



Chapitre d'actes

2000

Published version

Open Access

This is the published version of the publication, made available in accordance with the publisher's policy.

Kaddanarti, a lower pleistocene assemblage from Northern Sudan

Chaix, Louis; Faure, Martine; Guerin, Claude; Honegger, Matthieu

How to cite

CHAIX, Louis et al. Kaddanarti, a lower pleistocene assemblage from Northern Sudan. In: Recent research into the stone age of Northeastern Africa. Kiekrz. Poznań : Poznań archaeological museum, 2000. p. 33-46. (Studies in African archaeology)

This publication URL: <https://archive-ouverte.unige.ch/unige:106520>

Louis Chaix, Martine Faure, Claude Guerin and Mathieu Honegger

Kaddanarti, a Lower Pleistocene assemblage from Northern Sudan

Résumé

Un assemblage datable du Pléistocène inférieur du nord du Soudan est présenté ici. A côté de restes de mammifères, particulièrement *Palaeoloxodon recki*, ont été retrouvés plusieurs outils attribuables à l'Oldowayen. La datation, entre 1.6 Ma et 0.5 Ka, indique une occupation très ancienne de cette portion de la vallée du Nil.

Introduction

During the winter of 1991, the archaeozoologist of the Swiss Archaeological Mission in Kerma (LC), was alerted by Mr. Hassan Ibrahim who found during a trip along the Nile near his birth place some large fossilized bones which he brought to us. After an initial examination, this material seemed to us very ancient and interesting enough to be more closely examined. Several trips were organized between 1992 and 1997 to return to the site to collect new fossils and also many artefacts.

The site

Kaddanarti is situated in the Northern Province, 60 km north of its capital Dongola. The finds come from two *loci*. The more important one is located near the island of Badin, around 12 kilometres south of the 3rd cataract, on the west bank of the Nile. Last year, we found another *locus*, Kabrinarti, at the same level, but on the east bank of the river (Fig. A).

Bones and artefacts were found in a deposit of coarse pebbles, mainly constituted of quartzite (84%), jasper (15%) and ferruginous sandstone (1%). The pebbles are clearly rounded. The granulometry shows a dominance of stones

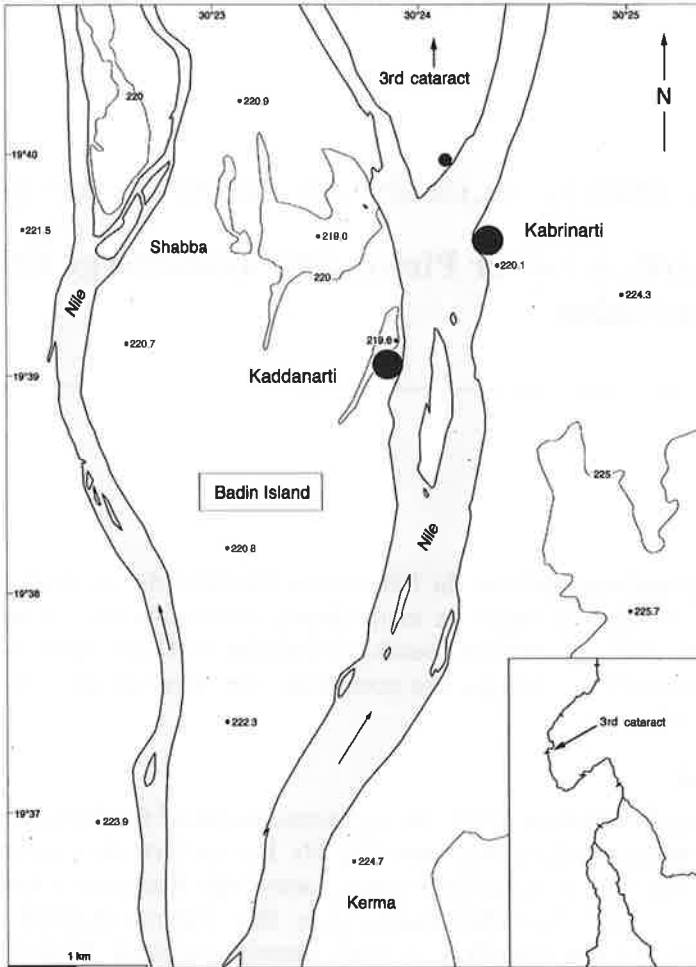


Fig. A.

Situation of the *loci* dating from the Lower Pleistocene. The two main *loci* (Kaddanarti and Kabrinarti) revealed faunal remains and stone artefacts, from coarse pebble layers. The third, northern, *locus* comprises the same coarse pebble deposits situated below the level of the Nile, but so far no investigation has been carried out to check for archaeological remains.

with an average length of 28 mm, against an average width of 20 mm. Some pebbles are larger, up to 120 mm in length and 70 mm in width. The matrix consists of quartzite gravel, with grains less than 10 mm. The thickness of this layer is unknown, because it is mostly under the water level, but it seems thicker

than 1 meter. It is covered by the silts of the Nile, with a thickness of around 5 meters at this place. The fossiliferous level seems to continue under the water-course, because we found it on the west bank, under a sandy island, and on the east bank, at Kabrinarti.

The fauna

Several teeth, bones and fragments of bones were recovered from *locus* 1 and some others from *locus* 2. All the bones are heavily mineralized. Their colour is black. Most of the pieces are eroded and rounded, but in many cases the surface is well preserved. We must also point out that amongst bones belonging surely to the Lower Pleistocene, some few pieces are more recent and indicate that the fossils are not in a primary position.

1. *Hippopotamus amphibius* Linnaeus, 1758

a: material

a canine fragment

part of an upper tooth row bearing M 1/-M3/

an incomplete mandible with partial M /1, the M /2 and roots of the M /3

two mandibular fragments bearing respectively M /2 and M /3

These five pieces are highly mineralized but rolled and poorly preserved. The main dimensions of the last four are given in Table 1 together with the homologous ones for about thirty recent *H. amphibius*.

b: description

Fragments of the maxillary and of the mandibles are too badly preserved for description, but several molars were preserved well enough to be studied. All present a classical Hippopotamid scheme of a brachyodont bunodont type with four main tubercles, each bearing the characteristic trefoil abrasion pattern and a thick enamel layer.

Upper molars show at their basis a thick continuous cingulum, which is frequently observed on recent *H. amphibius* (Faure 1985). Dimensions of M 2/ and M 3/ as well as the length of the molar row (accurate in spite of the fragmentary state of the M 1/) correspond to a rather small *H. amphibius*, not larger than the average of recent ones (Table 1).

Concerning the lower molars, the incomplete M /1 and the two M /2s are slightly smaller than the mean of modern *H. amphibius*. M/3 on the contrary is a little longer and narrower than the largest individual of *H. amphibius* observed (Table 1). Pleistocene and recent species of the genus *Hippopotamus* all possess molars of similar morphology and can be separated only on a biometrical basis. The Kaddanarti ones perfectly correspond to *H. amphibius* and cannot be confused with the much larger *Hippopotamus gorgops*.

c: discussion

Hippopotamus amphibius Linnaeus has an ancestor *H. kaisensis* Hopwood, which is anatomically very similar. *H. kaisensis* appeared about 5 My ago and is very common in the Plio-Pleistocene sediments of the Lake Albert Basin in Uganda (Faure 1994). Surprisingly enough, *H. amphibius* is rather rare as a fossil. The most ancient specimen was found in 1996 at Gafalo, Gobaad Basin, Republic of Jibutti, in a deposit roughly dated from 1.6 to 1.3 My (Faure and Guérin 1997). The species is already known in the lower Omo valley, in the Shungura (above member L, younger than 1.3 My, Harris 1991), Kalam (Gèze 1980) Formations and in the upper part of the Lower Pleistocene levels of the Nariokotome member of the Nachukui Formation, West Turkana (Harris 1991). It was also described from the Kapthurin Formation and from Isenya, Kenya, (Brugal and Denis 1989).

2. Large Bovid, cf. *Syncerus* sp. seu *Pelorovis* sp.

a: material

one upper left M 3/, rolled

the distal part of a left humerus, rolled

b: description

The upper molar has a length of about 37 mm; the most remarkable features are a strong entostyle and the presence of a fold on the posterior side of the prefossette. The distal part of the humerus presents the features of the African Buffalo (genus *Syncerus*) and, following J. Peters (1988), we are able to exclude *Bos primigenius*. The metrical data compares, respectively, with an adult male and an adult female of the largest form of the living African Buffalo (i.e. the South African subspecies *Syncerus caffer caffer*) of which two fine examples are preserved in the Museum National d'Histoire Naturelle, Paris with data as follows:

Minimal transverse diameter of the diaphysis: 50 mm (51; 47);

Antero-posterior diameter of the diaphysis at the same level: 66 mm (60; 51);

Maximal distal transverse diameter: 106 mm (113; 99);

Maximal distal antero-posterior diameter: 98 mm (108; 89).

The large Bovid from Kaddanarti shows the attributes, the dimensions, and the proportions of the African Buffalo. It is less likely that it belongs to the fossil genus *Pelorovis* but this is impossible to exclude totally owing to the absence of comparative material.

c: discussion

The African Buffalo *Syncerus caffer* (Sparrman 1779) is the sole recent Bovini of the Ethiopian biogeographical empire. It constitutes a cline whose extremes (the dwarf forest buffalo and the very large Caffer Buffalo) are

KADDANARTI			HIPPOPOTAMUS AMPHIBIUS						
				N	mean	min	max	st. dev.	var. coeff.
Length of upper molars	138			29	136.07	115	158	8.58	6.31
M1/ L	39			33	42	33	53	4.68	11.14
M1 /l ant.	31.5			33	39.86	36	45	2.66	6.68
M1/ l.post.	35			33	41.89	38	49	2.9	6.93
M2/L	51.5			30	49.43	37	60	4.52	9.15
M2/l ant.	47.5			31	47.85	42	54	3.14	6.56
M2/l post.	48.5			31	46.77	35	53	4.24	9.06
M3/L	50			28	48.61	41	56	3.53	7.26
M3/l ant.	49			26	46.81	38	52	4.06	8.67
M3/l post.	47			21	41.48	34	49	4.42	10.66
Length of the lower molars	~ 141			22	159.16	140	175	9.72	6.11
M1/L	~ 38			25	44.36	35	59	5.73	12.91
M1/l ant.	> 19			24	31.42	27	43	3.22	10.23
M1/l post.	31			25	34.72	29	43	2.98	8.58
M2/L	48.5	54		23	54.63	47	64	4.03	7.37
M2/l ant.	35	35		23	37.91	34	49	3.53	9.3
M2/l post.	36	36		23	39.59	34	47	3	7.58
M3/L			81	23	67.83	57	78	5.98	8.82
M3/l ant.			42	23	38.54	34	45	3.06	7.93
M3/l med.			42	23	37.39	32	43	2.82	7.55
M3/l post.			29.5	19	30.5	21	34	3.38	11.08

Table 1.

Dental measurements of the hippopotamus from Kaddanarti compared with those of modern hippopotami

very different in size (the former with shoulder height less than 1.20 m and weight less than 320 kg, the latter with a height of more than 1.70 m and weight of 800 kg), in general morphology, horn shape and way of life (the biotope ranges from the rain forest to the grassland). The plasticity and adaptability of the genus is remarkable.

The recent species *Syncerus caffer* occurs as a fossil in the Upper Pleistocene of West Turkana and Omo (Kibish Formation). Fossil *Syncerus* species are also known, of which only one has been found in East Africa: the large *Syncerus acoelotus* (Gentry and Gentry 1978) was defined at Olduvai Bed II where it is found along the whole formation (from Bed I up to Bed IV); it was also found at Omo.

From the Middle Pleistocene up to the Early Holocene another large Bovid genus existed in East Africa, *Pelorovis* Reck 1928. It includes very large Bovini with gigantic curved horns. The type species, *Pelorovis oldowayensis* Reck, was defined at Olduvai. It is probably the ancestor of *P. antiquus* (Duvernoy), which is abundant in the Pleistocene of North Africa, and is also known in East Africa, namely at Olduvai Bed IV. *P. turkanensis* Harris is a smaller form defined at the East-Turkana, and found also at the West-Turkana and at Melka Kunture. Recently one hypothesis was proposed, considering *Pelorovis* and *Syncerus* as the same genus (Gautier and Muzzolini 1991; Peters et. al. 1994). Such an interpretation was recently contested by Klein (1994) and was never considered acceptable by the majority of scholars involved in African palaeontology, whose position is founded on the precise and very comprehensive work done in 1967 by A. W. Gentry. Two butchery sites with *Pelorovis* are known in the Early Palaeolithic of East Africa, one at Olduvai (BK II) in Tanzania and another one in the Middle Awash Valley (Ethiopia).

3. Medium-sized Antelopes

a: material

a fragment of a first left upper molar

a fragment of occipital

b: discussion

The molar fragment, with a lingual ectostylid, belongs probably to the tribe of *Reduncini* (genera *Redunca* and *Kobus*), following A.W. Gentry (1978).

The fragment of occipital belongs to a medium-sized antelope. The dimensions and the morphology are comparable with those of the bushbuck, *Tragelaphus scriptus*, or eventually with those of the Hunter's hartebeest (*Beatragus hunteri*) but the piece is eroded and broken, which makes a more precise determination impossible. *Tragelaphus scriptus*, the type species of the genus, was found as a fossil at West Turkana (Nachukui Formation) and a very

similar form is present at Olduvai Bed IV. Other species are known in the East African Plio-Pleistocene. *Beatragus* is sometimes considered as a subgenus of *Damaliscus*. There is only one recent species, *B. hunteri* (P. L. Sclater 1889); *Beatragus antiquus* Leakey, 1965, from Olduvai Beds I and II, Shungura member G, and Koobi Fora, taller than *B. hunteri*, is probably its ancestor.

4. *Equus* of non-caballine type, ? cf. *Equus africanus* Fitzinger, 1857

a: material

two isolated lower cheek-teeth

b: discussion

Following V. Eisenmann (pers. comm.), one lower M/1 probably belongs to the wild ass *Equus africanus* Fitzinger, 1857, but it is impossible to exclude another of the numerous African Pleistocene species of non-caballine *Equus*. These has been known in Africa since 1.8 My. The wild ass was probably found in the Middle Palaeolithic of Bir Tarfawi in Upper Egypt (Wendorf et al. 1993). Another inferior molar, probably M/2, belongs surely to *Equus caballus*, known in Africa since the Aterian age (Upper Pleistocene). This tooth bears witness to the perturbation of the level.

5. *Palaeoloxodon recki* Dietrich, 1915

a: material

the postero-lingual part of a right lower molar, very rolled and incomplete: a little more than a half of its breadth is preserved.

b: description

The attributes of this tooth fragment, as defined by M. Beden (1979, 1987) are:

N = number of laminae: -5 x. A small posterior heel is visible;

L = total length of the fragment: about 85 mm;

l = width of the fragment: 57 mm, the width of the tooth can be estimated to about 70 mm at the level of the third lamina before the end;

e = enamel thickness: 3 mm;

Laminae and enamel folds: a longitudinal horizontal section was made 22 mm beneath the top of the tooth, showing rather strongly folded laminae, and a narrow median sinus (Beden 1979: 503, fig. 92).

L/N = laminar frequency: roughly 17;

100 x H/l = hypsodonty index: estimated to be greater than 170;

Distance between two successive laminae: from 3.5 to 11 mm.

The dimensions and proportions of the tooth, as well as the outline of the laminae are typical of *Palaoloxodon recki*.

c: discussion

Palaoloxodon recki (Dietrich 1915), was defined at Olduvai and is much more frequent in Plio-Pleistocene deposit than *Loxodonta*, the sole recent Probo-

scidean genus of Africa. It was found in numerous sites in East Africa, namely in Ethiopia, Kenya, Uganda and Republic of Jibutti. It is known also from North Africa, Chad, Namibia and South Africa. Several butchery sites with *P. recki* were discovered in the ancient Palaeolithic of East Africa (Chavaillon et al. 1986, 1987). The extinction of the Reck's elephant about 500,000 years ago could have an ecological cause.

A direct descendent of *Elephas ekorensis* from the oldest East African Pliocene, the lineage of *Palaeoloxodon recki* includes five successive subspecies easily distinguishable owing to their cheek-teeth which become: increasingly tall; with an ever reduced distance between the successive laminae; an increasingly folded enamel which becomes thinner and thinner:

P. recki brumpti Beden, 1980, from 3,7 My to 2,8 My;

P. recki shungurensis Beden, 1980, from 2,3 to 1,7 My;

P. recki atavus Arambourg, 1947, from 1,8 to 1,6 My;

P. recki ileretensis Beden, 1980, from 1,6 to 1,3 My;

P. recki recki Dietrich, 1915, from 1,2 to 0,5 My;

The molar fragment of Kaddanarti can be attributed to one or another of the last two subspecies, more probably to *P. recki ileretensis*.

The lithic industry

Lithic artefacts were collected at the *loci* of Kaddanarti in 1992 and Kabrinarti in 1995 and 1997. The findings comprise several tools and many flakes, which seem to be very ancient, in accordance with the dating proposed for the faunal remains. Most of them are made of relatively good quality brown flint, and some of petrified wood. Pebbles of the same flint can be found at this site. The artefacts are eroded; erosion by wind took place before fluvial erosion. This industry presents a few pieces of interest: seven choppers and ten worked flakes. The rest is composed of unretouched flakes which are not very characteristic.

Six choppers are worked on the lateral or distal side, with unifacial or bifacial removals (Fig. B. 1-4). One stands out because its removals are obtained in majority from the opposite part of the sharp side. A small number of retouches are made on the sharp edge in order to regularise it (Fig. B. 3). The seventh chopper is quite different from the others: one of its faces is entirely retouched with centripetal removals, whereas the second face presents only a few removals on proximal and distal parts (Fig B. 5). Its profile displays distinctive angles at its extremities. These characteristics indicate that this could be an unstruck Levallois core, rather than a discoidal tool or core (F. Wendorf, pers. comm.).

As for the flakes, the cortical areas are not so important. Their butts are

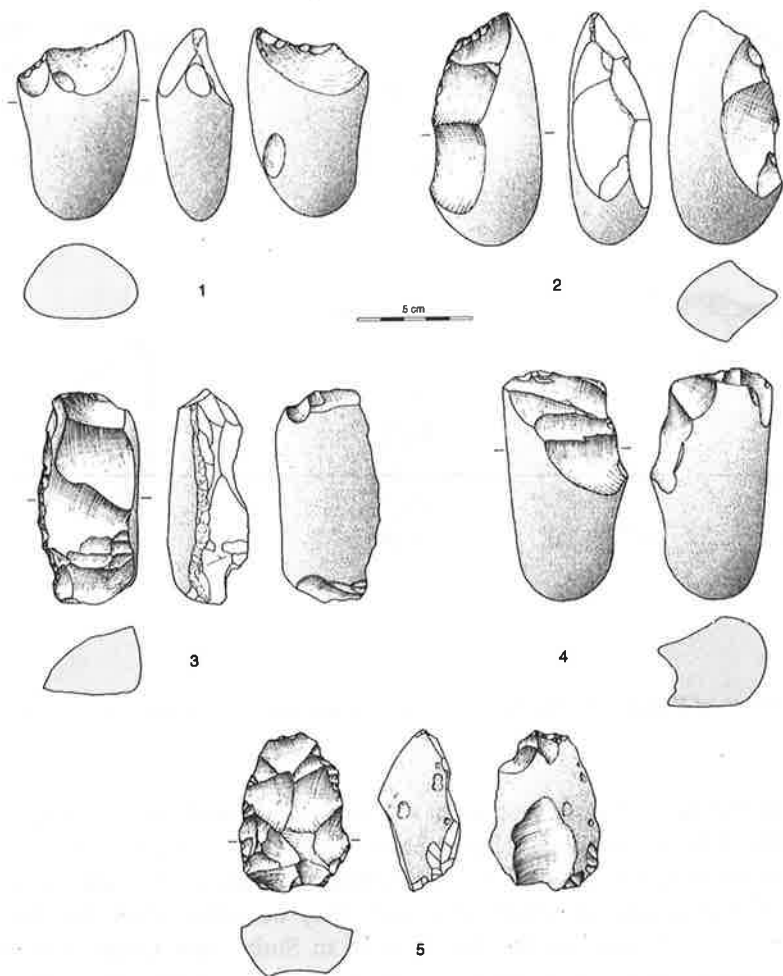


Fig. B.

The lithic industry of Kaddanarti. Choppers (1-4) and nucleus, probably Levallois (5).

generally plain or cortical and their bulbs are pronounced. In some cases, a cone of percussion is visible, indicating that a hard hammer was used. Many flakes present bifacial removals (Fig. C. 1, 3, 5). Some of these are thicker; these could represent small nuclei. Four flakes display a characteristic morphology: three of them present a single notch, and the fourth is probably a side scraper (Fig. C. 1-4). The morphology of the others is not clear enough to recognise particular implements.

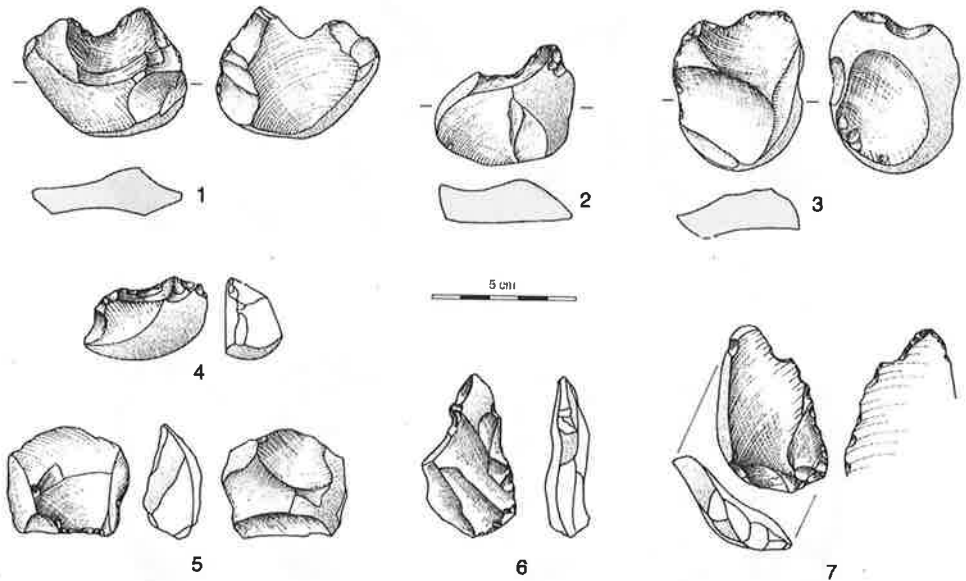


Fig. C.

Lithic industry of Kaddanarti. Notched flakes (1-3), side scrapers (4) and various flakes (5-7).

The presence of six choppers in this relatively small sample indicates that the industry may be part of an Early Stone Age technocomplex. No bifaces or cleavers were found to suggest an Acheulean assemblage. For this reason, the industry of Kaddanarti, in whole or in part, may be earlier than the Acheulean one. Such early findings are not documented in Sudan and Egypt, with the exception of some disputed discoveries (Midant-Reynes 1992:33). Comparisons must be sought in Ethiopia, Kenya or Tanzania, where the Oldowan industry expands between 2 and 1,4 My, before the rise in number of the bifaces. In this kind of industry, tools such as choppers, polyhedrals, or discoidal cores, as well as protohandaxes and scrapers, are frequent. Kaddanarti's artefacts present some analogies with these assemblages, but the date of 2 to 1,4 My seems very early when compared to those obtained with faunal remains (between 1,6 and 0,5 My).

In Ethiopia, Kenya and Tanzania, the Acheulean industry expands between 1,5 and 0,5 My, while coexisting with another industry which retains Oldowan characteristics. This Developed Oldowan is characterised by a large amount of choppers, flake implements, and a few handaxes (see bed 2, 3 and part of 4 of the Olduvai gorge) (Leakey and Roe 1994). It coexists for some time with Acheulean

assemblages, especially in Gadeb (Ethiopia) and Olduvai, and disappears about 0,6 MA (bed 4 of Olduvai gorge). Many hypotheses have been put forwards to explain this coexistence. The most recent one is functional (Jones 1994): the difference between the two contemporaneous industries could be due to the nature of the raw material and the use of the tools. It is conceivable that the Kaddanarti industry, despite its archaic characteristics, is contemporaneous to the Acheulean complex in the form of the Developed Oldowayan.

However, one element of the collection is clearly demarcated from the choppers and doesn't show their archaic characteristics. This core with centripetal removal is probably Levallois, and, therefore, belongs to the Middle Stone Age. Thus, some flakes out of the total assemblage at Kaddanarti may also belong to this period.

Conclusion

The Kaddanarti assemblage testifies to a very early occupation of the area. The paucity of sites from this period in the Nile Valley is probably due to the stratigraphical position of such assemblages. At Kaddanarti, the exact geological position of the pebble level is unknown. Bearing this problem in mind, one of us (L. Chaix) discovered some years ago a molar belonging to *Elephas iolensis* in a well at Tabo, 30 kilometers to the south. This *Elephas* is a little more recent than the fauna at Kaddanarti, but its stratigraphical position is also interesting: it was found beneath seven meters of silt, on top of a polygenical conglomerate. The latter was deposited on the Nubian Sandstone. Kaddanarti may be situated in the same geological position.

References

- BATE, D. M. A. 1951. The Mammals from Singa and Abu Hugar. In: *The Pleistocene fauna of two Blue Nile sites. Fossil Mammals of Africa*, n° 2: 1-28. London: BMNH
- BEDEN, M. 1979. *Les Eléphants (Loxodonta et Elephas) d'Afrique orientale: systématique, phylogénie, intérêt biochronologique*. Thèse Doctorat d'Etat, Univ. Poitiers, n° 294.
- BEDEN, M. 1987. *Les faunes plio-pléistocènes de la vallée de l'Omo (Ethiopie). T. 2 : les Elephantidae*. Cahiers de Paléontologie, Travaux de Paléontologie est-africaine. Paris: CNRS.
- BRUGAL, J. P. and C. DENYS. 1989. Vertébrés du site acheuléen d'Isenya (Kenya, District de Kajiado). Implications paléocéologiques et paléobiogéographiques. *C. R. Acad. Sci. Paris* 308 sér. t. II: 1503-1508.

- CHAVAILLON, J., C. GUERIN, J. L. BOISAUBERT and Y. COPPENS. 1986. Découverte d'un site de dépeçage à *Elephas recki* en République de Djibouti. *C. R. Acad. Sci. Paris*, sér. II t. 302 n° 5: 243-246.
- CHAVAILLON, J., J.-L. BOISAUBERT, M. FAURE, C. GUERIN, L. MAJ, B. NICKEL, G. POUPEAU, P. REY and SAID AHMED WARSAMA. 1987. Le site de dépeçage pléistocène ancien à *Elephas recki* de Barogali (République de Djibouti) : nouveaux résultats et datation. *C.R. Acad. Sci. Paris* t. 305, série II: 1259-1266.
- CHAVAILLON, J., A. BERTHELET, J.-L. BOISAUBERT, M. FAURE, C. GUERIN and SAID AHMED WARZAMA. 1990. Un *Elephas recki* découvert en connexion anatomique à Haïdalo près de As Eyla (République de Djibouti). *C.R. Acad. Sci. Paris* t. 310, sér. II: 441-446.
- CHURCHER, C. S. 1972. *Late Pleistocene vertebrates from archaeological sites in the plain of Kom Ombo, Upper Egypt*. Royal Ont. Mus., Life Sci. Contr., Toronto, 82.
- EISENMANN, V. 1983. Family Equidae. In: J. M. Harris (ed.), *Koobi Fora Research Project*, vol. 2, *The fossil Ungulates: Proboscidea, Perissodactyla and Suidae*: 156-214. Oxford: Clarendon Press.
- EISENMANN, V. 1985. Les Equidés des gisements de la vallée de l'Omo en Ethiopie (collections françaises). In: Y. Coppens and F. C. Howell (eds.), *Les faunes plio-pléistocènes de la basse vallée de l'Omo (Ethiopie)*1, Cahiers de paléontologie - Travaux de paléontologie est-africaine: 13-55. Paris: CNRS.
- FAURE, M. 1985. Les Hippopotames quaternaires non insulaires d'Europe occidentale. *Nouv. Arch. Mus. Hist. nat. Lyon*, fasc. 23: 13-79.
- FAURE, M. 1994. Les Hippopotamidae (Mammalia, Artiodactyla) du Rift occidental (Bassin du Lac Albert, Ouganda). Etude préliminaire. In: B. Senut and M. Pickford, *Geology and Palaeobiology of the Albertine Rift Valley, Uganda-Zaire*, vol. II : Palaeobiology: 321-337. Orléans: CIFEG Occas. Publ.
- FAURE, M. and C. GUERIN. 1997. Gafalo, nouveau site à *Palaeoloxodon recki* et *Hippopotamus amphibius* du Pléistocène ancien du Gobaad (République de Djibouti). *C.R. Acad. Sci. Paris* t. 324, sér. IIa.
- GAUTIER, A. 1968. Mammalian Remains of the Northern Sudan and Southern Egypt. In: F. Wendorf (ed.), *The Prehistory of Nubia*, vol. 1:80-99. Fort Burgwin Research Center, publ. 5, and Southern Methodist University Contrib. Anthropol., n 2, Dallas.
- GAUTIER, A. 1984. Quaternary mammals and archaeozoology of Egypt and the Sudan: a survey. In: L. Krzyzaniak and M. Kobusiewicz (eds.) *Origins and early development of food-producing cultures in North Eastern Africa*: 43-56. Studies in African Archaeology 4, Poznań.
- GAUTIER, A. 1989. General review of the known prehistoric faunas of the Central Sudanese Nile Valley. In: L. Krzyzaniak and M. Kobusiewicz (eds.), *Late Prehistory of the Nile Basin and the Sahara*: 353-358. Studies in African Archaeology 2, Poznań.
- GAUTIER, A. and A. MUZZOLINI. 1991. The life and times of the giant buffalo alias *Bubalus Homoioceras/Pelorovis antiquus* in North Africa. *Archaeozoologia*, (Grenoble) IV/1: 39-92.

- GENTRY, A. W. 1967. *Pelorovis oldowayensis* Reck, an extinct Bovid from East Africa. Fossil Mammals of Africa, n° 22, *Bulletin of the British Museum of Natural History, (Geology)* 14 n° 7: 245-299.
- GENTRY, A. W. 1978. Bovidae. In: V. J. Maglio and H. B. S. COOKE (eds.), *Evolution of African mammals: 540-572*. Cambridge: Harvard Univ. Press.
- GENTRY, A. W. and A. GENTRY. 1978. Fossil Bovidae (Mammalia) of Olduvai Gorge, Tanzania. Part I. *Bull. Br. Mus. Nat. Hist. (Geol.)* 29,4: 289-446.
- GENTRY, A. W. and A. GENTRY. 1978. Fossil Bovidae (Mammalia) of Olduvai Gorge, Tanzania. Part II. *Bull. Br. Mus. Nat. Hist. (Geol.)* 30,1: 1-83.
- GERAADS, D. 1979. La faune des gisements de Melka Kunturé (Ethiopie): *Artiodactyles, Primates*. n° 10: 21-50. Paris: Abbay.
- GERAADS, D. 1985. La faune des gisements de Melka Kunturé (Ethiopie). In: *Colloque internat. Singer-Polignac, L'environnement des Hominidés au Plio-Pléistocène. Paris juin 1981*: 165-174. Paris: Masson édit.
- GEZE, R. 1980. *Les Hippopotamidae (Mammalia, Artiodactyla) du Plio-Pléistocène de l'Ethiopie (Afrique orientale)*. Thèse Doctorat Univ. Paris VI.
- HARRIS, J. M. 1991. Family Hippopotamidae. In: J. M. Harris (ed.), *Koobi Fora research project, vol. 3, The Fossil Ungulates*: 31-85. Geology, Fossil Artiodactyls, and Palaeoenvironments Clarendon Press edit., Oxford.
- JONES, P. R. 1994. Result of experimental work in relation to the stone industries of Olduvai Gorge. In: M. D. Leaky and D. A. Roe, *Excavations in Beds III and IV and the Masek Beads: 1968-1971*: 254-298. Cambridge: Cambridge Univ. Press (Olduvai Gorge; 5).
- KLEIN, R. G. 1994. The long-horned african buffalo (*Pelorovis antiquus*) is an extinct species. *Journ. Arch. Sc.* 21: 725-733.
- LEAKEY, M. D. and D. A. ROE. 1994. *Excavations in Beds III and IV and the Masek Beads: 1968-1971*. Cambridge: Cambridge Univ. Press (Olduvai Gorge; 5).
- McDERMOTT, C. STRINGER, R. GRÜN, C. T. WILLIAMS, V. K. DIN and C. J. HAWKESWORTH. 1996. New Late-Pleistocene uranium-thorium and ESR dates for the Singa hominid (Sudan). *Journal of Human Evolution* 31: 507-516.
- MIDANT-REYNES, B. 1992. *Préhistoire de l'Egypte. Des premiers hommes aux premiers pharaons*. Paris: Armand Colin.
- PETERS, J. 1988. Osteomorphological features of the appendicular skeleton of African buffalo (*Syncerus caffer* (SPARMAN, 1779) and of domestic cattle (*Bos primigenus* f. *taurus* BOJANUS, 1827). *Zschr. f. Säugetierkunde* 53: 108-123.
- PETERS, J., A. GAUTIER, J. S. BRINK and W. HAENEN. 1994. Late Quaternary extinction of ungulates in Sub-Saharan Africa: a reductionist's approach. *Journ. Arch. Sc.*, 21: 17-28.
- SANDFORD, K. S. and W. J. ARKELL. 1933. *Paleolithic man and the Nile Valley in Upper and Middle Egypt: a study of the region during Pliocene and Pleistocene times. Prehistoric Survey of Egypt and West Asia* vol. 2. University of Chicago Oriental Institute Publication, vol. 17, University of Chicago Press.
- SANDFORD, K. S. 1934. *Paleolithic man and the Nile Valley in Upper and Middle Egypt: a study of the region during Pliocene and Pleistocene times. Prehistoric*

Survey of Egypt and West Asia vol. 3, University of Chicago Oriental Institute Publication, vol. 18, University of Chicago Press.

WENDORF F. and R. SCHILD. 1976. *Prehistory of the Nile Valley. Studies in Archeology*. New York: Academic Press.

WENDORF F., R. SCHILD, A. E. CLOSE and associates. 1993. *Egypt during the last interglacial. The Middle Paleolithic of Bir Tarfawi and Bir Sahara East*. New-York: Plenum Press.