity in Units P, Q and R to normal polarity in Unit S and those containing the Oldowan occurrences (Sahnouni *et al.*, 1996). Given the Villafranchian character of the vertebrate fauna, as well as the associated Oldowan archaeological material, the normal polarity is most likely the Olduvai (N) subchron, occurring between 1·95 and 1·77 Ma. (McDougall *et al.*, 1992). Unit Q, containing the Ain Boucherit faunal assemblage located lower in the formation with a reversed polarity, is likely correlated with the Matuyama (R) chron, and thus, is earlier than the Olduvai subchron. Therefore, the Ain Boucherit is younger than the Ahl al Oughlam paleontological site (ca. 2·5 Ma) (Geraads *et al.*, 1998) and slightly older than Ain Hanech (Figure 1). Ain Boucherit can be correlated to between 2·4 and 2·0 Ma based on the presence of *Equus*, whose earliest appearance in East Africa is 2·36 Ma (Bernor & Armour-Chelu, 1999).

In addition to previously recovered taxa (Sahnouni & de Heinzelin, 1998), the excavations yielded new faunal materials. Of interest is the presence of the suid genus

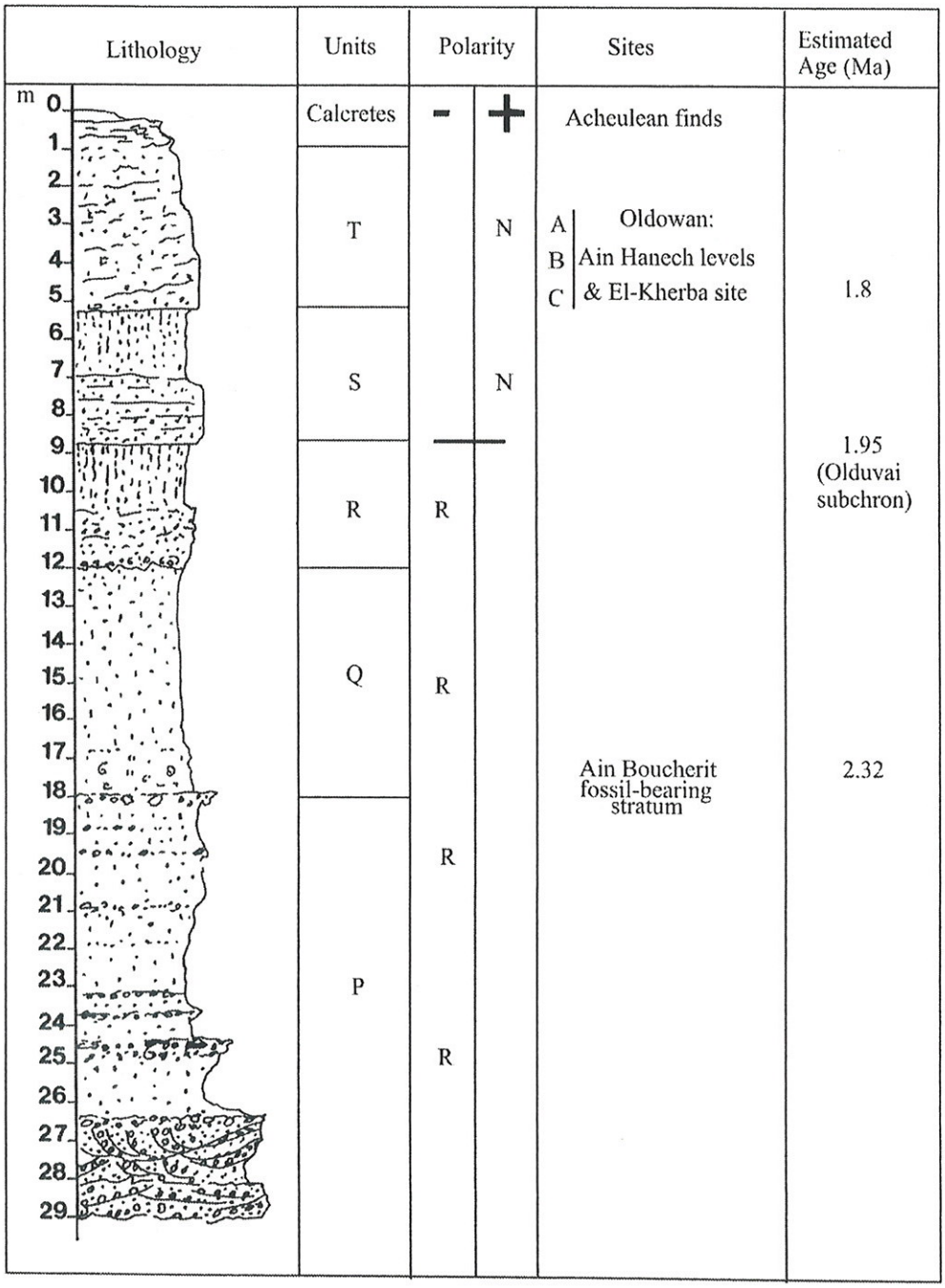

Figure 1. Reference profiles of Ain Hanech Formation, showing its component sedimentary Units, their geomagnetic polarity, and the associated sites. The Ain Boucherit fossil-bearing stratum with Plio-Pleistocene fauna is contained in Unit Q with reversed polarity. Ain Hanech Oldowan levels and the newly discovered locality of El-Kherba are contained within Unit T with normal polarity. The Acheulean finds derive from the calcrete deposit sealing the stratigraphic sequence.

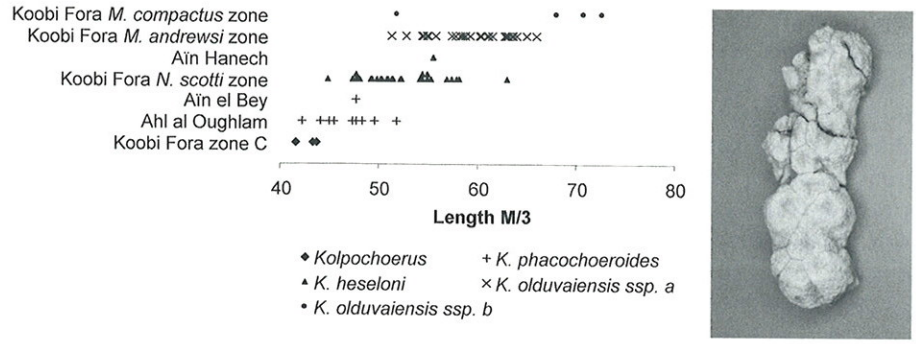

Figure 2. The length of the *Kolpochoerus* M_3 in different samples (left) and the Aïn Hanech specimen (right). The localities and "zones" are arranged in approximate order from oldest (bottom) to youngest (top). Data on Koobi Fora are from Harris (1983), and from Ahl al Oughlam and Aïn el Bey are from Geraads (1993).

Kolpochoerus. Arambourg (1979) described a mandible and canine from Ain el-Bey, a mandible fragment from Ain Boucherit, and an M^3 fragment from Ain Hanech, which he assigned to *Omochoerus* (=*Kolpochoerus*) *phacochoeroides*. Jaeger (1975) cast doubt on the presence of this species at Ain Hanech, arguing that it may have been derived from the older fossiliferous deposits (i.e., Ain Boucherit). Geraads (1993) considered that the suid remains found at Ain Hanech do not belong to *K. phacochoeroides*, but to *K. limnetes* because of the wide enamel strip on the upper canine. The new material from Aïn Hanech confirms the occurrence of *Kolpochoerus* in level B of that locality.

In order to discuss the biochronological implications of the new *Kolpochoerus* remains, some recent nomenclature changes need to be mentioned. Pickford (1994) suggested that the type of "*limnetes*" might not be a *Kolpochoerus*, and he referred the material that is usually assigned to this species to *K. phacochoeroides*. Cooke (1997) agreed with Geraads (1993) that *K. phacochoeroides* differs from the East African material usually assigned to *K. limnetes*, and reintroduced the name *K. heseloni*. Based on the updated nomenclature, the Ain Hanech material would thus be assigned to either *K. phacochoeroides* or *K. heseloni*.

There are two proposed models of evolution of *Kolpochoerus* that are relevant to the interpretation of Ain Hanech material. In the first model, Harris & White (1979) recognized a single long lineage of *Mesochoerus limnetes* (=*K. heseloni*). In the second model, Cooke (1985, 1997) and Geraads (1993) proposed a more complex and branching model of evolution. They consider the North African *K. phacochoeroides* and the South African *K. paiceae* as different from the East African *K. limnetes* (=*K. heseloni*) lineage. In addition, Cooke proposed a lineage with two species: *K. heseloni* and the more progressive *K. oldowayensis*.

The new *Kolpochoerus* remains from Ain Hanech consist of an M^2 and M_3. The third molar has four lobes, the fourth consisting of numerous cusps (Figure 2). Morphologically it is close to the more "advanced" specimens of *K. phacochoeroides* from Ahl al Oughlam, where the talonids tend to be simple (Geraads, 1993) and to the "primitive" specimens from Koobi Foora from the "*Notochoerus scotti* zone" (Harris, 1983), where the talonids tend to be more complex. Metrically the specimen is outside the range of the sample from Ahl al Oughlam (Figure 2) and is well within the range of *K. heseloni* from the *N. scotti* zone at Koobi Fora. The material from Ain Hanech

is thus more similar to *K. heseloni* than to *K. phacochoeroides*, and we therefore assign the remains to *K.* cf. *heseloni*. Thus, the Ain Hanech material establishes the presence in North Africa of two species of *Kolpochoerus* at different grades of evolution.

Even though Geraads (1993) recognized the North African *K. phacochoeroides* as different from the East African *Kolpochoerus*, he used the size increase in M_3 in East African *K. heseloni* to estimate the age of Ahl al Oughlam at 2·4 Ma. However, the biochronological interpretation of the material depends on whether one recognizes a single lineage model or a branching model of evolution. The average, minimum, and maximum dimensions of Ahl al Oughlam are clearly below the respective values of the sample from the *N. scotti* zone at Koobi Fora (Figure 2). That zone overlies the Tulu Bor Tuff dated to 3·36 ± 0·04 Ma (Feibel *et al.*, 1989). Ahl al Oughlam still has *Hipparion* instead of *Equus* (Geraads *et al.*, 1998). The equids do not contradict an old age for Ahl al Oughlam relative to the Koobi Fora sequence. At Koobi Fora there is a clear size increase in *Kolpochoerus* M_3 from the *N. scotti* to the *Metridiochoerus andrewsi* zones and again to the *Metridiochoerus compactus* zone (Figure 2). The available data are in line with a single species model, but even if *K. phacochoeroides* is considered to be a separate branch the Aïn Hanech suid does not belong to that species. The M_3 from Ain Hanech is comparable to *Kolpochoerus* from the *N. scotti* and *M. andrewsi* zones at Koobi Fora (Figure 2). The KBS tuff, dated to 1·88 ± 0·02 Ma (Feibel *et al.*, 1989), is found between those two zones. The stage of evolution of the Ain Hanech *Kolpochoerus* corroborates the correlation of the sediments with the Olduvai subchron (Sahnouni *et al.*, 1996).

In addition, the ongoing analysis of the new faunal assemblage reveals the persistence of *E. numidicus* at Ain Hanech. The occlusal features and the size of a P_4 recovered in the recent excavations in Level B suggest its affinities with zebrine equids (Figure 3). The occlusal surface is characterized by a double knot of stenonine type, convex posterior edge of the metaconid, deep vestibular groove, and slightly developed caballine fold. Although metrically close to *E. tabeti* in its maximal dimensions, morphologically the P_4 resembles *E. numidicus* from Ain Boucherit. As indicated above, *E. numidicus* is close to *Equus* from Shungura Member G (G4-13) (Eisenmann, 1985).

Identifying additional Oldowan deposits

Further stratigraphic studies and archaeological excavations undertaken in 1998 and 1999 have allowed us to identify three Oldowan-bearing strata at Ain Hanech. We named the levels, from the youngest to the oldest, A, B, and C (Figure 4). Level C was recognized in the course of digging a stratigraphic test trench below the conglomerate supporting the base of level B. This layer is easily discernable as it is separated from level B by 0·5 m of sterile deposits. However, layers B and A are difficult to distinguish lithologically because they are contained in a rather homogeneous sedimentary matrix. It was possible to delineate them using an archeo-stratigraphic approach (Canals, 1993) that consists of studying the vertical distribution of the archaeological materials and taking into account criteria such as inclination and density. Stratigraphically, levels A and B comprise a gravel layer at the bottom, abruptly overlain by a silty stratum. Based on modern environments, these deposits suggest an alluvial floodplain cut by a meandering river channel (Selley, 1985). It may be inferred that at the time of deposition of level A, the river had created an oxbow lake. The hominid activities

Figure 3. *Equus numidicus* P_4 (Catalogue #:AH99-Q101-49) recently recovered from Ain Hanech Level B; bottom: tooth size; top: occlusal features.

took place during level B on the riverbank, and during level A on the floodplain proper.

Level C is 50 cm thick and consists of dark sandy clay with pebbles and cobbles of relatively medium size dimensions (80 × 60 × 40 mm) and black flint fragments. A test trench yielded four bone fragments and 16 lithic artefacts. Subsequently, we conducted a 2 × 2 m test excavation, which yielded an additional nine bones and 15 lithic artefacts.

The archaeological remains contained in level C are fresh, show no preferred orientation, and overall were found in horizontal positions. Preliminary indications allow us to infer that the assemblage did not undergo major disturbance. The bones include few anatomically identifiable elements. Stone tools are more numerous, and include six cores, six whole flakes, 15 retouched pieces, and four fragments. The large cores are made of limestone, comprising a lightly flaked unifacial chopper, a moderately flaked subspheroid, and a heavily flaked discoid-like core. There are also several small flint cores more amorphously shaped. The retouched pieces, made primarily of flint, include simple scrapers, denticulates, and notches. Overall, the stone tools retrieved from level C are Oldowan-like artefacts and are similar to those of levels A and B in terms of raw material, as well as technological and typological patterns.

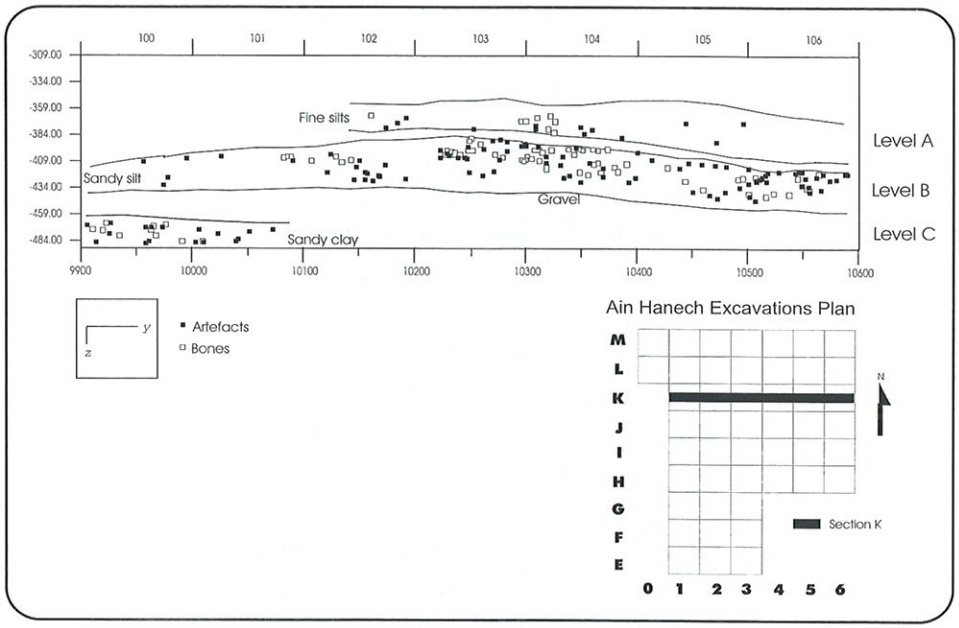

Figure 4. Archaeological levels at Ain Hanech, namely A, B, and C. Level C is still unexplored, as it was exposed in the course of a limited test trench. The position of the section (referred to as K) relative to the grid system is shown in bold below.

Level B consists of red sandy silt that includes gravel and calcic grains. It is relatively thin and deposited on top of a 40 cm-thick conglomerate characterized by gravels of various sizes and shapes. The ferruginous sediments suggest that the surface was inundated probably for a long period of time. The archeological material contained in level B is rich, and is characterized by a low density (i.e., 25 finds per m^3). Unlike level A, broken bones and artefacts contained in level B were reworked by water action. For example, both lithic artefacts and bones show slightly preferred orientation in a north–south direction. In terms of dip, few remains exhibit an inclination greater than 20°. Some artefacts show polish on their surfaces and a few are moderately to heavily abraded. Nevertheless, it is unlikely that the occurrences were heavily disturbed: the material is not sorted by size, nor the bones by anatomical parts; bones (pelvis and vertebra) of a large-sized animal are in anatomical position; the lithic assemblage comprises a full range of production materials including cores and micro-debitage (Figure 5); and the occurrences are contained in a fine grained sedimentary matrix.

Compared to the two other archaeological levels, level A is the thickest (70 cm). It consists of mottled white silts capping level B. Broken bones and lithic pieces contained in this level were buried in a floodplain environment as a result of a low velocity sedimentary regime, although minimal rearrangement of small remains might have occurred (Sahnouni & de Heinzelin, 1998), and may have contributed to the low density (4 finds per m^3) of archaeological material. Bone weathering patterns indicate that they were buried rapidly. Anatomically, the faunal assemblage includes all categories of skeletal elements, making hydraulic sorting

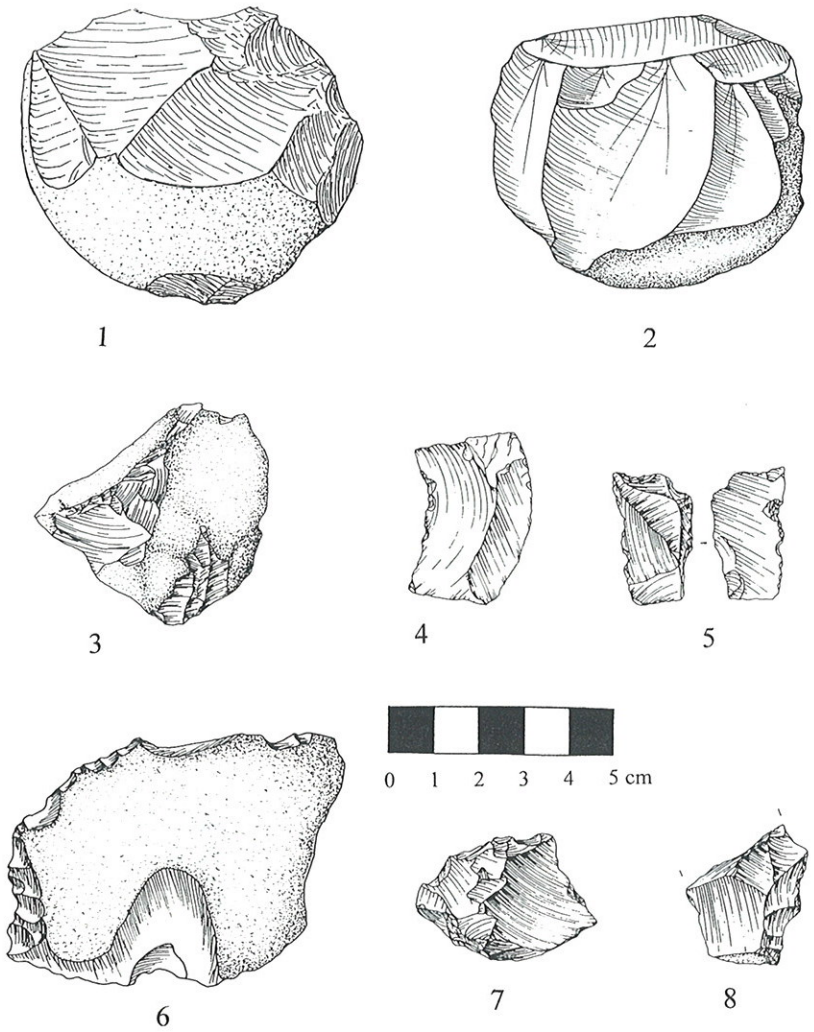

Figure 5. Oldowan artefacts from level B, including a unifacial chopper (1); polyhedron (2); core (3); whole flake (4); scrapers & denticulates (5 to 8). Artefacts 1, 2 and 6 are made of limestone, and 3, 4, 5, 7 and 8 are made of flint. Samples 2 and 6 are drawn by C. Gnatef, and the remainder by the late J. de Heinzelin.

unlikely. In addition, they show neither a preferred orientation nor a high dip. Likewise, the artefacts (Figure 6) are fresh and include cores, debitage and small fragments. Small elements (<2 cm of maximum dimension) are abundant simulating the size distribution curve produced by experimental studies of artefact manufacture (Schick, 1986).

The lithic assemblages

The excavated lithic assemblages total 1502 artefacts (excluding small debitage <2 cm of maximum dimension), including: Level C, 31 (2%); Level B, 947 (63%); Level A, 254 (16·9%); and El-Kherba, 270 (17·9%) (Table 1). They all comprise cores and microdebitage. The lithic industry is characterized by a low degree of

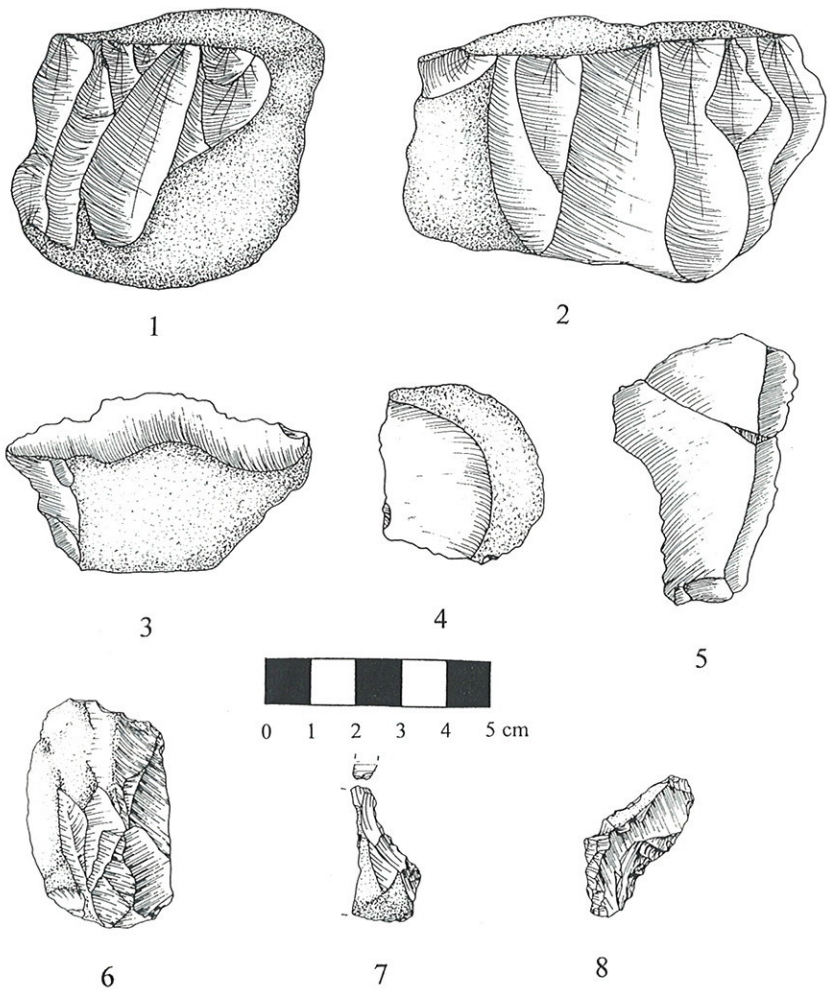

Figure 6. Oldowan artefact samples from level A, including core-forms (1 & 2); whole flakes (3 to 5); retouched pieces (6 to 8). Artefacts from 1 to 5 are made of limestone (drawn by C. Gnatef) and 6 to 8 are made of flint (redrawn after the late J. de Heinzelin).

standardization, and is typical of Mode I Technology artefacts (simple core forms and debitage). The large-scale excavations show the total absence of any Mode II artefacts. The assemblage includes the following categories: (1) core forms primarily made of limestone, which include unifacial and bifacial choppers, polyhedrons, subspheroids and spheroids; (2) small cores made primarily of flint; (3) whole flakes; (4) retouched pieces; (5) fragments (snapped and split flakes and pieces without a diagnostic morphology); (6) hammerstones; and (7) split limestone cobbles. Within the retouched pieces category, scrapers and denticulates predominate, followed by endscrapers and notches. Burins and awls occur, but are rare. The frequency of retouched pieces is slightly inflated, especially in Level B, because some of the blanks are pebbles that were directly transformed into tools. A difference is observed between the assemblage of Level B and those of Level A and El-Kherba, especially

Table 1 General presentation of the lithic assemblages retrieved from Ain Hanech and El-Kherba

Artefact categories	Level C		Level B		Level A		El-Kherba		All assemblages	
	n	%	*n*	%	*n*	%	*n*	%	*n*	%
Core-forms and cores	6	0·3	212	10·1	62	7·5	55	5·7	335	8·6
Retouched pieces	15	0·9	276	13·1	37	4·4	83	8·7	411	10·6
Whole flakes	6	0·3	194	9·25	72	8·7	63	6·6	335	8·6
Fragments	4	0·2	239	11·3	71	8·5	68	7·1	382	9·8
Percussors	0	0	0	0	2	0·2	1	0·1	3	0·07
Split cobbles	0	0	26	1·2	10	1·2	0	0	36	0·9
Subtotal	31	2	947	45·1	254	30·7	270	28·3	1502	38·7
Debitage <2 cm	NA		1150	54·8	573	69·2	682	71·6	2405	62
Total	31		2097	100	827	100	952	100	3876	100

Small debitage (<2 cm of maximum dimension) count and the totals under Level C are not available (NA).

in terms of artefact density, core form categories and flaking extent, and flake type representation. The significance of this variability requires further detailed study.

The artefacts are primarily made of limestone and flint. There is also rare use of a few other types of rocks, such as silicified limestone, quartzite, and sandstone. At both Ain Hanech and El-Kherba, limestone and flint predominate, but the large cores are primarily made of limestone cobbles, while the small cores are frequently made of flint pebbles. Another interesting pattern is evident with regard to raw material: while the whole flakes occur in limestone and flint in nearly equal numbers, retouched pieces are predominantly in flint. These two rocks would have been available to hominids in the general vicinity of the site in forms of cobbles and pebbles. Presently, they can be found eroding out of Plio-Pleistocene conglomerates, with clasts of the same sizes and shapes as those uncovered in the excavations (Sahnouni *et al.*, 1997).

Summary and conclusions

This paper presents the results of continuing research carried out at Ain Hanech, Algeria. The following conclusions are highlighted:

(1) The Ain Boucherit fossil-bearing stratum was relocated and positioned relative to the regional stratigraphy. It provides a lower biostratigraphic boundary for the Ain Hanech Oldowan occurrences. The fauna recovered from Ain Boucherit is older than that from Ain Hanech, which is located higher in the stratigraphic sequence. Paleomagnetically, Ain Boucherit is contained in Unit Q with reversed polarity. Chronologically, Ain Boucherit is younger than Ahl al Oughlam (ca. 2·5 Ma) (Geraads *et al.*, 1998) and older than Ain Hanech (ca. 1·8 Ma) (Sahnouni & de Heinzelin, 1998). The evidence indicates that the Ain Boucherit fossil-bearing stratum may be dated to between 2·4 and 2·0 Ma.

(2) It has been suggested previously (Jaeger, 1975) that *Kolpochoerus* was derived from the older Ain Boucherit deposits. Our research shows that *Kolpochoerus* cf. *heseloni* is directly associated with the Oldowan material at this locality. The stage of evolution of the Ain Hanech *Kolpochoerus* fits

well with the suggested age of about 1·8 Ma (Sahnouni *et al.*, 1996; Sahnouni & de Heinzelin, 1998).

(3) The newly extended excavations at Ain Hanech reveal the occurrence of three successive Oldowan deposits. These occurrences may indicate repeated activities by early hominids at a shallow river embankment, attracted by the availability of good quality raw materials and by the passage of game.

Acknowledgements

The authors thank several institutions and people for making further research at Ain Hanech possible, including the Algerian Ministry of Culture and Communications for the research permit; the University of Algiers, Agence Nationale d'Archéologie et des Monuments Historiques, The L. S. B. Leakey Foundation, The Wenner–Gren Foundation, CRAFT Research Center at Indiana University, Friends of CRAFT, and the Quaternary Research Group and associated unit to the CSIC at University Rovira I Virgili (Spain) for financial support. This paper is also a contribution to project PB96-1026-C03-02. The local authorities are thanked for their interest in our research project; the Thabet family for their warm hospitality; and finally the Archaeology students of the University of Algiers who actively participated in the excavations despite the tough field conditions. We are also grateful to Professors Nicholas Toth and Kathy Schick and anonymous reviewers for many valuable comments and suggestions on the manuscript.

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