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NEW PLIOCENE MAMMALS FROM AÏN EL BEY AND KARA BORNI LOCALITIES (CONSTANTINE, NORTH-EAST ALGERIA) WITH A SPECIAL FOCUS ON THE SMALL THREE-TOED HORSE *HIPPARION SITIFENSE* AND REVIEW OF POMEL 1897 TYPE SERIES

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ABSTRACT

We describe in this article the new fossil mammal bones from continental Pliocene localities of Constantine (north-east Algeria). The most abundant bones are related to a small three-toed species which is characterized by the presence of third incisors; labial grooves on I2; persistent dp1; small to moderate size of upper and lower cheek teeth; short and rounded protocone or little labio-lingually developed; moderate number of upper cheek teeth folds; ectostylids on both milk and permanent lower teeth may occur; small postcranial bones. These features are quite close to *Hipparion sitifense* which we re-exhibit here the original (Pomel, 1897) type-specimens.

The occurrence of such species at the base of Aïn el Bey Pliocene long Sequence shows that it has survived from the upper Miocene to Pliocene drier opened landscape. Despite the evident local tectonic discontinuities and the presence of the bones at the base of Aïn el Bey long sequence, it is not easy to assign a specific age to that species. However, the associated vertebrates seem to belong to upper Pliocene mammal assemblage.

Keywords - Mammals - Pliocene - Three-toed equids - Northeast Algeria - Aïn el Bey locality - Lacustrine deposits.

NOUVEAUX MAMMIFÈRES DU PLIOCÈNE DE AÏN EL BEY ET KARA BORNI (CONSTANTINE, NORD-EST ALGÉRIEN) ET DESCRIPTION DÉTAILLÉE DU PETIT ÉQUIDÉ À TROIS DOIGTS *HIPPARION SITIFENSE* ET DE LA SÉRIE-TYPE DE POMEL, 1897

RÉSUMÉ

Nous décrivons dans cet article des ossements de grands mammifères découverts dans le Pliocène de Aïn el Bey et de Kara Borni (Constantine), plus particulièrement ceux présents en

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plus grand nombre et appartenant à un hipparion. Cette espèce se caractérise par la présence des troisièmes incisives ; de rainures sur la face labiale des deuxièmes ; la persistance de la première prémolaire de lait ; des jugales permanentes à faible hypsodontie ; un protocone arrondi ou légèrement ovale et des plis-fossettes peu nombreux. Sur les jugales inférieures, des ectostylides, très réduits, peuvent apparaître à la fois sur les dents lactéales ou définitives. Enfin, les ossements post-crâniens sont peu robustes. Ces caractères nous orientent vers *Hipparion sitifense* dont nous publions à nouveau les types définis par Pomel en 1897 et déclassés depuis.

Sur le plan stratigraphique, la présence de ces ossements à la base de la séquence de Aïn el Bey et les discontinuités tectoniques relevées localement montrent qu'ils sont postérieurs au Miocène et antérieurs à la coupure plio-pléistocène. Les espèces associées ont plus ou moins la même valeur biochronologique.

Mots-clés - Mammifères - Pliocène - *Hipparion* - Nord-Est d'Algérie - Aïn el Bey - Dépôts lacustres.

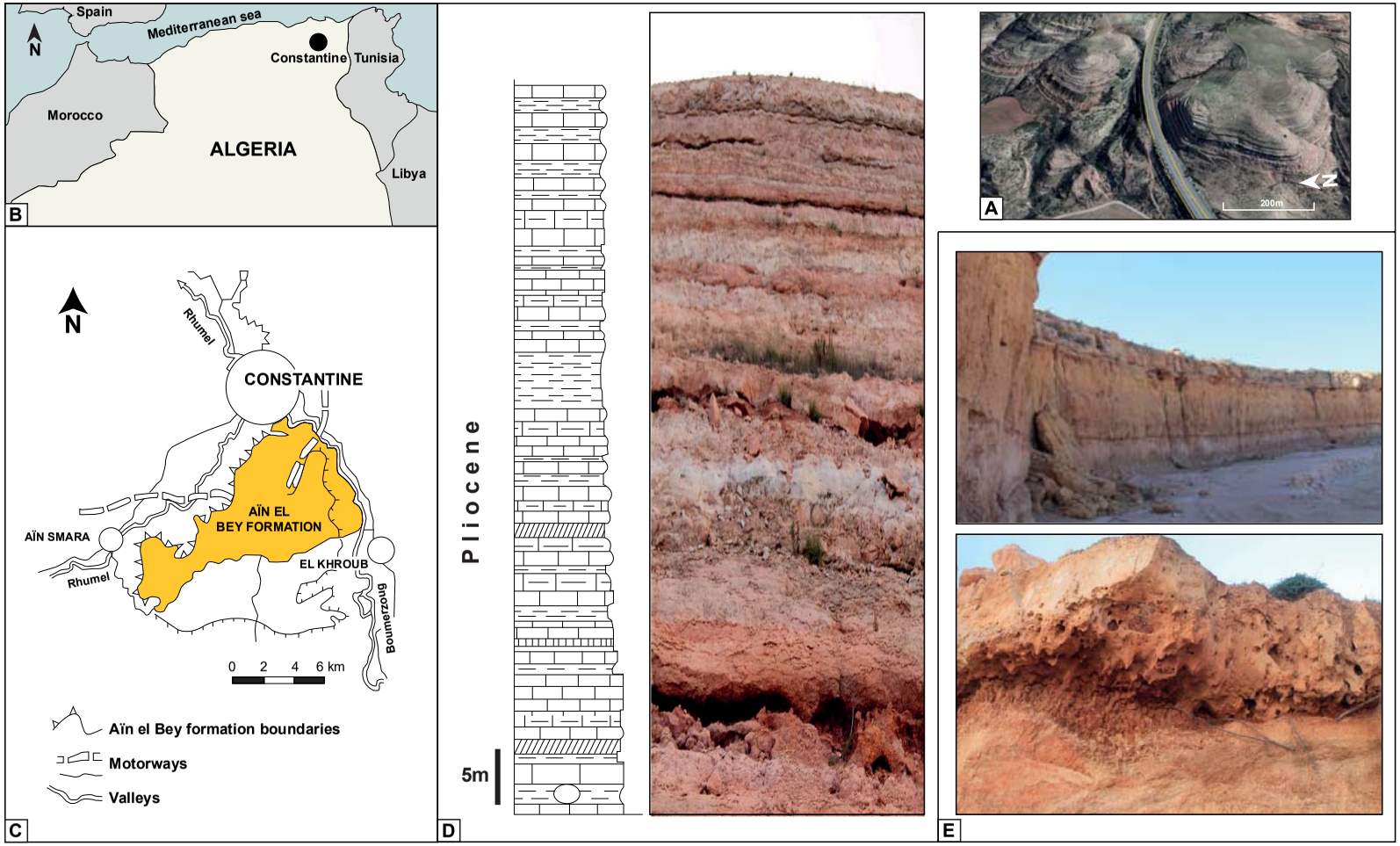
I- INTRODUCTION

The first detailed work ever carried out on North African Neogene vertebrates concerned Constantine locality, where lacustrine deposits yielded in the middle of the 19th century to Thomas (1880, 1884) the earliest mammalian assemblages. Following Coquand (1862), Thomas attempted to define the sedimentary component of the main localities that he discovered, and highlighted two successive series: Aïn el Bey and El Hadj Baba, and the more recent Aïn Jourdel and Mansourah series.

Even nowadays, Aïn el Bey sedimentary deposits form a powerful fluvio-lacustrine formation of more than 100 meters (pl. I). They are attributed by the former and latter geologists to lower Pliocene (Coquand, 1862; Thomas,1880,1884; Tissot, 1881; Ficheur, 1894; Pallary,1901; Joleaud, 1911; Jodot, 1955; Arambourg, 1970; Marmi *et al.,* 2018). Aïn el Bey formation overlies the discordant upper Miocene levels as well as the Paleogene and/or the Cretaceous (Ficheur, 1894; Vila, 1980; Coiffait, 1992; Bougdal *et al.,* 2006; Marmi *et al.,* 2018) and ends by a slightly discordant Quaternary limestone recently discovered (pl. I). Aïn el Bey deposits yielded to Thomas (1880,1884) a rich malacofauna (*Helix pyramidata* Forbes; *Leucochroa subsemperiana* renamed *H. subsemperiana* Thomas; *H. fossulata* Pomel; *Bulimus bavouxi* Coquand, renamed *Rumina decollata*, Linnaeus, 1758) and vertebrate species such as *Hippopotamus*, *Sus phacochoeroides* Thomas, 1884 (renamed *Kolpochoerus phacochoeroides*) and *Hipparion gracile* Thomas, 1884 (renamed *Hipparion sitifense* Pomel, 1897 and more recently *Eurygnathohippus feibeli* (Bernor *et al.,* 2020). Later, the mollusks were used by Jodot (1955) to establish a biozonation of North African Pliocene localities. He reported species from Aïn el Bey pink limestones to the middle zone of the lower Pliocene, which he differentiated by small reference species such as *Limnaea cirtana* Pallary, 1901; *Planorbis jobae* Bourguignat,1862 and *Bulimus gaudryi* Pallary,1901.

The second lacustrine series of Mansourah was first attributed to upper Pliocene (Thomas, 1880 and 1884; Vila, 1980; Coiffait, 1992) and then updated to Villafranchian (Pomel, 1894) and lower Pleistocene (Arambourg, 1910; Chaïd-Saoudi *et al.,* 2006). Travertines and yellow sands from the base yielded rather advanced and diversified

Plate I



Location of Aïn el Bey and Pliocene sequence: **A-** Aïn el Bey Plateau deposits (Google Earth image); **B** and **C-** Location of Aïn el Bey and Constantine (modified after Spiga, 1994); **D-** Lithostratigraphic sequence (after Marmi *et al.*, 2018); **E-** Photos showing Quaternary deposits of Aïn el Bey Sequence.

Localisation de Aïn el Bey et séquence du Pliocène : A - Dépôts du plateau de Aïn el Bey (image Google Earth). B et C - Localisation de Aïn el Bey et Constantine (modifié d'après Spiga, 1994). D - Séquence lithostratigraphique (d'après Marmi et al., 2018). E - Photos montrant les dépôts quaternaires de la séquence de Aïn el Bey.

fauna (Bayle, 1854; Gervais, 1869; Thomas, 1884; Joleaud, 1918; Chaïd-Saoudi *et al.,* 2006) associated with Oldowayen industry (Laplace, 1956; Camps,1964; Chaïd-Saoudi *et al.,* 2006), documenting one of the earliest human occupation of Constantine.

New discoveries from Aïn el Bey and Kara Borni localities, which are beyond the scope of the current paper, display a lot of three-toed equid bones from a small hipparionine little-known species, that we will try to better identify even if it is difficult to deal with these forms due to the lack of craniums. Because of their extreme polymorphism and their great intraspecific variability (Eisenmann, 1983; Bernor and Armour Chelu, 1999 a and b; Zouhri and Bensalmia, 2005), paleontologists tend to no longer stop at typological entity but to arrange the forms in larger groups. In Algeria and North Africa, many records were discovered. Information about their synonymies, diagnosis, chronology (when allowed) and regional range are summarized in the appendix but it is not irrelevant to remember that :

1. The earliest Vallesian representative *Hipparion africanum* Arambourg, 1959 from Bou Hanifia (Arambourg, 1959; Ameur *et al.,* 1976) and *Hipparion primigenium* from Menacer (Arambourg, 1959) and Oued Mya (Sudre and Hartenberger, 1992) were assigned to *Hippotherium primigenium* (Wood-burne and Bernor 1980; Bernor and Armour Chelu, 1999 a and b) and later to *Cormohipparion africanum* (Bernor and White, 2009);
2. The small *Cremohipparion* aff. *matthewi* from Sahabi upper Miocene Libyan locality (Bernor and Armour Chelu, 1999 a and b), the more wide ranged *Eurygnathohippus feibeli* from Lothagam, Sahabi and Tizi N'Taddert (Bernor *et al.,* 2020) and *Stylohipparion* (Arambourg, 1970) were included to the major clade *Eurygnathohippus*.
3. During the Pliocene, *Eurygnatohippus* lineage species have evolved with an increase in crown height, ectostylid diameter and metapodial size (Bernor *et al.,* 2005). *Hipparion pomeli* (Eisenmann *et al.,* 2006) from Ahl Al Oughlam (Morocco) seems to reflect this development. Concerning the Algerian taxa *H. sitifense* and *H. libycum* (Pomel, 1897) whose skulls remain unknown, no current bones revision has been undertaken and *H. sitifense* is nowadays considered *nomen dubium* (Bernor and Scott, 2003). The new material from Aïn el Bey, fully Pomel type-series description that will follow and other material related (housed in MNHN Paris) may help to know more about their anatomical features.

II- Aïn el Bey locality and faunal description

II.1- Lithostratigraphy

The new lithostratigraphic section (pl. I), opened up by the recent motorway, confirms the previous descriptions. It exhibits horizontal and regular strata which begin with an alternation of very vacuolar pinkish limestone, compact and crystalline white banks of clayey marls and paleosols. The presence of emersion and pedogenesis (marmorizations) indicates periods of draining and re-watering of the paleolake on a warm climate (Marmi *et al.,* 2018). This section ends on the southern edge of the basin with a slightly discordant Quaternary limestone formation. It is at the extreme base of this formation that the new bones described bellow were collected lying in a level of marls and carbonates. They were nested one on top of the other, forming a more or less indurated mass. Young individuals are predominant, but permanent teeth are pres-

ent. Comparisons were conducted having age in mind. The term *Hipparion* (which is especially devoted to primitive hipparionine forms with a high dorsally facial fossa) (Woodburne and Bernor, 1980) will be used here in the general sense and to stress the similarities with *Hipparion sitifense* (Pomel, 1897) without considering the last generic and specific modifications. For that, see appendix. We will also use *Hipparion libycum* instead of *Eurygnathohippus libycum*. The abbreviation: AeBey is for Aïn el Bey.

II.2- Faunal description

Hipparion cf. *sitifense* (Pomel, 1897).

Synonymies

- *Hipparion gracile* Thomas, 1884.
- *Hipparion sitifense* Pomel, 1897; Arambourg, 1956.
- *Hipparion gromovae* Alberdi *et al.*, 1986.
- *Cremohipparion* aff. *mathewi* Bernor and Scott, 2003.
- *Eurygnathohippus feibeli* Bernor *et al.,* 2020.

Type-series: first upper molar n°7264055; second upper molar n°7264054; calcaneus n°7264050 (Pomel, 1897).

Type-locality: St. Arnaud (current Aïn Boucherit).

Age: upper Pliocene.

New material: serie of AeBey 2015: housed at University of Constantine, Institute of Geology (Algeria) and collected by Marmi; series of AeBey 2019: housed at Geological Museum of Central Faculty of Algiers (MGFCA) and collected by Chaïd-Saoudi.

Collections examined for comparisons

- *H. sitifense* from St. Arnaud (Aïn Boucherit) stored at MGFC Algiers (Geological Meseum of Central Faculty of Algiers); *H. sitifense* from Aïn el Hadj Baba, St. Donat (Chaâbet el Matagna) and Mascara stored at MNHN Paris ;
- *H. libycum* from Brunie Quarry (Oran), Puits Karoubi (Oran); *H. massoessylium* from Carrière des grès St. Pierre (Oran); *H. ambiguum* from Sillègue stored at MGFC Algiers;
- *H. pomeli,* Geraads collection, MNHN Paris;
- *H. primigenium* from Menacer, stored at MNHN Paris;
- *C. africanum* from Bouhanifia, stored at MNHN Paris and MGFC Algiers.

Composition of the new material : 1 occipital bone, 1 muzzle with three upper incisors in place and a closed canine socket on each side; 1 mandibular symphysis with I2 in place; about twenty upper and lower molars, numerous milk teeth carried by fragments of jaws and mandibles; post-cranial bones fragmented: radius, metatarsal, astragalus, calcaneus and phalanx 2. Measurements are given in mm.

II.2.1- Cranial bones

A cranial part with only the occipital condyles has been preserved. The rest of the skull was lost because of the erosion or during the motorway works which uncovered the new Aïn el Bey Sequence. The width of occipital condyles and the width of foramen magnum are respectively: 70 and 32 mm. These measurements are close to those of *H. pomeli* from the upper Pliocene of Ahl el Oughlam cranium (AeO 3647) which according to Eisenmann and Geraads (2006), are 68 and 34 mm, respectively.

The muzzle from AeBey (tabl. I) has incisival arcade, almost straight, but the strong constriction of the geni surface forming a central ridge near the foramen and the two deep depressions on either side are characteristic of rounded-arch hipparions like in the moroccan *H. pomeli* on which the arcade is rounded on AeO 3647 sample (Eisenmann and Geraads, 2006). The I3 is also placed rather close to the I2 on AeBey bone, since it is placed behind the I2 on AaO 3647; and AeO 2104 samples [29]. The shape of the muzzle is used to discriminate between the rounded incisival arcade from the primitive *Hipparion* pattern and the advanced flat one from later forms. However, as the shape changes with age, it is necessary to stress on the young age of AeBey fowl muzzle. If we apply *Equus* incisor eruption and wear stage dates (Guadelli, 1998), we can state that it works with a young adult up to 4-5 years. I3 are present; the incisors infundibula are rounded and the first incisors are larger than long indicating wear stage 2 or 3. At this age, the animal does not yet have the final outline of his muzzle, so the AeBey sample was in a development process when the animal died. The most significant measurement that we were able to take is the width behind I3 which seems to be as short as *H. pomeli* and some specimens of Hadar. Unfortunately, we were unable to take the length to range it in the long and short muzzle group (*H. hasumense*) or in the short and wide muzzle group (*H. afarense*). However, the large size of the upper incisors, the presence of the I3, the grooves on the labial side of the I2 are also discriminating features of *H. pomeli*. The canine alveolus is still closed.

The mandibular symphysis (AeBey 2015-2) belongs to a very young individual.

It shows single well-preserved milk teeth. The single first incisor is 16.5 mm wide and 11 mm high. The second incisors are broken at the crown and the third ones are not out yet. The age is estimated around 1 to 5 months according to Guadelli classification (1998). The symphyseal outline is quite rounded as is always the case with too early wear stages in Equidae. Its width behind I3 is 55 mm. It is perhaps not negligible to note the presence of the lateral asymmetry that already exists in today's very young horses and also the shift from one side to the other, due to the presence of a gap between the incisors in the foals of the first few months. Three other isolated milk incisors are present. Their labial surfaces are very smooth and their neck is well marked.

• Milk upper teeth

The maxillary fragment (AeO 2019-2 to 5) carries on its right side D2-D3 and D4 which is broken distally and on the left side half of a D2. The wear stage of all is comprised between 1 and 2. A prominent Dp1 (remnant P1) is attached to the mesial edge of the left

Table I - Measurements of some *Hipparion* muzzles (compared data are according to Eisenmann and Geraads, 2006).

Mensurations des museaux de quelques hipparions (données comparées d'après Eisenmann et Geraads, 2006).

Parameters	AeBey 2015-1	AaOughlam AL164-3	Hadar AL340-8	Hadar Al164-3	Hadar Al363-18	Olduvai 2845/6
Muzzle width at I3	57	60	57	60	80	59
Minimal muzzle width		(35)	(31)	44		

D2. It is monoradicular; the crown is well marked; the labial side is smooth and two small internal cingula exist at its base. The second fragment (AeBey 2019-8a; 8b) shows D3 and D4 with wear stage 2 (pl. II).

• Permanent upper teeth

Part of a palate shows a permanent unworn dentition. The right side contains M1-M2 and M3 (AeB2019-7a; 7b). The latter is not out yet. The left side of the mandible displays one M3 (AeB2019-7d); probably two M2 isolated upper molars and one M3.

These upper teeth (tabl. II; pl. II) are characterized by their small size and squared shape. On adult and unworn teeth, the height is low, the maximal crown height is 49.5 mm. Except for one permanent M3, the protocone is short and almost rounded labio-lingually. It is different from *H.libycum* milk and permanent upper teeth, where the protocone is usually more extended mesio-distally. The hypocone forms a pronounced lingual fold. On an unworn M3, it is well-individualised and separated from the protocone by a deep groove. The enamel is rather thick, the mesostyle is quite proeminent, the fossette wrin-

Table II - Upper and lower dentition measurements.

Mensurations des jugales supérieures et inférieures.

	Tooth	L. 2 cm crown	W	H	LP	WP	IP	Fold fossettes	Caballine folds
Upper dentition									
AeBey 2019-2	D2	34	21	(14)	6.5	4.5	19.11		
AeBey 2019-8a	D3	20.5	23.5	18	7.5	6.5	36.58	9	0
AeBey 2019-4	D3	26	21	(23)	5.5	4	21	3	3
AeBey 2019-3	D4		21						
AeBey 2019-8b	D4	22	23	22	6.5	05	29.54	5	0
AeBey 2019-6	P3/P4	24	24.5	37.5	6	4.5	25	7	1
Kara Borni	M1/2	19	19	27	8.5	3.5	44.7	6	1
AeBey 2019-7a	M1	20	21	49.5	6	3	30		
AeBey 2019-7b	M2	23	18	49					
AeBey 2015-6	M2	19	20.5		6.5	5	34.21		
AeBey 2019-7d	M3	22	16.5	47					
AeBey 2015-7	M3	21.5	19		6.5	4	30.23		
Lower dentition									
AeBey 2019	P4	21.5- 22	14-15.5						
AeBey 2019	m1	20-19	14						
AeBey 2019	m2	22	14						
Kara Borni	m1/2	23	20	45.5					

Plate II

Hipparion cf. *sitifense* material from Aïn el Bey (from top to bottom and from left to right) : row 1: occlusal side of upper M1/2 and M2/M3, broken D4 and D3; row 2 : D2, labial side of dp1 and dp2, medial side of unworn M1/2; row 3 : lower cheek-teeth : m3 broken, m2, m1, p4; row 4: anterior side of astragalus, anterior side of second phalanx. Scale = 1 cm.

Hipparion cf. sitifense de Aïn el Bey (de haut en bas et de gauche à droite) : rangée 1: face occlusale de M1/2 et M2/M3 supérieures, D4 incomplète et D3; rangée 2: D2, face labiale de dp1 et dp2, face mésiale de M1/2 immature; rangée 3: jugales inférieures: m3 incomplète; m2; m1 et p4 ; rangée 4: astragale, face antérieure: deuxième phalange. Echelle = 1 cm.

kling is low and the caballine fold is marked and sometimes large. These three latter traits are also present on *H. pomeli* and *H. libycum* (Pomel, 1897; Arambourg, 1956; Eisenmann, 1977) but Aïn el Bey's teeth are closer to those of *H. sitifense* with which they share the smallness of the teeth, the low degree of hypsodonty and the shape of the protocone (fig. 1A).

The type-series of this species (Pomel, 1897) housed at MGFC Algiers displays the same morphology (pl. III). The probably first upper right molar (M1) has a curved column and a small protocone which has not completely reached the occlusal surface. This tooth is very small and even if the roots are broken, the degree of hypsodonty is low (pl. III for measurements). On occlusal side, the crests are well-marked, and fossette wrinkling is moderate and not easy to count due to the presence of central cingulum formations and poor enamel condition. The caballine fold is well developed. The upper left second molar figured by Pomel (1897), has also little wear and is similar but with a short protocone, that is slighly mesio-distally compressed (pl. III).

It should be remembered that the material used to describe *H. sitifense* is housed at Algiers Geological Museum with the rest of the Pomel legacy. Unavailable, it was first attributed to *Cremohipparion matthewi* (Bernor *et al.,* 2003) before being classified « *nomen dubium* ».

• Lower cheek teeth (pl. II; tabl. II)

Three mandibular parts (carrying for one probably a dp3-dp4-m1-m2, the second dp3 and dp4 and the third dp2, dp3, dp4, unworn m1) were present. On the first and second mandible, the roots are almost completely embedded. The length of segment dp3-m1 is 64 mm and the width is 19.5 mm at the widest tooth. The most important feature, apart from their smallness even for fowls, is the lack of ectostylids on teeth of two mandibles and their presence on the third. When they exist, they are large flattened and duplicated. This is rather unusual because generally the absence of ectostylide is attributed to *H. sitifense* while its presence characterizes *H. libycum* or *H. pomeli*. The discriminant double-knot associated is difficult to estimate on the first two mandibles because of the poor teeth condition and such an unclear shape is frequently observed with molars due to their posterior compressed position and their smallness. The other sample which displays ectostylids has a hipparion double-loop and developed parastylids with bladed hypoconulids. On heavily worn teeth, we note that the vestibular sulcus curves sharply towards the metaconid, whereas on the relatively less worn teeth, it goes straight to the contact of the lingual sulcus. Such orientation may be linked to the asymmetrical shape of the hipparionian double-loop pattern. At the beginning, we separated the two mandibles and assigned them to two different species: *H. setifensis* and *H. libycum* but the collection seems very homogeneous in other features and dimensions. According to the palate described above, one mandible and a part of postcranial bones obviously belong to the same individual with almost the same dental wear stage. The rest of the material is similar except perhaps the muzzle which can express variability within *H. sitifense*.

II.2.2- Postcranial bones

• Humerus and radius

A poor part of a humerus diaphysis without proximal and distal articulations displays small proportions at the mid-shape compared to *H.pomeli* samples. The middle width is 23.5 mm and the middle antero-posterior diameter is 41 mm. For the first value, 3 humerus of *H. pomeli* have given 27.6 mm,

Plate III

Three-toed equids type-series described by Pomel (1897).

Teeth length and measured from a starting point of 2 cm after the roots; height is measured starting from the divergent point of the roots to the mesostyle.

A - Top and left: upper M1 of *Hipparion sitifense* from St. Arnaud (Aïn Boucherit), occlusal side (length: 20.5; width: 19.5; height: 35); protocone length: 5.5; protocone width: 3; fossette folds: 11; caballine fold: 1 (this tooth is drawn by Pomel, 1897), upper M2 of the same (length: 21; width: 21; height: 42.5; p. length: 7.5; p.width: 4.5; fossette folds: 8; caballine fold: 1) (drawn tooth, Pomel, 1897). Top and right: upper P2 of *Hipparion libycum* from Beni Fodda, formerly Sillègue (near Aïn Boucherit) (= *H. ambiguum* Pomel, Arambourg, 1970), occlusal side. This immature tooth has been sawn in the middle and is presented here in two separate parts (length: 32; width: 22; height: 68.5) Scale = 1 cm.

B - Middle: lower p4 of *Hipparion libycum* type from "Carrière Brunie, Oran" (Pomel, 1897), occlusal side (considered as molar by both Pomel, 1897, Arambourg, 1970) (length: 28.5; width: 18; height: 52; length of ectostylid: 7; width of ectostylid: 3.5). Scale =1 cm. Bottom from left to right: upper left M3 of *H. libycum* (= *H. massoessylium* Pomel, 1897), from "Puits Karoubi, Oran, lignite layer": (length: 23; width: 22; height: 46. Upper left M1 (or M2), length: 23.5; width: 23; height: 52 upper right M1-M2-M3 of the same. The right M1 is around 23 mm length and 23 width; the second M2 is broken, the third has the same measurements as the left mentioned above.

C- The same teeth but from a lingual side except for the lower p4 which which is shown from a vestibular side;

D - From top to bottom and from left to right: M1, M2 of *H. sitifense* (St. Arnaud), vestibular side; P2 of *H. libycum* from Beni Fodda, Sillègue, vestibular side; left upper M3, M1 (or M2) of *H. libycum* from Puits Karoubi, vestibular side; lower p4 (or molar) of *H. libycum* from Carrière Brunie, lingual side (same teeth as on plate 3; figs.A and B);

Equidés à trois doigts décrits par Pomel (1897).

La longueur et la largeur des dents sont mesurées à partir de 2 cm après la racine et la hauteur à partir du point de divergence des racines jusqu'au mésostyle.

A - En haut et à partir de la gauche: M1 supérieur de Hipparion sitifense de St. Arnaud (Aïn Boucherit), face occlusale (longueur : 20,5; largeur: 19,5; hauteur: 35); longueur du protocône: 5,5; largeur: 3; plis-fossettes: 11; pli caballin: 1, M2 supérieure (longueur: 21; largeur: 21; hauteur: 42,5; longueur protocône: 7,5; largeur: 4,5; plis-fossettes: 8; pli caballin: 1). En haut et à droite : P2 supérieure de Hipparion libycum de Beni Fodda, anciennement Sillègue (= H. ambiguum Pomel, Arambourg, 1970), face occlusale. Cette dent a été sciée et se présente ici en deux parties. (longueur: 32; largeur: 22; hauteur: 68,5). Echelle = 1 cm.

B - Au milieu: p4 inférieure de Hipparion libycum type de la "Carrière Brunie, Oran" (Pomel, 1897), face occlusale (elle a été classée comme une molaire par Pomel, 1897 et Arambourg, 1970) (longueur: 28,5; largeur: 18; hauteur: 52; longueur de l'ectostylide: 7; largeur de l'ectostylide: 3,5). Echelle =1 cm.

En bas, de gauche à droite: M3 supérieure gauche de H. libycum (= H. massoessylium Pomel, 1897), provenant du "Puits Karoubi, Oran, niveau à lignites". Longueur: 23; largeur: 22; hauteur: 46. M1 supérieure gauche (ou M2), longueur: 23,5; largeur: 23; hauteur: 52 mm. M1-M2-M3 supérieures droites du même maxillaire ; M1 droit: longueur environ 23 mm; largeur 23; la M2 est cassée, la M3 a les mêmes mensurations que la M3 gauche.

C- Les mêmes dents mais de face linguale à l'exception de p4 qui est de face labiale.

D - De haut en bas et de gauche à droite : M1, M2 de H. sitifense (St. Arnaud), face vestibulaire (ou labiale); P2 de H. libycum de Beni Fodda, Sillègue, face vestibulaire; M3, M1 supérieures gauche de of H. libycum du Puits Karoubi, face vestibulaire; p4 de H. libycum de Carrière Brunie, face linguale.

37 mm and 38 mm (Eisenmann and Geraads, 2006).

An incomplete left radius without distal articulation also shows small dimensions and seems to be rather straighter than *Equus*. At mid-height, the anterior and lateral sides sections are flattened since the medial is rounded. The thickness index of the middle of the diaphysis is 165.9 mm. The measurements are: diaphysis width: 36.5 mm (contra min 42.3 mm - max 43.3 mm on *H.pomeli*). Depth at the middle of the diaphysis: 22 mm; proximal articular width: 61 mm (contra min 64.8 mm - max 72.1 mm); proximal depth: 32 mm (contra min 38.5 mm - max 40 mm); proximal maximal width: 64 mm (contra min 67 mm - max 78.2 mm). All these dimensions are smaller than the minimum limits of *H. pomeli* given by Eisenmann and Geraads (2006).

• Metatarsal bone

(figs. 1B and C; tabls. III and IV)

Two parts of proximal and distal third metatarsal and a fragment of the lateral one have been collected.

The plots 2 and 3 (figs. 1B and C) show that the proximal and distal ends of the metatarsus of AeBey are smaller than the species used for comparison and are similar to those given to *H. sitifense*. *H.pomeli* is more distant.

The distal measurements of *H. libycum* from Oran, which should be similar to *H. pomeli*, form two sets, one of which is closer to *H. sitifense* since the other is more developed. It is not known whether these are two different species or variability within one of the two species.

Compared to a metatarsal from *C. africanum,* the AeBey proximal and distal widths are less developed since the depths are rather similar. This was noticed by Eisenmann and Geraads (2006) on 5 other metatarsals of *C.africanum* she studied (tabl. III; fig. 1B). According to Eisenmann and Geraads (2006), the most ventrally position of the lateral fingers is expressed by narrower widths and deeper depths diaphysis. That interesting fact can not be verified on a single specimen, but one retains the slenderness of the AeBey finger.

• Astragalus

On that astragalus, the posterior edge of the lateral condyle of the tibia is very sharp with no interruption with the calcaneal surface as it usually occurs on *Hipparion* (Eisenmann, 1985). Compared to measurements with *H.pomeli* and Omo small hipparionine (Eisenmann and Geraads, 2006), it shows small proportions, but it must be included within the minima values (pl. II; fig. 1D; tabl. V).

Table III- Compared measurements of metatarsal III proximal parts.

Dimensions comparées des parties proximales des métatarses III.

Species	Proximal articular breadth	Proximal depth	Middle breadth diaphysis	Middle depth diaphysis
H. sitifense AeBey 2015	35	33		31
C. africanum	41	34	24.5	29
H. pomeli (Eisenmann and Geraads, 2006)	(x-min-max) 45.3-42.3-49	(x-min-max) 39-35.5-43.2		(x-min-max) 32.44-30.3-34

Table IV- Compared distal parts of metatarsal III.

Mensurations comparées des parties distales des métatarses III.

Species	Distal max. articular breadth	Distal supra articular breadth	Distal max. depth keel	Depth medial condyle	Distal depth of lateral condyle
H. sitifense AeBey	(30)	34	30	26	24
C. africanum	37	36	29.5	25	26.5
H. libycum Oran	(32.5)	37.5	(25)	(22)	26
H. pomeli (Eisenmann and Geraads, 2006)	43.2-40.7-45	47.1-44.7-50.5	36.9-35.1-38.7	39.9-29.7-33.6	28.2-27.2-29
H. sitifense St. Arnaud (Eisenmann, 1985)	30.5	32	26		

• Calcaneum

The calcaneum is almost complete. The length of the proximal part and the proximal and distal breadths and depths are higher than two calcaneus from St. Arnaud (one from Pomel Algiers collection, the second from MNHN). These values are very close to *H. africanum* but below those of *H.pomeli* (tabl. VI).

• Phalanges

In isolated phalanges, it is not easy to distinguish between anterior and posterior ones, especially when they are represented by a single specimen as in this case. One lateral first phalanx, one second central phalanx and one second lateral were collected. We can just notice that the second phalanx of the third digit is smaller than the posterior and anterior phalanges of *H. pomeli* (tabl. VII).

II.3- Associated fauna

The Aïn el Bey 2015 assemblage includes several bovid species. The material is composed of 2 juvenile ossicones related to Girafidae family, 2 tragelaphine pattern molars, 5 horn-cores of Gazella and few post-cranial bones.

Table V- Compared astragalus measurements (data from Omo and Afar, min. and max. values of *H. pomeli* according to Eisenmann and Geraads, 2006).

Mensurations comparées des astragales (Omo et Afar, minimas et maximas de H. pomeli, d'après Eisenmann et Geraads, 2006).

	Maximal length	Max.diameter of the medial condyle	Breadth of the trochlea	Maximal breadth	Distal articular breadth	Distal articular depth	Maximal medial depth
***H. sitifense* Aebey**	55	57.5	25	50	42.5	32.1	45
Omo	(56)-72	53	27 to 28		44.5-(42)51.5	31-(29)	
Afar	65 to 74	61 to 68	28 to 36.5		50 to 57	35 to 41.5	

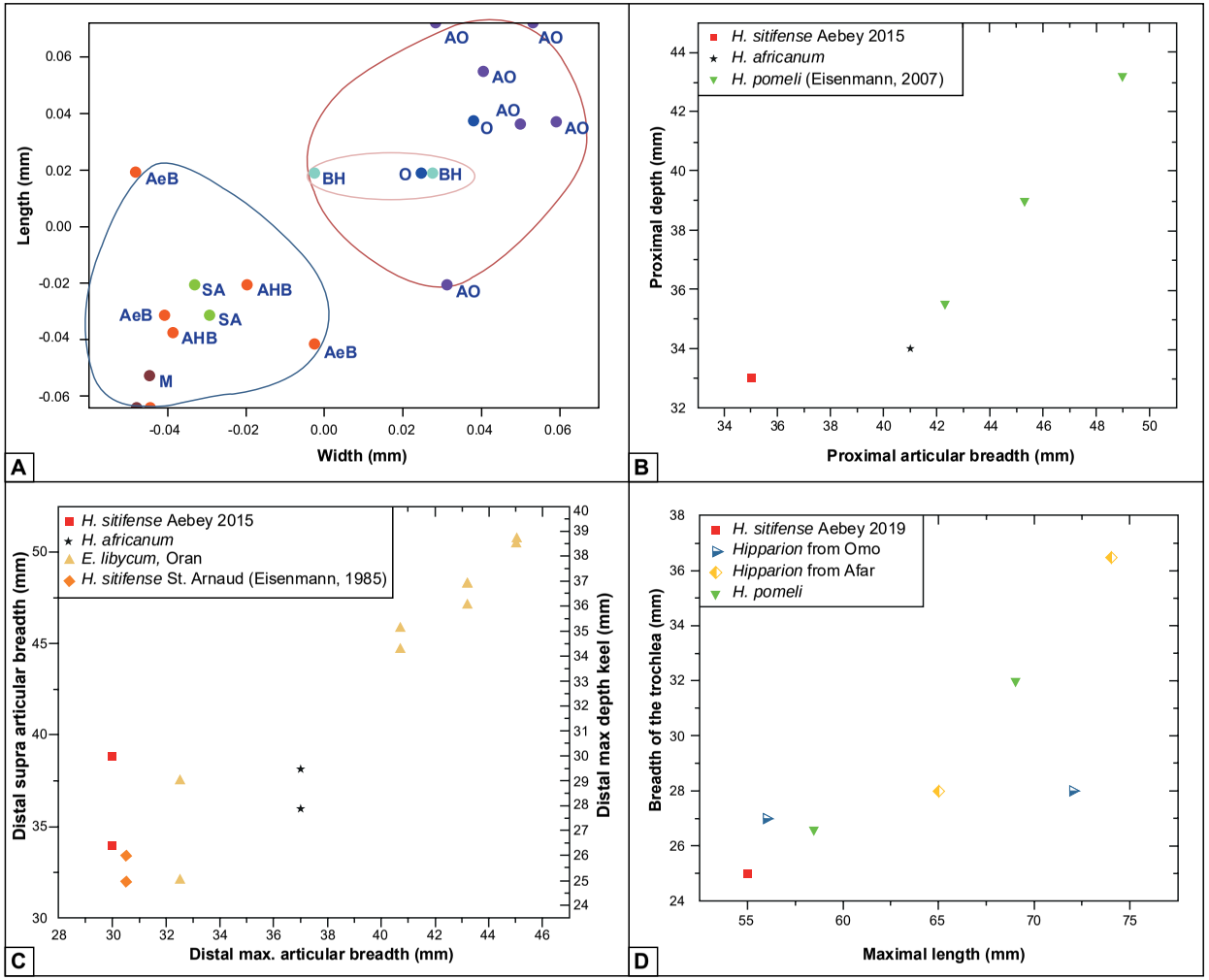


Fig. 1- A- Upper molars (M1.M2) distribution of some *Hipparion* (AeB: Aïn el Bey; SA: St. Arnaud; M: Mascara; AHB: Aïn el Hadj Baba; BH: Bouhanifia; AO or AeO: Ahl el Oughlam). **B-** Distribution of proximal metatarsal parts III of some *Hipparion*. **C-** Distribution of distal metatarsal parts III of some *Hipparion.* **D-** Distribution of the astragalus.

A- Diagramme de comparaison des molaires supérieures M1/M2 de quelques hipparions (AeB: Aïn el Bey; SA: St. Arnaud; M: Mascara; AHB: Aïn el Hadj Baba; BH: Bouhanifia; AO or AeO: Ahl el Oughlam). B- Diagramme comparé des articulations proximales des métatarses III de quelques hipparions. C- Diagramme comparé des articulations distales des métatarses III de quelques hipparions. D- Diagramme comparé des astragales.

Table VI- Compared calcanei measurements (data of *H.pomeli* according to Eisenmann and Geraads, 2006; approximate value : between brackets).

Mensurations comparées des calcaneums (données de H.pomeli, d'après Eisenmann et Geraads, 2006; les valeurs approximatives sont entre parenthèses).

	Maximal length	Length of the proximal part	Minimal breadth	Proximal maximal breadth	Proximal maximal depth	Distal maximal breadth	Distal maximal depth	Maximal length of the sustentaculum	Maximal length of the articular facet on the sustentaculum
***H. sitifense* AeBey**	(103)	71	17.5	30.5	47	39	45	57.5	34.5
***H. sitifense* St. Arnaud**		61	13	27.5	42.5		40.5		
***H. africanum* Eisenmann, 1980**	108								
***H. sitifense* Eisenmann, 1980**	93								
***H. pomeli* :x**		76.5	21.5	51.6	57	35.5	52.5		
Min-max			17.5-23.3	47-53.3			47-59		

Table VII- Measurements of *H.* cf. *sitifense* phalanges from AeBey.

Mensurations des phalanges de H. cf. sitifense de Aïn el Bey.

Parameters	First lateral phalanx	Phalanx 2 of the central digit	Phalanx 2 of the lateral digit
Maximal length	34	(35)	15
Proximal maximum breadth	12.5	(33)	13.5
Proximal maximum depth	19	22	14
Distal maximum breadth	11.5	35	12
Minimal breadth diaphysis	8	31	
Anterior height		32	

The giraffid ossicones are stocky, conical and large at the base. Their faces are highly vascularized and the section is not very rounded. On the least broken specimen, there is no secondary growth bone concentrated at the apex as it occurred on young *Giraffa* genus (Arambourg, 1979; Danowitz *et al.,* 2017). At their place, we just see linear streaks on the shaft. According to Bohlin (1926), this morphology is a characteristic of the Sivatheres pattern. Apart from other elements, it is difficult to say more about these two isolated and juvenile ossicones but they seem to be different from those of young *Giraffa*. This later displays long curved ossicones, thin in the middle and concentrated growth bone at the apex.

In North Africa, both *Sivatherium maurusium* and *Giraffa pomeli* have been described (Pomel, 1893; Arambourg, 1979; Geraads, 1996). Their remains come from the upper Pliocene of Ahl el Oughlam, Puits Karoubi, Aïn Boucherit, Ichkeul lake and Aïn Brimba, and survive till the lower Pleistocene of Aïn Hanech (Arambourg, 1970; Geraads *et al.*, 1998).

Two lower molars (m1 and m2) can be assigned to *Tragelaphus* cf. *gaudryi*. They

display tragelaphine characteristics (Gentry, 1978) such as brachyodontia, narrowly pointed lateral lobes and lack of goat folds. This species has been discovered in the upper Pliocene sites such as Aïn Jourdel where the holotype originated (Thomas, 1884) Aïn Boucherit (Arambourg, 1970), Ahl el Oughlam (Geraads *et al.,* 1998) and Shungura members E and G (Gentry, 2010). It will last until the lower Pleistocene at Mansourah (Chaïd-Saoudi *et al.,* 2006) and Aïn Hanech (Arambourg,1970;1979).

Two gazelle horn cores can be related to the species *Gazella setifensis* from the upper Pliocene of Aïn Boucherit and Aïn Jourdel. They are characterised by a strong antero-posterior curvature, lateral compression, an ovoid section at the base, and a surface strongly and entirely covered with parallel grooves. Another horn, while resembling *G.setifensis,* evokes *G.atlantica* because it is more arched and thicker. Arambourg (1979), who noted similar forms, attributes them to the great variability that exists within *G. setifensis* horn cores pattern.

III- KARA BORNI LOCALITY

Kara Borni is located in the constantinois, near the Zighoud village (ex. Condé/Smendou). The lithological sequence forms a detrital series composed of clays at the base and then alternating silt-sandstone with coarse paleochannel deposits. This series ends in a conglomeratic bed containing vertebrate remains (Marmi *et al.,* 2018). Paleontological remains indicate a primitive elephant, *Hipparion* and *Hippotragus* medium antelope.

III.1- Faunal remains

III.1.1- *Hipparion* sp.

Two isolated teeth display small proportions. The probably M1/M2 upper molar is quite small but has a well stretched mesio-distally protocone. The caballine fold is rudimentary. The wrinkling of the fossetes is low to medium. The mesostyle is protruding and three enamel formations are present (one central and the other two ones at the metacone and paracone level). The lower tooth displays the double caballine loop characteristic of modern hipparions and a subtriangular ectostylide. If they were not small, these teeth would have been attributed to *H. libycum* or *H. pomeli*.

III.1.2- *Mammuthus* sp.

A proboscidian form is represented by one broken tooth. It is low-crowned (63 mm at the greatest of the talon) or at least meso-crowned. It has moderate thick enamel, unfolded, spaced plates and rather deep cementum valleys. The distal part displays 2 accessory conules. The following lophs have 4 and 6 conelets. The more mesial fused plate is broken so we can not see if it displays lozenge-shaped enamel wear figure characteristic of *Loxodonta* genus or not, but the enamel is smooth. In North Africa, two elephantid species were distinguished (Pomel, 1895; Arambourg, 1970). The mid-to late Pliocene *Mammuthus africanavus* were discovered at Aïn Boucherit in Algeria and *Mammuthus meridionalis* of the early Pleistocene from Aïn Hanech locality.

Mammuthus africanavus (*E. meridionalis*: Pomel, 1895; *E. africanavus*: Arambourg, 1952, 1970; *Loxodonta africanava*: Cooke, 1960; Coppens, 1965; *Mammuthus africanavus*: Maglio, 1973) is « a more primitive species with a low number of third molar plates, unfolded and moderately thick enamel, modest plate spacing and retention in the anterior half of molar crowns of accessory central conules. Sides of molars taper strongly toward the apex of the crown » (Sanders *et al.,* 2010). *Mammuthus meridionalis* (*E. planifrons*: Doumergue, 1928; *E.moghrebiensis*: Aram-

Plate III

Three-toed equids type-series described by Pomel (1897).
A - Calcaneus of *H. sitifense* from St. Arnaud (Aïn Boucherit) (Pomel, 1897; wrongly considered as astragalus), articular or anterior side; third metatarsal of *H. libycum* from Carrière de grès du quartier St. Pierre d'Oran (Pomel, 1897), distal part, anterior side. **B -** The same calcaneus on medial side.
The same MTIII, posterior side. Scale = 1 cm.

Equidés à trois doigts décrits par Pomel (1897).
A - Calcaneum de H. sitifense de St. Arnaud (Aïn Boucherit) (Pomel, 1897; présenté par erreur comme astragale), face articulaire antérieure; métatarse III de H. libycum de la Carrière de grès du quartier St. Pierre d'Oran (Pomel, 1897), partie distale, face antérieure. B - Le même calcanéum, partie médiale. Le même MTIII, face postérieure. Echelle = 1 cm.

bourg, 1970; *E. recki ileretensis*: Geraads and Metz-Muller, 1999) has hypsodont crowns without development of accessory conules and a higher plate number.

The most significant characteristics of Kara Borni's tooth are close to *Mammuthus*. Compared to *M. africanavus* (specimens from Aïn Boucherit and Lac Ichkeul housed in MGFC Algiers), this tooth seems a bit more primitive due to its smallest height and widest plate spacing.

III.1.3- *Hippotragini*

Two lower molars, m2 and m3, that were discovered embedded in a mandibular part before separation, seem to belong to the Hippotragini tribe. They are semi-hypsodont. They have compressed distal lobes. The goat fold

is important. It is long and lingually curved at its end, extending by a fold over the entire height of the tooth. The interlobar column is displayed on both molars. It is medium size and runs the full height of the tooth. It appears thicker at the root and duplicates on the m3. The hypoconulide of the m3 rises slightly upwards at its termination. A blade starts at the root and stops halfway up.

Features such as the presence of a goat fold, interlobar column, distal lobe compression and protruding cones are reminiscent of *Hippotragini* tribe which counts 3 living genera: *Hippotragus*, *Oryx* and *Addax* (Gentry, 1978). Compared to *Oryx el-eulmensis* record from Aïn Hanech (Arambourg, 1970), Kara Borni teeth have smaller height and size. Upper molars of *Hippotragus priscus* from the localities of Bel Hacel and Ichkeul are not yet hippotragine (Gentry, 2010) and the only best-known advanced North African *Hippotragus* is *H.gigas,* which lived later in the middle Pleistocene locality of Ternifine (Geraads, 1981). As hippotragini are mainly described by their horns, it is therefore difficult to determine their membership on the basis of few dental features alone. For the moment, it is important to notice that the Kara Borni samples are hippotragine form with rather early characteristics such as lesser hypsodonty, small proportions (tabl. VIII) and on the m3, a blade at mid-crown height is present. The bifid interlobar column is thought to be an evolved characteristic found in modern *Hippotragus* (Geraads, 1981).

IV- RESULTS AND DISCUSSION

IV.1- *Hipparion sitifense* characteristics

The small *Hipparionine* species from Aïn el Bey displays some useful traits such as: unrounded muzzle on young animals; presence of third incisors, labial grooves on I2; persistent dp1; small to moderate size on upper and lower cheek teeth; short and rounded protocone or little labio-lingually developed; presence or absence of ectostylids on both milk or permanent lower teeth; small postcranial bones (third proximal and distal parts of metatarsal, astragalus, calcaneus, phalanx).

Until much more diagnostic skull can be found, we think that these characteristics match for the moment with what we know about *Hipparion sitifense*. Comparisons with *H. sitifense*'s material provided from St. Arnaud, Aïn el Hadj Baba, Chaâbet el Matagna, Aïn Jourdel and Mascara localities, showed that it was a rather small species with rather low-height teeth.

Ectostylid could be random, it may or may not appear as it was the case with some small east-African teeth from Kanapoi and Shungura (Hooijer and Maglio, 1974) discussed by Eisenmann (1976; 1977; 1980; 1985) or by Churcher and Richardson (1978). The *H. sitifense* tooth bearing an ectostylid figured by Thomas (1884, pl.II; fig.4) was reattribu-

Table VIII- Lower molars measurements of *Hippotragini* from Kara Borni locality.
Mensurations des molaires inférieures de l'Hippotragini de Kara Borni.

	Length at the collet	Occlusal length	Breadth at the collet	Occlusal breadth	Heigth	L. goat fold	Heigth m3's blade
m2	18	19.5	13	11	16.5	10	
m3	28	26.5	12	10.5	22	09	12.5

ted to *H.libycum* (Pomel, 1897; Arambourg, 1956) due to the presence of this accessory used as a key to separate the two species. On the studied material, ectostylid is present on only the third and the fourth premolar of both lacteal and permanent teeth: on AeBey dp3-dp4 and on the permanent left p3-p4 from Chaâbet el Maatgna (Joly and Joleaud). When it occurs, ectostylid is strongly reduced, deeply inserted and embedded with cementum. It is interesting to note that it's rather the same for the Miocene *H. africanum* known to be without ectostylids which shows reduced and deep ones only on the dp3. Half of the examined young mandibles without canines display ectostylids since the other 2 young mandibles where canines have appeared do not. Such a character can be correlated to age stages. The main difference observed about the *H. libycum* ectostylid is that it occurs on both milk and adult premolars and molars, and that it is much more independently developed with a clear labial position. So, the shape and the localization are more important than the absence/presence of criteria.

Of course, other characters such as more hypsondont and more robust teeth size are specific to *H.libycum*. It is well-expressed through the p4 holotype from the Brunie Quarry (Pomel, 1897: pl.I, fig. 5) which is large enough with associated caballine double-knot and ectostylid, and also through re-exanimated upper molars from the fallen specimen *H.massoesylium* from puits Karoubi, Oran (Pomel, 1897)well-ranged by Arambourg (1956) under *H. (Stylohipparion) libycum* and then under *Eurygnathohippus libycum* (Bernor *et al.,* 2010). The third metatarsal (Pomel, 1897; fig. 11) is also rather robust even if it is not easy to estimate the size on the basis of one broken single element. Our comparisons have also demonstrated that Aïn el Bey *Hipparion* shares the incisor's pattern with *H. Pomeli* but we do not know how about *H.libycum'*s pattern (or *H. sitifense* one) to state the differences, but we noticed that *H.pomeli* and *H.libycum* are very probably the same species.

It is evident that *H. sitifense* shares a lot with *Cremohipparion* aff. *mathewi* from Sahabi (Bernor and Armour Chelu, 1999; Bernor *et al.,* 2010): smallness, low crown height (under 50 mm on adult unworn cheek teeth), rather rounded and isolated protocone, developed caballine fold; however, it differs by the presence of the dp1 and of course the *H. sitifense* skull is unknown to go more in comparison and the age too. For that and while waiting to see even more clearly, we maintain the name of *H. sitifense*. On the other hand, one wonders whether the name could not be rehabilitated on the basis of the principle of anteriority.

Like others, Eisenmann (1979; 1980) has hypothesized that *H. sitifense* could be evolved from the vallesian *H.africanum* (Bouhanifia) with a decrease in size. Our plots (figs. 1A, B, C and D) confirm such a decrease compared to *C. africanum* and also to *H.primigenium* from the Menacer Tortonian-Messinian locality too. But while these two Miocene species have numerous folds on pre and post-fossettes upper cheek-teeth, the species from Aïn el Bey displays a clear reduction. Such ecological data may express more adaptation on drier Pliocene climate changes which occurred around 4-3 million years (De Menocal, 2008). In our Constantine area, Mio-Pliocene climate shift accelerated the closure of the sedimentary basin, giving way to the Aïn el Bey fluvio-lacustrine deposits and the occurrence of more advanced pattern species. But as climate shift was progressive, *H. sitifense* species which is attested since upper Miocene (Coiffait, 1992) may have overcome the chronological upper Miocene barrier.

IV.2- Associated fauna and chronological considerations

The fauna provided by these two localities has revealed the following species occurrences: *Hipparion sitifense*, *Sivatherium* sp., *Tragelaphus* cf. *gaudryi, Gazella setifensis* at Aïn el Bey locality and *Mammuthus* sp., *Hipparion* sp., *Hippotragini* sp. at Kara Borni. This fauna is undoubtedly incomplete, but the species represented at both localities occurred from the beginning of Pliocene to late Pliocene and early Pleistocene biozone (Chaïd-Saoudi, 2010). Within this assemblage, some characteristic species associations can be highlighted to evaluate the relative mammal antiquity of Aïn el Bey. They are related to *Equus* arrival which probably occurred in North Africa between 2.6 million years, date of its arrival in Europe (Alberdi and Palombo, 2013), 2.4 million years, date of its presence at Aïn Boucherit (Sahnouni *et al.,* 2018) and 2.27 million years, date of its presence in East Africa (McDougall *et al.,* 2012). The lack of *Equus* at Aïn el Bey, coupled with stratigraphic data could be significant to its more or less anteriority. At Ahl el Oughlam, *Equus* is also absent (Geraads *et al.,* 1998; 2006) but the *Hippariorine* species seems to be different (Eisenmann and Geraads, 2006). Its lack is also noted in Tunisian Pliocene localities such as Aïn Brimba and Ichkeul Lake.

Aïn el Bey's anteriority is also supported by geological history of Neogene series which reveals three discontinuities related to tectonic episodes (Mattauer, 1953; Durozoy, 1961; Coiffait,1992; Marmi *et al.,* 2018). Such breaks generated coarse deposits requiring strong currents to ensure their transport (Marmi *et al.,* 2018). The first discontinuity is intra-turolian and is underlined by a slight discordance between the clays of the basal Messinian and the fluvial sands. It is clearly seen in the nearby locality of Argoub Kamellal. The second discontinuity coincides with the base of the Pliocene, where sediments cover the lower Pliocene lacustrine limestones. The third discontinuity occurs towards the base of the lower Pleistocene (upper Villafranchian). It is marked by a level of conglomerates which surmount an eroded surface. These clues are observed at the end of Aïn el Bey, at Kara Borni and Mansourah where a travertine limestone slab lies in slight discordance on the Pliocene series. As elsewhere, these events were controlled by tectonic instability and climate change shifts which affected the entire Mediterranean area beginning with the early Messinian salinity crisis, the Pliocene Mediterranean re-flooding and Pleistocene cooling phases. In response to that north African faunal assemblages decline but progressively from Miocene mid-woodland species dominated at Menacer locality by primates and mixed brachyodonts and hypsodonts mammals (Arambourg, 1959) to Pliocene drier environment dominated by a savanna-type mammal species and arid-adapted bovids. The first data appearance of *H. sitifense* seems to be contemporary of the first tectonic discontinuity. Upper Miocene localities such as Amama 2 and Mekhencha (eastern Algeria), dated about 8 and 7.6 million years (Eisenmann, 1980; Coiffait, 1992), yielded the earliest teeth before the species dispersal (or affine *H. sitifense* forms) to the south African localities (dated between 6 and 4 million years).

It evolves throughout Pliocene at Aïn el Bey, Chaâbet el Matagna (St. Donat, Joly and Joleaud material housed at MNHN), Aïn el Hadj Baba (Thomas's material housed at MNHN), Aïn Boucherit (2.4 M.a) (Arambourg, 1970; Sahnouni *et al.,* 2018), Mascara (Arambourg, 1956; 1970; unknown age) and disappeared after the third discontinuity where it was recognized for the last time at Aïn Jourdel and Aïn Hanech

(Thomas, 1880; 1884; Arambourg, 1956). It is not really known to which species the *Hipparion* of the lower Pleistocene of Mansourah (Laplace,1956; Chaïd-Saoudi *et al.*, 2006) refers to, but what can be said is that it was attested by little lost material which contrasts with rather more abundant remains from Aïn el Bey.

V- CONCLUSION

The described material has highlighted the presence of several taxa that enrich our data on large mammals. Some of them are common to the Pliocene and Plio-Pleistocene stages and expressed the non-abrupt nature of north African climate shift and the low impact on mega-mammal renewal despite effective local tectonic discontinuities. The *Hipparionine* form present at Aïn el Bey locality is a small one and seems to be midway species reminiscent of *H. sitifense* but displaying a variability of ecological adapted modern characters. Its affinities with others cannot really be discussed here due to the lack of skull and relevant metapodial data but many bones currently under restoration will soon be put to contribution.

The base of the Aïn el Bey Sequence referred to the Pliocene (or at most its posterior limit) can be considered as a biostratigraphic reference at a local scale and the whole Sequence including Kara Borni deposits as a member documenting two local algerian Neogene major phases.

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Appendix

Appendix - Three-toed equids from Algerian localities (summarized data).

Equidés à trois doigts des régions algériennes (données résumées).

First attributed taxon	Synonymies	Cranial properties	Cheek teeth	Post-cranial bones traits	Localities	Lithology	Associated fauna	Age	Main references	Collections
Hippotherium africanum, Arambourg, 1959	*Cormohipparion africanum,* Woodburne and bernor, 1980 *Hippotherium africanum,* Bernor *et al.,* 1996 *H.primigenium,* Forsten, 1968	Long POF placed above P2, posteriorly pocketed, deep with anterior rim. Wide POB.	Maximum crown heigt 60 mm, low plication of the upper cheek teeth, lack of ectostylids on the lower cheek teeth	Gracile limb bones, modest metapodial length, slender, well-developped at the midshaft	Bouhanifia (Oued el Hammam) Camps Bertaux (Melka el Ouidane) Feid el Atteuch	Marls	*Dinocrocuta algeriensis Dicerorhinus* sp. Cf. *Nyanzachoerus* *Paleotragus germaini* *Samotherium Damalavus Gazella pregaudryi Orycteropus mauritanicus Progonomys cathalai*	Vallesian 10 m.y Tortonian	Ennouchi and Jeannette, 1954 Arambourg, 1959, 1956 Forsten, 1968 Chabbar Ameur *et al.,* 1976 Eisenman, 1977 Churcher and Richardson, 1978 Woodburne and Bernor 1980 Bernor, *et al.,* 1996	MNHN Paris
H.africanum, Arambourg, 1959	*H.primigenium* Von Meyer, 1827	One FPO deep, large preorbital bar (BPO), Shallow naso-incisal notch (ENI). conventional basi-cranials proportions.	Large upper teeth. Low degree of hypsodontia Upper teeth oval protocone, strong wrinkling of the tooth enamel, lower teeth hipparionian. P2 without ectostylide at Menacer	The bones members more or less robust.	Menacer Oued Mya	Lignites Lacustrine limestones	*Macaca* sp. *Colobus flandrini Z.turicensis* *S.*cf.*Nyanzachoerus* *I.arctoides Paleotragus germaini Tragocerus Cephalophus Hystrix* sp. *Myacyon dojambir Aceratherium* sp. *Proboscidien indet Paleotragus germaini*	Vallasian Turolian	Arambourg, 1959 Eisenmann,1977 Thomas and Petter,1986 Sudre and Hartenberger, 1992	MNHN Paris ONIG Algiers

First attributed taxon	Synonymies	Cranial properties	Cheek teeth	Post-cranial bones traits	Localities	Lithology	Associated fauna	Age	Main references	Collections
Hipparion gracile, Thomas,1884	*H.gracile* Thomas,1884 *H.sitifense*, Pomel, 1897 *Cremohipparion* aff. *matthewi*, Bernor *et al.*, 1999, *Eurygnathohippus feibeli*, Bernor *et al.*, 2020	Unknown	Upper teeth: -small; variable Protocone; short to moderate hypsodonty; reduced folds fossettes, presence of caballine fold; isolated hypocone, M3 subsquared. Lower teeth : hipparionine double-boucle; ectostylid absent	Thin limb bones; important lateral metapodes	St-Arnaud (Aïn Boucherit) Aïn el Hadj Baba, Aïn el Bey, Mascara, Amama 2, Mekhencha, Chabet el Matagna (St Donat)	Lacustrine limestones Marls	*Hippopotamusamphibius, Kolpochoerus phacochoroides, Sivatherium* sp. *Tragelaphus gaudryi, Gazella setifensis*	Upper Pliocene Lower Pliocene Upper Miocene	Thomas, 1884; Pomel, 1897; Arambourg, 1956; Eisenmann, 1977 -This paper	MGFC Algiers MNHN Paris Univ. Constantine
H.libycum, Pomel, 1897	*Eurygnathohippus libycum* Woodburne and Bernor, 1980 *Stylohipparion libycum*, Arambourg, 1956 *Hipparion massoesylium* Pomel, 1897. *Hipparion ambiguum* Pomel, 1897. *Hipparion steytleri* Van Hoepen, 1930. *Stylohipparion hipkini* Van Hoepen, 1932. *Libyhipparion ethiopicum* Joleaud, 1933. *Equus (Hippotigris)* sp. Joleaud, 1933.	Large size. FPO absent. ENI short; Muzzle long. and narrow. Basal-cranial proportions caballine type.	Arcade incisor rounded. I3 developed and displaying grooves on the labial side. Protocon ovale; tooth enamel is slightly wrinkled Lower teeth with a double caballoid notch and developed ectostylide.		Carrière Brunie, St. Eugène Karoubi Gambetta Aïn Jourdel Kara Borni Beni Foudda Mansourah (?)	Lacustrine limestones Lignites Marls	*Theropithecus Ursus* sp. *Anancus osiris, Mammuthus africanavus, M. moghrebiensis, Equus numidicus, K.phacochoroides K.heseloni Cannochaetes tournoueri Tragelaphus gaudryi Gazella pomeli Parandidorcas*	Plio-Pleistocene	Pomel, 1897 Arambourg, 1970 Bernor and Bernor Chelu, 1999 a and b	MGFC Algiers