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▶ **To cite this version:**

Denis Geraads. Plio-Pleistocene Mammalian biostratigraphy of Atlantic Morocco. Quaternaire, 2002, 13 (1), pp.43-53. halshs-00009946

HAL Id: halshs-00009946
https://shs.hal.science/halshs-00009946

Submitted on 4 Apr 2006

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PLIO-PLEISTOCENE MAMMALIAN BIOSTRATIGRAPHY OF ATLANTIC MOROCCO

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Abstract

The recent Moroccan-French cooperation programme has brought about the discovery and excavation of several rich sites in the area of Casablanca. The earliest of these is the newly discovered locality of Lissasfa, which is at least 5 Myr old, and shows that the "Quaternary" sequence of Atlantic Morocco is at least twice as long as previously thought. The other localities provide a biochronological frame for the North-African Upper Pliocene and Quaternary. Ahl al Oughlam, dated to about 2.5 Myr, is one of the richest faunal localities in the whole African Cenozoic, but man had probably not arrived in North Africa at that time. In Thomas Quarry 1, the earliest archaeological level in Morocco, level L, is probably of lower Pleistocene age. In the same complex of quarries, the faunas of cave fillings, of which the *Homo erectus* level of Thomas 1 looks the oldest, can be grouped within a single faunal unit.

Résumé

Le récent programme de coopération franco-marocain a permis la découverte et la fouille de plusieurs riches sites dans la région de Casablanca. Le plus ancien d'entre eux est celui de Lissasfa, âgé d'au moins 5 M.a., qui montre que la séquence "quaternaire" du Maroc atlantique est au moins deux fois plus longue qu'on ne le pensait naguère. Les autres sites permettent l'établissement d'un cadre biochronologique pour le Pliocène supérieur et le Quaternaire nord-africain. Ahl al Oughlam, daté d'environ 2,5 M.a., est l'une des plus riches localités de tout le Cénozoïque africain, mais l'Homme n'avait sans doute pas encore gagné l'Afrique du Nord à cette époque. Dans la carrière Thomas 1, le plus ancien niveau archéologique du Maroc, le niveau L, est probablement d'âge pléistocène inférieur. Dans le même ensemble de carrières, les faunes de remplissages de fissures, dont la plus ancienne est associée à l' *Homo erectus* de Thomas 1, peuvent être regroupées dans un même ensemble.

Key-words: MOROCCO, PLIO-PLEISTOCENE, MAMMALIA, BIOSTRATIGRAPHY

INTRODUCTION

Although Quaternary Vertebrate remains have been known from Morocco for more than a century, there has been little systematic collecting. Over a long period, Mammalian fossils were collected by geologists without proper record of their exact provenance, context or associations, sometimes just as curiosities for Museum display. As a result, few reliable assemblages of large Mammal remains are available for research. Of these few significant samples from well-defined localities, I may cite those of Aïn Maarouf and Jebel Irhoud (Hominid site). Arambourg's synthesis (1938) dealt mainly with the upper Pleistocene and includes many fossils of doubtful stratigraphic provenance.

The first serious attempt to establish a biochronology of Morocco and indeed, the whole Maghreb, was that of Jaeger who systematically collected Rodents which were studied by him (1971a & b, 1975, 1988) and Tong (1989). Unfortunately, most of Jaeger's localities lack large Mammal remains, so his framework cannot be extended to them.

In the late sixties, following the stratigraphic studies of Biberson (1961), attention focused on the Thomas Quarries south of Casablanca, where several *Homo erectus* remains were found at that time (Ennouchi, 1969, 1972; Geraads et al., 1980). Renewed stratigraphic research on these quarries was carried out from 1978 onwards by the University of Bordeaux. It is mainly thanks to the "Programme Casablanca", initiated by the "Institut National des Sciences de l'Archéologie et du Patrimoine" from Rabat, in co-operation with the "Mission Préhistorique et Paléontologique Française au Maroc" that systematic collecting and controlled excavations have been undertaken in several localities around Casablanca (map, Fig.1).

As a result, the Quaternary palaeontology of Morocco which, except for the Rodents and the Upper Pleistocene, was practically unknown until quite recently, is now documented from several well-dated sites. These sites are reviewed below, starting with the oldest.

Upper case is used for upper teeth (M1, M2…); lower case is for lower teeth (m1, m2…).

THE LOWER PLIOCENE

Lissasfa

The new locality of Lissasfa, discovered in 1995 by D.Lefevre and J.-P.Raynal, is outside the chronological period covered by this review, since it certainly pre-dates the Quaternary. However, it is worth referring to, because it demonstrates that the Plio-Pleistocene deposits of Casablanca certainly cover a much longer period than previously believed.

Lissasfa is a karstic filling within aeolian sandstone near Casablanca, 12 km from the coast. Up to now, it has yielded only a few poor scrappy remains of large Mammals, but a good collection

of microfauna, consisting mainly of Rodents, which can provisionally be referred to the following taxa (Geraads, 1998):

- *Mus ique*. A few teeth indicate the presence of this small species of mouse, the earliest one of the genus in Africa.
- *Paraethomys lissasfensis*. The genus *Paraethomys* consists of several long lasting lineages, ranging from the Upper Miocene until the Upper Pleistocene. The Lissasfa species differs by several features from the one found in the early Pliocene of Garaet Ichkeul (Jaeger, 1971b) and in the latest Miocene of Algeria (Coiffait-Martin, 1991). It looks closer to some Spanish forms whose age is close to the Mio-Pliocene boundary.
- *Praomys* sp.

No other Murid has been discovered, whereas *Stephanomys* or *Apodemus* are present in some other sites of similar age (Argoub Kemellal, Aïn Guettara: Brandy & Jaeger, 1980).

- *Lophiomys maroccanus.* Only four teeth have been found at Lissasfa. This genus is known from the late Miocene and Pliocene of both sides of the Gibraltar strait (and the Pleistocene of East Africa), but is still too rare to have much biochronological value.
- *Ruscinomys africanus*. This Cricetid, previously known in North Africa by a few teeth only, is very common here. The Lissasfa species, which also occurs in Algeria, is remarkably primitive by its third molars which are less reduced than those of contemporary and even earlier European species, and it might belong to a lineage of its own, long detached from the Northern group.
- *Myocricetodon* sp. This primitive Gerbillid, represented at Lissasfa by 4 teeth only, is unknown after the Miocene in North Africa and Spain.
- *Protatera davidi*. This most interesting species is the most common Mammal of Lissasfa. It is again with Spanish forms close in age to the Mio-Pliocene boundary (Alcoy, Caravaca: Agustí, 1991) that it displays the most significant similarities. The genus is unknown in North Africa after the late Miocene.
- *Irhoudia* sp. This is the only Ctenodactylid known in the Mio-Pliocene of North Africa.
- *Atlantoxerus* sp.

This unusual assemblage does not easily fit into the biostratigraphic sequence reconstructed by Coiffait-Martin (1991) in Algeria. The most similar site, unfortunately very poor, could be that of Garaet Ichkeul in Tunisia, which Coiffait-Martin (1991) puts in the earliest Pliocene. The occurrence of *Mus* and of *Paraethomys* confirms that Lissasfa cannot be much older than the earliest Pliocene, but that of *Myocricetodon*, of a primitive *Ruscinomys* and the lack of *Golunda* show that it cannot be younger than this date, even though lower Pliocene biochronology of North Africa is still imperfectly established. The best estimate for Lissasfa is close to the Mio-Pliocene boundary, around 5.5 Myr. (Raynal & al., 1999).

UPPER PLIOCENE

Ahl al Oughlam

This locality near Casablanca, formerly known as "carrière Déprez" (Déprez quarry) was made famous by Biberson (1961) who described some pebbles from a marine conglomerate at about 105m above sea level as man-made artefacts. They are now thought to have a natural origin (Raynal et al., 1990). This marine layer is overlain by a thick aeolian calcareous sandstone. In 1985, J.-P.Raynal and J.-P.Texier discovered a rich fauna in fissure fillings within this aeolianite, that I first examined in Rabat in 1989 (Raynal et al., 1990). The obvious importance of the locality prompted us to start systematic excavations where the fillings had been exposed by quarry works. The site has now been regularly worked for about 10 years.

Ahl al Oughlam is by far the richest late Cenozoic locality of North-Africa, and one of the richest of the whole Africa. It has yielded more than 55 species of Mammals, and the total list of Vertebrates will probably reach about 80, including Amphibians and Reptiles (Bailón, 2000) and many species of birds now being studied by C.Mourer-Chauviré from the University of Lyons. Most of the Mammals have also been studied: Suids (Geraads, 1993b), Rodents and Insectivores (Geraads, 1995), Carnivores (Geraads, 1997), Giraffids (Geraads, 1996), Bovids (Geraads & Amani, 1998), Primates (Alemseged & Geraads, 1998), Proboscideans (Geraads & Metz-Muller, 1999). The rest of the fauna has also been identified, with varying degree of precision. Unfortunately, there are only a few sites of similar age in North Africa, and they are all much poorer than Ahl al Oughlam. The richest ones have only about 15 species of Mammals. They include Garaet Ichkeul and Aïn Brimba in Tunisia, both of Pliocene age, and Aïn Boucherit in Algeria, close to the Plio-Pleistocene boundary (Arambourg, 1970, 1979; Jaeger, 1971a & b, 1975; Geraads, 1987; Tong, 1989).

The most conspicuous biochronologic indicator for that period is *Equus*. It arrives in Europe at about 2.5 Myr (Roccaneyra: Eisenmann & Brunet, 1973) or even perhaps 2.7 Myr in Spain (Aguirre & Morales, 1990), in East Africa at about 2.3 Myr (Omo lower member G: Eisenmann, 1985a), and perhaps 2.5 Myr in South Africa (Sterkfontein member 4: Klein, 1994). It is absent from Ahl al Oughlam, although we have collected more than 200 specimens of its relative *Hipparion*. It is also lacking from Garaet Ichkeul and Aïn Brimba, but common at Aïn Boucherit. Thus, even if the date of arrival of *Equus* in Africa is diachronic, comparison with the rest of the western Old World shows that a date of less than 2.3 Myr for Ahl al Oughlam is extremely unlikely, given the facility for faunal exchange with various parts of this region, as is demonstrated by the rest of the fauna. Consequently the absence of *Equus* allows the age of Ahl al Oughlam to be fixed at 2.3 Myr at least.

Most of the other species of Mammals do not provide such a clear age estimate, but their

evolutionary grades can be used to confirm and refine this dating.

The Suid *Kolpochoerus phacochoeroides* belongs to a lineage endemic to North-Africa, but is poorly known in other localities (Geraads, 1993b). At its type-locality, Aïn Jourdel in Algeria (Thomas, 1884), it comes from a layer where only *Hipparion*, but not *Equus*, is known (but there are only a few fossils). In East Africa, the size of the third molars of *Kolpochoerus* (and other Suids) provides one of the best biochronological tools (Harris & White, 1979; Cooke, 1976, 1978), and the teeth of Ahl al Oughlam can tentatively be compared with the East African ones. If we assume that the rate of evolutionary changes is roughly the same in East and North Africa, the best fit for Ahl al Oughlam would be close to Omo member D, at about 2.4 Myr.

Seven Bovid species only are present at Ahl al Oughlam (Geraads & Amani, 1998a): a rare *Tragelaphus*; a Bovine close to *Pelorovis* ? *praeafricanus* but mostly known by teeth; a new species of kob, *Kobus barbarus*, perhaps of an endemic lineage; a *Parmularius* slightly more primitive than at Olduvai; *Beatragus*, mentioned for the first time in North Africa; *G. thomasi*; and *Gazella (Deprezia) psolea*, noticeable by its nasal region. The Alcelaphines are in good agreement with an age of 2.5 Myr, being slightly more primitive than those of Olduvai bed I.

The same is true of the skeletal proportions of the Giraffid *Sivatherium* (Geraads, 1996), which differ both from those of the Middle Pliocene and from those of the Pleistocene.

Other large Mammals, such as *Anancus* (Geraads & Metz-Muller, 1999), elephant, *Ceratotherium* and *Hipparion*, do little more than indicate a Plio-Pleistocene age.

The Carnivore assemblage of Ahl al Oughlam is quite diverse with 23 species (Geraads, 1997), but this group has been less studied in Africa than the Ungulates, and is almost unknown in the Plio-Pleistocene of the Maghreb. The civet from Ahl al Oughlam is identical to that of Omo member D. The spotted hyena recalls that of the Middle Pliocene of Laetoli, but there is also a primitive Hyaenid, which can be referred to the Mio-Pliocene genus *Hyaenictitherium*. Among the 6 species of Felids, the panther and wild cat might belong to the Recent species, but there are also primitive relatives of the lion and cheetah which suggest great antiquity. The last species of some chronological significance is a zorilla close to *Prepoecilogale bolti* known from Laetoli and the latest Pliocene of South Africa (Cooke, 1985; Petter, 1987). On the whole, the Carnivores are perhaps indicative of a greater age than some the other groups, especially because they are more similar to those of Laetoli than to those of Olduvai, which appear comparatively modern.

The cercopithecid Primate *Theropithecus atlanticus*, whose type-locality is Aïn Jourdel, is not rare at Ahl al Oughlam but is unfortunately mostly illustrated by teeth (Alemseged & Geraads, 1998). Although it is specifically distinct, its evolutionary stage is comparable to that of *Theropithecus darti* from the East and South African Pliocene.

Rodents show little diversity in North African faunas of the late Cenozoic, and there are only

6 species at Ahl al Oughlam, although thousands of teeth have been collected (Geraads, 1995). The Murid *Paraethomys* is more evolved than at Garaet Ichkeul and Aïn Brimba, which is also in agreement with the absence in these sites of the modern genus *Gerbillus*, present at Ahl al Oughlam (Tong, 1989; Geraads, 1995). The Rodents from the latter site are more similar to those of Irhoud Ocre, a fissure filling in central Morocco (Jaeger 1971a, 1975) but the Murids show that Ahl al Oughlam is the earlier. Irhoud Ocre, which contain no macro-mammal remains, has been dated as lowermost Pleistocene by Jaeger, but the similarity of its Rodents with those of Ahl al Oughlam would prompt me to put it in the latest Pliocene, an opinion shared by Coiffait-Martin (1991).

Fig. 2 shows the placement of some Plio-Pleistocene North-African localities in respect to Ahl al Oughlam, which is now the best reference locality for the Plio-Pleistocene of North Africa.

PLEISTOCENE

For the lower Pleistocene of the Maghreb, the best fauna is that of Aïn Hanech in Algeria (Arambourg, 1970, 1979) which has also yielded several polyhedric artefacts, but no hand-axe, nor micro-fauna. Its age can roughly be estimated at 1.2 - 1.5 Myr (Eisenmann, 1985b; Geraads, 1987; Sahnouni & Heinzelin, 1998).

Next comes, among the previously known sites, that of Tighenif (= Ternifine, = Palikao) in Algeria (Arambourg & Hoffstetter, 1963; Geraads, 1981; Geraads & al., 1986). Most of its rich fauna has been studied, or at least identified (Fig. 3) making it the best reference for the middle part of the Quaternary in the Maghreb. Only one site of Morocco, Aïn Maarouf near El Hajeb, can be directly correlated with it.

Aïn Maarouf

This open-air locality, discovered in 1950 (Choubert & Sittler, 1957) has yielded Acheulian artefacts and an *Homo erectus* femoral shaft (Geraads & al., 1992; Hublin, 1992) and an interesting fauna, where hippos and elephants are predominant, but which contains also *Parmularius ambiguus*, an antelope previously known only from Tighenif (Geraads, 1981). The age of the fossiliferous layer (which is now under water) cannot be much different from that of the Algerian site, but the probable occurrence of *Rabaticeras* suggests that it is slightly more recent (Geraads & Amani, 1997).

By far the most important complex of Pleistocene localities in Morocco is that of the southern sea-shore of Casablanca, where large quarries have revealed the stratigraphy, and exposed numerous fossiliferous cave and fissure fillings. Some of them were described by Biberson (1961), but it is only with the systematic survey and excavations of the "Programme Casablanca" that paleontological collections have been made with rigorous stratigraphic control in the "Thomas

Quarries": Thomas 1 and Oulad Hamida 1 (formerly Ben Sina, formerly Thomas 3).

Level L of Thomas Quarry 1

The earliest archaeological level known in Morocco (Raynal & Texier, 1989) was discovered in a calcareous sandstone deposited in a lacustrine or marshy environment. Its palaeomagnetism is most probably reverse (Sen, pers. comm.), suggesting a Lower Pleistocene age. Unfortunately, the fauna is sparse and poorly preserved. The large mammal remains, probably left by *Homo erectus* as food refuse, are only fragmentary.

Hippopotamus is the most common large mammal, as it may be expected in a wet open air site. A gazelle horn-core can probably be referred to *G. atlantica*, a species known from the level of Tighenif onwards, but this certainly does not allow an earlier age to be ruled out. There is an *Equus* and the Elephant *Loxodonta*, as in Tighenif, but these large Mammals do not imply a correlation with this site. Of greater biochronological significance is an upper M3 of the Suid *Kolpochoerus*, which was discovered outside the archaeological excavations, but in the same level. It matches fairly well the type of *K. maroccanus* (ENNOUCHI, 1953) which is of unknown age but recalls *K. majus* of East Africa. *Kolpochoerus* is absent from all Middle Pleistocene localities of North Africa, and its occurrence in level L definitely points to an earlier age.

The microfauna, whose extraction from the calcareous sediment is tedious, consists of a few teeth only. Apart from a few Reptiles and Amphibians, it consists mainly of Mammals. A single tooth of shrew recalls *Crocidura darelbeidae* from OH1-GDR but is smaller than the mean size in this species. An upper anterior premolar of Lagomorph is too primitive to belong to the common hare of the Middle Pleistocene of these quarries, *Serengetilagus raynali*, but could be of *Lepus*, also known there (Sen, pers.com.).

Of about 15 rodent teeth, 3 incomplete specimens only belong to Murids, and 13 to Gerbillids, suggesting open country. The absence of the dormouse *Eliomys* may be without meaning, because this genus is always rare in later Middle Pleistocene sites, whereas that of *Ellobius*, a vole already present at Tighenif but absent in early Pleistocene sites, may be more significant, because this genus is common when present. This suggests that level L is earlier than Tighenif. A single incomplete m1 of the Murid *Praomys* is not diagnostic at species level, but an anterior m1 fragment of *Paraethomys* is distinct from all other *Paraethomys* found in Morocco (Fig. 4a). The anterior two lobes (Sl and Sv in Jaeger's nomenclature), instead of being set at right or slightly obtuse angle, are almost perfectly transversely oriented. Such a morphology is unknown at Oulad Hamida as well as in the later levels of Thomas Quarry (which have yielded almost 100 m1 of *Paraethomys*), and has not been described, either at Tighenif or Thomas, by Jaeger (1975). However, it recalls *P. mellahe* AMEUR, 1988 from Oued Mellah, an Algerian site earlier than

Tighenif (according to Ameur, 1988). The material from level L is too scanty for this species to be positively identified or named as new, but its distinctiveness from *P. tighennifae* is not doubtful. It suggests that level L is more remote in age from other levels in Thomas 1-Oulad Hamida quarries, than the latter are from each other.

Among the Gerbillids, several teeth are indistinguishable from *Meriones maximus* TONG, 1986, known from Tighenif onwards, while the others belong to two species of *Gerbillus*, both distinct from the species occurring in the other levels of these quarries:

- *Gerbillus* sp A is represented by an m1 with a posterior cingulum stronger than the average of *G. grandis* from later levels, but weaker than that of *G. cingulatus* from Tighenif (Tong, 1986). This tooth is otherwise similar to *G. grandis*, but it is quite peculiar by its great breadth / length ratio (0.69), which sets it apart from all other Gerbillids from these quarries.

- the second species of *Gerbillus*, sp.B, is represented by a very small M1 (Fig. 4b). The central cusps (paracone and protocone) are less alternate than in *G. jebileti* (unknown at Casablanca) or *G. campestris*, which is known in other layers but is slightly larger and has also high longitudinal crests, unlike *Gerbillus* sp. B. The size of *Gerbillus* sp.B is similar to that of *G. minutus* TONG, 1986 from the late Pliocene of Irhoud Ocre, but this species has weaker crests. No *Gerbillus* of this size is known from Tighenif. The evolutionary changes in *Gerbillus* are still imperfectly known, so that it is hard to fit this species into the phylogenetic tree of this genus, but its evolutionary grade is between *G. minutus* from the Plio-Pleistocene and *G. campestris* of the middle Pleistocene.

Overall, although the Rodent fauna from level L is still quite poor, several of its elements are distinct from those of the later levels, and also from those of Tighenif. It is unlikely that ecology plays a great role, since most of the genera (*Praomys*, *Paraethomys*, *Meriones*, *Gerbillus*) are the same. These differences must therefore mainly be attributed to chronology. The fauna from level L clearly does not belong to what is called hereunder the "Thomas 1-Oulad Hamida 1 (Th1-OH1) faunal unit", and even the Tighenif fauna is more similar to the latter than is that from level L. The best fit for the latter, in the present state of our knowledge, is the second half of the Lower Pleistocene, but perhaps not its latest part. Thus, human occupation of Atlantic Morocco is probably at least 1 Myr old.

Hominid level of Thomas Quarry 1 (Th1-G)

An exposure through deposits in a marine cave in the northern section of Thomas Quarry 1 was cleaned and trial trenched in 1993. Several square meters were then excavated in 1994 and 1995. The lower part of the cave consists of a hard pink filling, provisionally called Th1-G (Fig. 5), overlain by several stalagmitic layers. The latter are covered by a dark-red clay (called Th1-α), of Late Pleistocene age. Th1-G has yielded in 1994 an *Homo erectus* upper premolar.

Most of the present features of this section of the quarry match those shown on a sketch drawing made at the time of the discovery of the *Homo erectus* mandible known as Thomas Quarry 1, kindly made available to me by P.Beriro. This shows beyond doubt that Th1-G is the level where the mandible was found, in association with the artefacts and fauna which we published in 1980 (Geraads *et al*., 1980; Geraads, 1980).

This layer corresponds to the right (eastern) part of the "remplissage ancien" in Sausse, 1975, but it must be stressed that, contrary to Sausse's figure 4, it is definitely not continuous with the left (western) part of the same, hereafter called Th1-ABCE (Fig. 5).

The *Homo erectus* locality, Th1-G, is poor in micromammals, and it is certainly not the place where Jaeger collected the microfauna studied by him (1975, 1988) and Tong (1989).

The faunal list of micromammals from this level recalls that of OH1-GDR, with some differences:

- *M. maximus* and *G.* cf *campestris* are absent, but the collection is too small to assert that this difference is significant.

- *Eliomys* is morphologically similar to the Recent species, *E. quercinus*, and to *E. darelbeidae* from OH1-GDR, but is much smaller than the latter (Fig. 6), implying a clear age difference.

- two m1 of *Meriones* are also slightly smaller than those of *M. maghrebianus* from OH1-GDR, and from later levels of Thomas Quarry 1. Their dimensions are given in table 1:

Table 1: m1 dimensions in *Meriones*.

	m1 length	m1 width
Thomas 1-G	2.35 ; 2.56	1.60 ; 1.71
OH1-GDR (N = 57)	2.61 - 3.03 (mean 2.81)	1.64 - 2.03 (mean 1.85)
Th1-ABCE (N = 14)	2.65 - 2.93 (mean 2.81)	1.71 - 1.92 (mean 1.82)

Th1-G is therefore more distinct from OH1-GDR than the later is from Th1-ABCE, and the smaller size of *Eliomys* and *Meriones* suggest that Th1-G is the earliest.

Several Carnivores are probably identical with those of OH1-GDR (see below). Some others (*Lutra, Mellivora, Phoca*), although rare, display some differences from the Recent species, thus pointing to a rather ancient age. Most of the other species found by the recent excavations are also present in the old collection (hereafter called Th1-Md) associated with the *Homo erectus* mandible, but this argument supporting the identity of Th1-G and Th1-Md is not very strong since, unlike Rodents, macromammals do not have a sharp resolution power, at the degree of precision requested here.

The Th1-Md collection (Geraads, 1980; Geraads *et al*., 1980) is similar to that of OH1-GDR, although there are some differences, which could result either from the chronology or from incomplete sampling. The absence of characteristic horn-cores of *Damaliscus* in the Th1-Md collection could have been included in the former category, but the almost complete absence of horn-cores of any bovid in this collection, where teeth are common, suggests a taphonomic or collecting bias instead. Another possible difference is the apparent absence at OH1-GDR of *Connochaetes* (wildebeest), present in the Th1-Md collection.

Anyhow, the 1993, 1994 and 1995 field campaigns have provided, for the first time, an unambiguous association, in Th1-G, of Rodents with at least one *H. erectus* find.

Oulad Hamida 1 - *Homo erectus* cave (OH1-HEC)

Cranial fragments of *Homo erectus* where found in this cave, formerly known as Thomas 3 (Ennouchi, 1972). The site has now been almost completely destroyed for commercial extraction, and details of its complex stratigraphy are no longer visible. It has yielded no microfauna, but the occurrence in old collections (Geraads, 1980) of some of the most typical large mammals of the OH1-GDR and Th1-G / Th1-Md sites (*Canis* aff *adustus*, *Damaliscus* sp, *Theropithecus* cf *oswaldi*) speaks in favour of its belonging to the OH1-Th1 faunal unit.

Oulad Hamida 1 - Rhino cave (OH1-GDR)

The fauna from this cave, which has also yielded numerous Acheulian artefacts, and the first absolute age estimates of the Moroccan Quaternary, has been partly described elsewhere (Raynal et al., 1993; Rhodes et al., 1994; Bernoussi, 1994; Geraads, 1993a, 1994). Its richness makes it the best reference locality for the Moroccan Middle Pleistocene, second only to Tighenif in North Africa. It can be taken as the type-locality of a faunal unit that I shall call "Th1-OH1", which also includes Th1-G, OH1-HEC and Th1-ABCE. Figures 2 and 3 show that there are a number of similarities of variable significance with Tighenif but also some differences, which set the latter apart from all levels of the Th1-OH1 group. The following taxa, present at Tighenif, are no longer known from Th1-OH1:

- *Homotherium*, the sabre-tooth cat, is a survivor of the Pliocene, also present at Ahl al Oughlam;
- *Metridiochoerus compactus*, known only from Tighenif in North Africa, is replaced by the ecologically similar *Phacochoerus* in Th1-OH1. The same change seems to occur in East Africa, and may be time-related;
- *Parmularius*, an Alcelaphine only recently recognised in North Africa (Geraads, 1981) is probably present at OH1-GDR as *P.* cf *angusticornis*, but is certainly distinct from that of Tighenif at species level. Most of the Alcelaphines from OH1-GDR might belong to another genus, known from the

lower Pleistocene of Koobi Fora.

- *Gazella dracula*, the dominant bovid species at Tighenif, is known from no other locality.

A few other taxa present at Tighenif but not in Th1-OH1 include the giraffe, the primitive kudu-like eland *Tragelaphus algericus*, *Hippotragus gigas* (known at Olduvai), and the Gerbillid *Mascaramys*. They demonstrate the lower Pleistocene affinities of the Algerian site.

The micromammals from OH1-GDR are strongly reminiscent of those of Tighenif, with three important new elements: the dormouse *Eliomys*, the common mouse *Mus*, and the hare *Serengetilagus*, but the latter two have probably no chronological meaning, because they are already present at Ahl al Oughlam.

Overall, there are good arguments for putting Tighenif earlier than OH1-GDR, but the differences are not only time-related. Some of them certainly arise from the fact that Tighenif is an open-air site, while all levels of the Th1-OH1 group are fissure or cave fillings

Thomas Quarry 1 -ABCE

As mentioned above, the system of cave and fissure fillings on the northern section of the Thomas Quarry 1 (Fig. 5), exposed by earthworks in 1993, match the sketch-drawing made in the 1970s by P.Beriro. Thin infillings several meters below the upper cave have yielded several samples of micromammals, that we have called Th1-A, B, C, E (Fig. 5). They correspond topographically to the place where, according to Sausse (1975), the *H. erectus* mandible was found but, as noted above, this is certainly incorrect, particularly as these spots have yielded no macrofauna.

The 4 loci A, B, C and E probably belong to the same stratigraphic unit and, since there is no clear biometric difference between their Rodent samples, I shall consider them as a single fauna. The Rodent fauna studied by Jaeger (1975) and Tong (1989) probably comes from one of them but its precise provenance is not known.

The Rodent fauna which we collected from these levels in 1993-1994 is very similar to that of OH1-GDR, with most of the species certainly identical, especially all Gerbillids, and *Mus hamidae* with its characteristic anterior lobe of m1. However, there are some biometric differences: *Praomys* is larger (Fig. 6c; the smallest M1 has its length reduced by strong wear), and the same is true of *Eliomys*, especially the upper molars (Fig. 6b), and of *Ellobius* (mean length of 12 m1 3.60 instead of 3.45 for 69 m1 from OH1-GDR). There is no significant difference for the Gerbillids and the other Murids, but since there is a similar size increase in three lineages, it can be confidently concluded that Th1-ABCE is slightly more recent than OH1-GDR. A small problem arises from the mean length of *Ellobius* m1 given by Jaeger (1988) as 3.45 mm, which is more similar to the mean of OH1-GDR than to that of Th1-ABCE as expected, but this may be due to the small size of his sample, and to the strong individual variation which depends considerably upon the degree of wear.

Jebel Irhoud (Hominid site)

The fauna from this cave, collected by Ennouchi without record of its precise stratigraphic provenance, has recently been revised (Amani, 1991; Amani & Geraads, 1993; Geraads & Amani, 1998b). A few differences between this fauna and the small sample more recently collected by J.Tixier (Thomas, 1981) suggest that the filling was not homogeneous, and all human remains (there are now 5 specimens) were perhaps not quite contemporaneous with each other. The fauna has a modern aspect, containing Cervids and *Sus scrofa*, both unknown in Middle Pleistocene faunas. However, there are also an Alcelaphine with a simple occlusal pattern and *Gerbillus grandis*, both species with Middle Pleistocene affinities. The morphology of the human remains does not contradict an age close to the Middle / Upper Pleistocene boundary.

CONCLUSION

Once again, Mammalian faunas have shown how useful they are for dating purposes. Little more than 10 years ago, the coastal sequence of Casablanca was still believed to belong entirely to the Quaternary. Since then, the discovery, excavation and study of Ahl al Oughlam showed that the deposition of this sequence started in fact before the Plio-Pleistocene boundary. More recently, Lissasfa pushed its lower limit further back in time, close to the Mio-Pliocene boundary. The "Middle Pleistocene" of the Thomas quarries underwent a similar extension downwards. While the Hominid level, first estimated to be around 0.2 Myr old, looks now closer to Tighenif (thus to the Lower/Middle Pleistocene boundary), level L provides evidence of a Lower Pleistocene level, with fauna and artefacts, in this quarry. These discoveries, together with the great improvement of our knowledge of the faunal content in each level, allows us to establish the biochronological framework of the Moroccan Plio-Pleistocene much more firmly than just 10 years ago. It can now be compared to that of East African, and some periods or aspects are even better sampled. However, it still needs refinement and some aspects such as the transition between Middle and Upper Pleistocene, where the faunal changes are incompletely understood, and the early Pleistocene, which lacks a good association between macro- and microfauna, could certainly be improved.

ACKNOWLEDGEMENTS

I am especially grateful to J.Hassar Benslimane, F.Z.Sbihi-Alaoui and J.-P.Raynal, who invited me to join their cooperation programme in Morocco. Many thanks also to Prof.Y.Coppens, Chaire de Paléoanthropologie et Préhistoire, Collège de France, for constant support.

Autorisation de publier N° 03/01-02

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