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A YABROUDIAN EQUID SKULL AND UPPER CHEEK TEETH FROM THE SITE OF HUMMAL (EL KOWM, SYRIA)

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Introduction

This paper deals with Equid remains from an archaeological site in Syria, in particular from Yabroudian layers relatively dating between 350 000 and 250 000 years BP. The site of Hummal (El Kowm, Central Syria) yielded very rich archaeological and paleontological assemblages, indicating human activities at the site during the Middle Pleistocene (Le Tensorer *et al.* 2011). The fauna, coming from different levels, comprises Camelids, Equids and Bovids (especially Gazelle, and the absence of Aurochs and Antelopes). An Equid skull with upper cheek teeth are described. Particular attention is paid to dental enamel fold morphology and criteria are established for identifying to which species these remains belong.

The fauna of this site is dominated by steppe and desert species which are part of a faunal type called Saharo-sindian, studied for some years by Dr. P. Schmid (Schmid 2006, 2007, 2008). We find remains of Bovids; principally Gazelles (the absence of Aurochs and Antelopes should be noted), Camelids and Equids. Those Camelids are represented principally by two species, the dromedary (*Camelus dromadarius*) and a huge species (*Camelus nv. sp.*) unknown in the region. (Schmid 2007). The Equids could be distinguished by a small size (*E. hemionus*) (Schmid 2006). During the excavation of 2006, an almost complete skull of a very small size of Equid (inventory number E-6276) (figs. 1 and 2), a mandible and a metapodium of Hemione have been found in the Yabroudian layer 12. The main purpose of this paper is to study the skull and the upper cheek teeth (premolars and molars), to determine this specie of Equids which seem to have appeared for the first time in the region of El Kowm during the Yabroudian epoch. The conservation of this skull was undertaken in the laboratory of Tell Arida (El Kowm), by Dr. Peter Schmid (University of Zürich-Irchel, Switzerland), who conducts the anthropological and paleontological study of the site of Hummal. A cast of the skull had been manufacutred by Ms. Margrit Peltier, (Institute of Anthropology - University of Zürich-Irchel, Switzerland), to facilitate transportation.

The study of this skull has dual interests, first, it is situated in an important and palaeontologically little known period of the middle Pleistocene (the transition from the lower to the middle Paleolithic; relatively dated to 350 000 BP), second, it is the only discovered intact skull from this region. The detailed description of this skull will, therefore, serve as reference for the Near East and a contribution to the knowledge of the Pleistocene Equids of the Near East, whose Phylogeny is still unclear.

Material

The skull and the dental series of the fossil and recent Equids that we have personally examined to perform the paleontological study of the skull of Hummal came from the Naturhistorisches Museum Basel (Switzerland) and the Muséum National d'Histoire Naturelle (Paris, France), i.e. *Equus asinus* Linnaeus, 1758, No. C.III.50; *Equus asinus* Linnaeus, 1758, No. C.3271; *Equus asinus somaliensis* Noach, No. C.4597; *Equus asinus* Linnaeus, 1758 No. C.2061 from Naturhistorisches Museum Basel and *Equus hemionus hemippus*, No. A-65 from Muséum National d'Histoire Naturelle. In addition, the published descriptions and measurements of the different studies by V. Eisenmann (Eisenmann 1980, 1986, 1999, 2000).

Taphonomy

The layer 12 where the skull was found had two phases of formation. At the bottom, there is a layer of aeolian carbonate-silt, formed by precipitation of carbonate by algae and microorganisms in the water of the spring. This silt was covered by a layer of freshwater carbonate, which contains many shells of molluscs, ostracods and remains of algae (oogonia and stems of Characeae). This layer formed during a wet phase with a high water table in the local spring. On top of these limnic carbonates there is a travertine that was been partly eroded after its deposition, laying down detritic sediments in a palustrine environment in this part of the excavation. At the end of this cycle, drier conditions prevailed and aeolian sands were blown in (layer 11). In the sequence of layer 12 many calcified roots of plants that grew on the surface of the layer 11 have been found (Ismail-Meyer 2001 and personal communication).

We can say that the skull, after the death of the animal, was deposited at the bottom of a shallow pond. With time, the

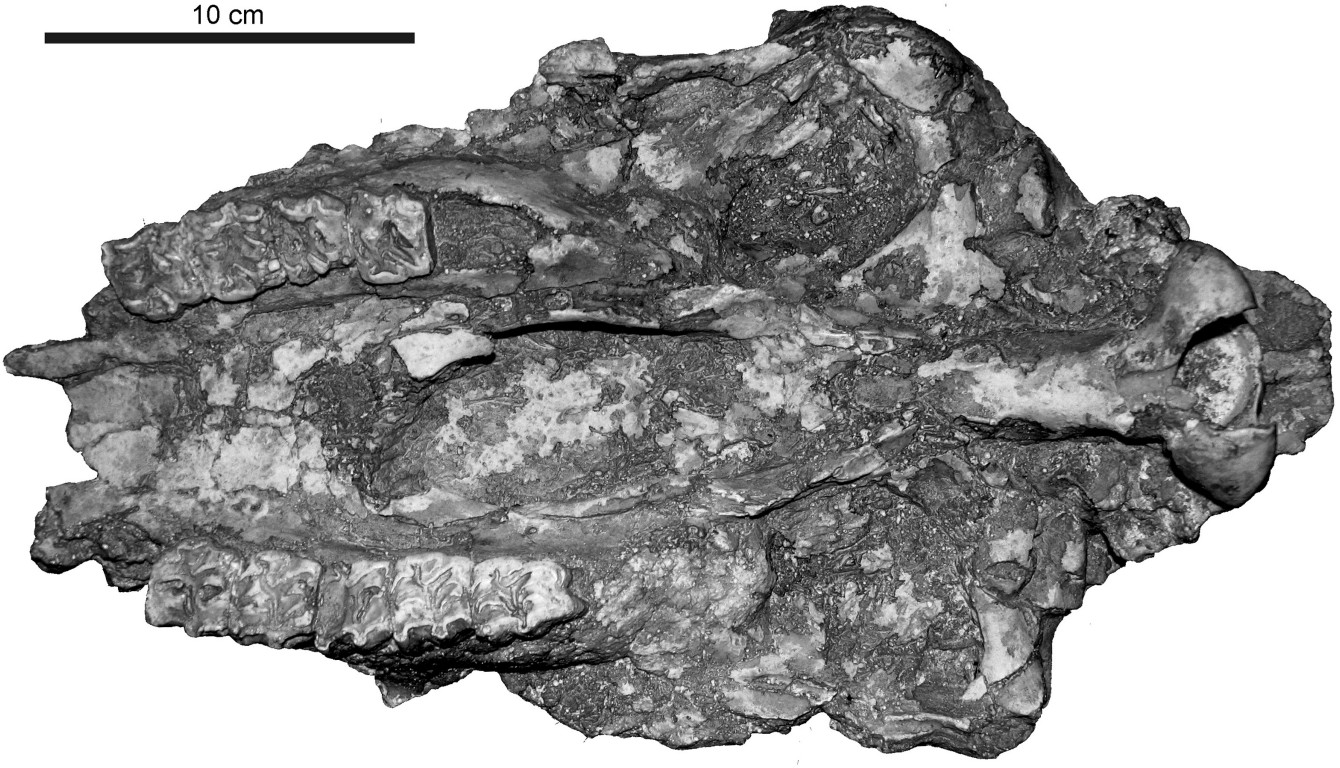

Figure 1 - View of the palate and underside of the Hummal Equid after full restoration.

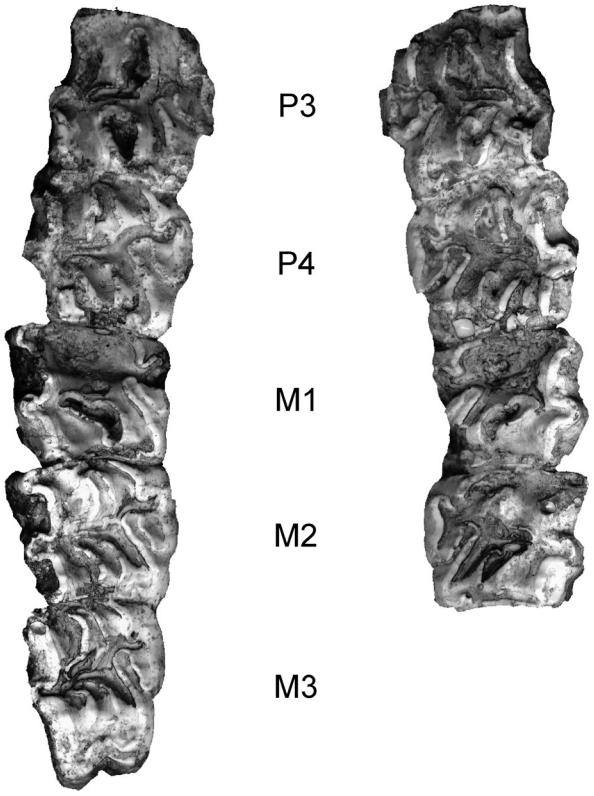

Figure 2 - Teeth rows of the Hummal Equid shown in actual size.

carbonates have covered it in a quiet environment permitting perfect preservation. The weight of the sediments affected the skull and flatted the fossil to a thickness of a few centimetres.

Methods

The measurement systems used in this paper are those of A. Von Den Driesch (Driesch 1976) and of V. Eisemann (Eisenmann 1986). Further measurements of the enamel folds of each tooth have been taken according to the method of P. Turnbull (Turnbull 1986) (fig. 3) The protocone index (the length of the protocone* 100/ the occlusal length of the tooth) was calculated according to V. Eisenmann (Eisenmann 1986) (tab.1). Similar measurements have been made on the comparative materials.

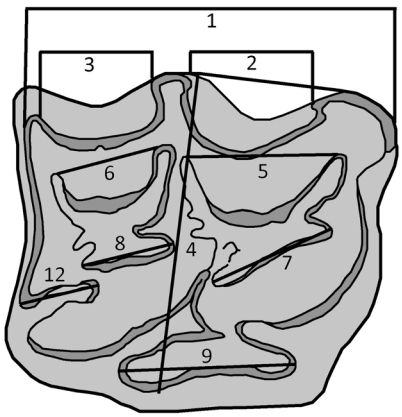

Figure 3 - Schematic drawing of upper cheek tooth of Hemionus locating the measurements taken for this study (after Turnbull).

measures	P3		P4		M1		M2		M3	
	dext	sin	dext	sin	dext	sin	dext	sin	dext	sin
Lo	22.73	23.55	20.51	21.78	17.78	17.55	19.20	18.31	23.60	--
lo	22.94	22.63	22.88	23.40	21.76	21.30	22.06	22.23	19.56	--
1	23.43	--	20.00	--	16.93	--	17.64	--	22.15	--
2	4.99	--	--	--	6.24	--	5.54	--	7.05	--
3	6.46	--	6.46	--	--	--	4.32	--	8.38	--
4	22.61	22.27	27.18	22.89	21.78	--	20.46	21.29	18.61	--
5	9.77	--	9.28	--	--	--	6.46	--	7.27	--
6	--	--	7.23	--	8.69	--	6.14	--	4.97	--
7	--	--	4.86	--	--	--	--	--	6.96	--
8	--	--	6.37	--	4.50	--	6.16	--	5.22	--
9	7.87	7.48	8.69	8.57	7.86	--	9.06	9.27	8.78	--
12	3.01	3.05	2.33	--	1.99	--	2.46	2.34	--	--
LOM	4.72	--	--	4.39	3.78	3.80	4.08	4.27	3.32	--
IP	34.62	31.76	42.36	39.34	44.20	--	47.18	50.62	37.20	--

23	60.88
48	107.8
29	64.9
30	29.9

Table 1 - Different dental and cranial neasurements in mm of the skull Hummal E 6276. L: occusial length, lo: occusal width, LOM: mesostyle length, IP: protocone index, 23: molar length, 29: width of the occipital condyle, 30: breath of the foramen magnum, 48: greatest palatal width.

Descriptive study of the skull and the upper cheek teeth

Skull

The skull of this Equid belongs to a rather aged individual, having quite worn molars. The incisors, canines and the left P^2 and P^3 are not preserved. Due to the sediment pressure the skull is highly compressed, so many characteristics are very difficult to observe. The measurements taken on each of the two upper cheek teeth, right and left, show small differences. Is this due to individual variation (Equids have a strong inter- and intraspecific variation) or to the deformation of the skull due to the weight of the sediments? S. Payne (1991) mentions that "*the pattern of enamel folding at the occlusal surface changes considerably as the tooth is worn. It is important, therefore, to consider occlusal enamel measurements and morphology in relation to the varying extent to which different teeth are worn. It has also long been recognized that the pattern of enamel folding differs in different teeth in the same tooth raw (especially between premolars and molars)*". The Equid skull found at the site of Hummal is currently a unique specimen, so its paleontological importance is considerable.

Determination of Sex and Age

Determination of the sex

In many species of mammals, some parts of the skeleton differ morphologically between the two sexes. In Equids, the jaws of males in general present big permanent canines, while they are missing or very small in the females (Klein & Cruz-Urbid 1984).

V. Eisenmann (Eisenmann 1980) mentions that in *Equus caballus*, the canines exist, in principle, only in the males. The females sometimes have two canines on the both upper and lower jaws but these teeth are in general rudimentary, in the other cases, there are females having well-developed canines in only one of the two jaws, most often on the lower jaws (Eisenmann 1980). On the skull of the Equid of Hummal, the part with the canine is destroyed, so we can not know if the canine existed or not. Indeed, it is impossible to determine the sex of the specimen of Hummal.

Determination of the age

There are several methods for determining the age of an animal from its teeth (cementochronology, the wear- teeth). There are some drawbacks of the first method. Theoretically, the main difficulty is that the causes of annual formation are not fully understood. The seasonal differences in alimentation are generally considered as responsible (Klein & Cruz-Urbid 1984). It also requires thin sections for the microscopic study of the lines of arresting growth, which are often difficult to read and requires a good practice (Chaix & Méniel 1996). Furthermore, depending on the conditions of fossilization, the cement can be poorly preserved, preventing a good observation. On the Hum-

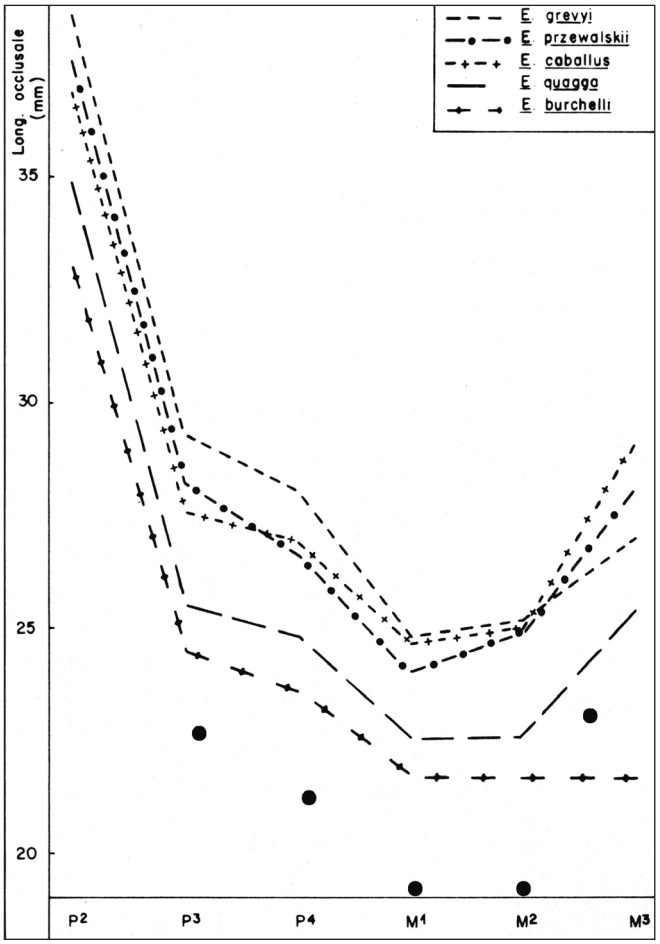

Figure 4 - Mean occlusal lengths in mm of the upper cheek teeth of current Equids. The black dots indicate the measurements of the Hummal Equid (modified after Eisenmann 1980).

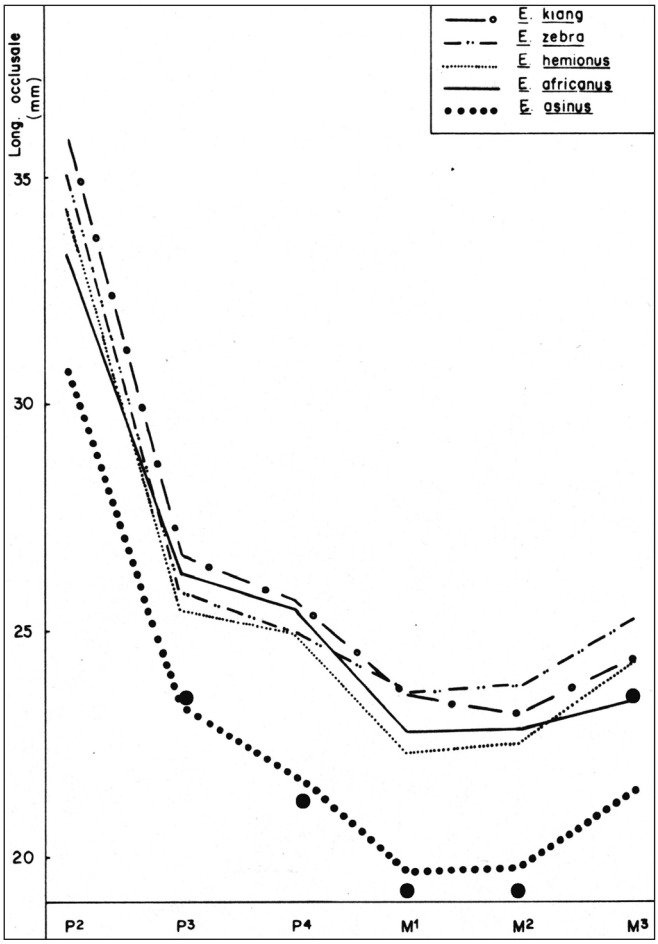

Figure 5 - Mean occlusal lengths in mm of the upper cheek teeth of asses, half-asses and zebras. The black dots indicate the measurements of the Hummal Equid (modified after Eisenmann 1980).

mal fossil this method cannot be performed, as it is destructive. Morover this method can not be applied to the specimen of Hummal, as access to the original material is restricted and work has to be done basically on a cast.

The second method has however an important drawback. The abrasion depends very strongly on the type of alimentation and the environment of the animal (Klein & Cruz-Urbid 1984; Davis 1987; Chaix & Méniel 1987, 1996). Nevertheless, this method is suitable for an approximate age estimation of Equids. It was developed by C. A. Spinage, and Klein who applied it to collections of Zebra and other animals in many sites of South Africa (Davis 1987 and literature therein). With this method, the height of the crown of a tooth is measured

The obtained data of the Hummal fossil can be compared to the curves of reference material of known age (Spinage 1972; Davis 1987). By comparing the obtained data on the specimen of Hummal with those shown in the work of Spinage (Spinage 1972), we can estimate the age of this specimen between 12-18 years. We have to note that this is not a definitive age because the study was made on a cast, and the different type of alimentation between the region of El Kowm and that in South Africa should be considered. In future, we should return to work on original material, to have a better estimate of the age of the Equid of Hummal.

Upper cheek teeth morphology

The third premolar P^3

The parastyle is well marked and has more or less external oblique flattening on its extern edge. The mesostyle is prominent, its contour is generally rounded. The metastyle is well marked. The hypocone reaches the metastyle level on the posterior surface of the tooth. The external walls of the paracone and metacone are slightly convex. The protocone is short, the general shape is almost globular, the mesial lobe is very short. The fold Caballine is not very visible or almost absent. The postprotoconic valley is wide, while the preprotoconic valley is small.

The fourth premolar P4

The parastyle is well marked and has more or less external oblique flattening on its extern edge. The mesostyle is prominent, it has a rectangular shape. The metastyle is not very visible. The hypocone reaches the metastyle level of the posterior surface of the tooth. The external walls of the paracone and metacone are flat or slightly concave. The protocone is short but longer than that of P^3 and more elongated, slightly developed in front, the lower wall is convex. The fold Caballine is not very visible or almost absent. The postprotoconic valley is wide, while the preprotoconic valley is small.

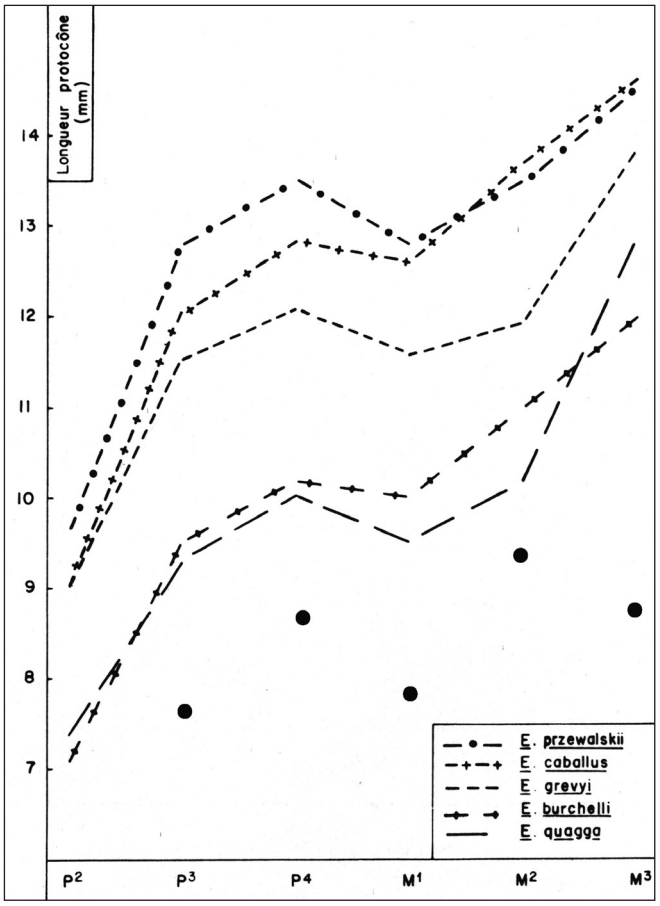

Figure 6 - Mean protocone lengths in mm of the upper cheek teeth of current Equids. The black dots indicate the measurements of the Hummal Equid (modified after Eisenmann 1980).

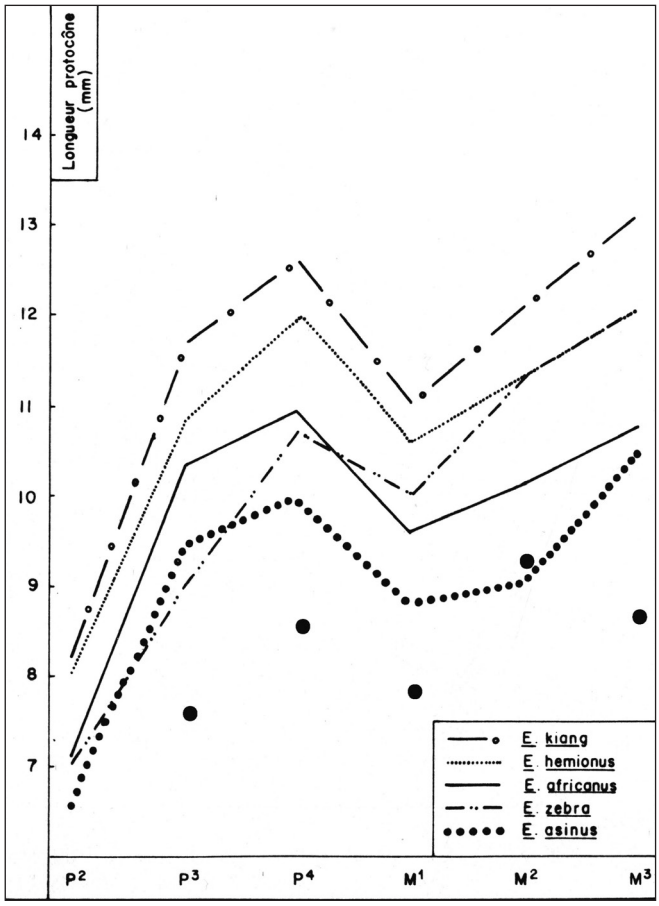

Figure 7 - Mean protocone lengths in mm of the upper cheek teeth of asses, half-asses and zebras. Black dots indicate the measurements of the Hummal Equid (modified after Eisenmann 1980).

The first molar M¹

The parastyle is stronger than on P³ and P4, it has a semicircular shape. The mesostyle is rounded and smaller than on P³ and P4. The metastyle is a bit visible. The hypocone reaches the metastyle level of the posterior surface of the tooth. The external walls of the metacone and paracone are flat or slightly concave as on all other teeth. The paracone is destroyed on both series. The metacone is deep and elongated upward. The protocone is slightly smaller than that on P4 and less elongated. The fold Caballine is absent. The postprotoconic valley is narrower than that on P4, while the preprotoconic valley is smaller than on P4.

The second molar M²

The characteristics of the M² are very close to those of the M¹. The parastyle is not clearly visible. The hypocone reaches the metastyle level of the posterior surface of the tooth. The protocone is more elongated and larger than on M¹, more developed in front. The fold Caballine is absent. The postprotoconic valley is wider than on M¹ and the preprotoconic valley is larger as that on M¹.

The third molar M³

The characters of the M³ are very close to those of M². The styles in general are weaker than the M². The parastyle is not clearly visible. The metastyle is more advanced than the hypocone on the posterior surface of the tooth. The protocone is elongated as on the M², particularly, on the distal face, the lower wall is more flattened than on the M². The fold Caballine is absent. The postprotoconic valley is wider than on M¹, and the preprotoconic valley is large as on M².

Upper cheek teeth metrics

The fossettes in general are rarely folded. On the M², a contact between the two fossettes is marked. The length of P³ is greater than P4, while their widths are almost equal. The length and width of the M¹ are smaller than those of the P4 and M². The M¹ is particularly very small (tab. 1, figs. 4 and 5), it has an almost trapezoid shape, its protocone is very small. The length of the M³ is greater than the M², but its width is smaller. In fact, the M³ (tab. 1, figs. 4 and 5) is the longest and narrowest of all the teeth of the skull of Hummal, it forms a trapezoid, its protocone is too elongated.

The lengths of the protocone of the skull of Hummal (tab. 1, figs. 6 and 7) increase gradually from P³ to P4, then decrease on the M¹. The length of the M¹ is smaller than on the P4 as in *E. asinus* (Bonifay, 1991). The length of the protocone increases on M² where it is the longest, then decreases again on the M³. The protocone index (tab. 1, fig. 8 and 9) of the M¹ in comparison with the P4 is increased on the skull of Hummal as in *E. grevyi*,

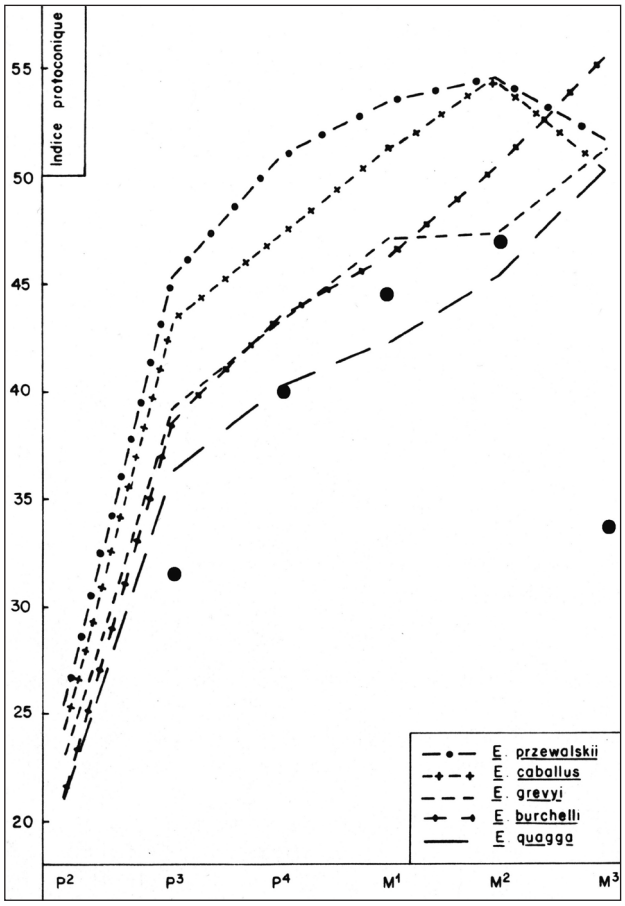

Figure 8 - Mean protocone lengths in mm of the upper cheek teeth of current Equids. The black dots indicate the measurements of the Hummal Equid (modified after Eisenmann 1980).

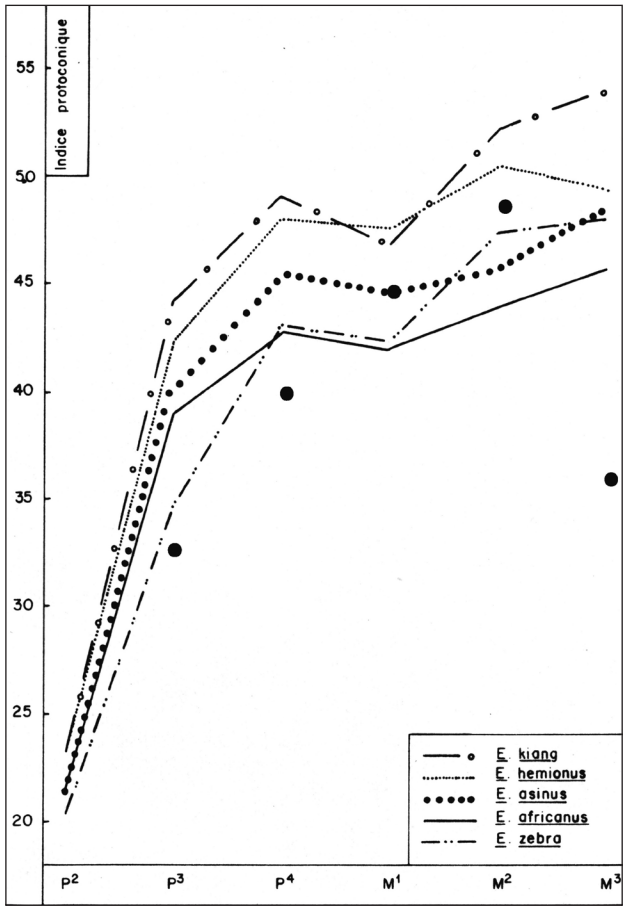

Figure 9 - Mean protocone lengths in mm of the upper cheek teeth of asses, half-asses and zebras. Black dots indicate the measurements of the Hummal Equid (modified after Eisenmann 1980).

E. burchelli, *E. quagga*, the *E. caballus*, and in the fossil Equids of Lunel Viel (France), while it is smaller in Hemiones, Asses, and Zebras (Bonifay 1991).

Comparative study

The comparative study of the skull from Hummal and other Equids covers several cranial and dental characters. The premolars and molars are much more reliable for the identification of species. Specifically, the fold caballine, the buccal region, and the protocone are distinctive characters. We can add the hypocone and the metastyle for the upper molars. Therefore, we can accept the presence or absence of a well developed fold caballine as a good feature to distinguish the upper cheek teeth of Horses from those of Hemiones and Asses. All these indexes permit the creation of graphs that show the evolution of the protocone index on the dental series for each species and the respective position of the Hummal fossil.

These results will be principally compared to those established by V. Eisenmann (1980) for the different actual Equids (figs 4-9). Thus, it will be possible to specify to which species the skull of Hummal belongs. According to V. Eisenmann (Eisenmann 1980), it is possible to establish a protocone formula to describe the form. Class 1 corresponds to protocone index between 15 and 20, class 2 corresponds to protocone index between 20 and 25, Class 3 corresponds to protocone index between 25 and 30, Class 4 corresponds to protocone index between 30 and 35, Class 5 corresponds to protocone index between 35 and 40 etc. (Eisenmann 1980).

According to V. Eisenmann (Eisenmann 1980) the protocone formula for the different Equids is:
234,456 in *E. burchelli*
234,345 in *E. quagga*
234,334 in *E. africanus*
245,344 in *E. asinus*
356,555 in *E. przewalskii*
245,555 in *E. caballus*
245,454 in *E. hemionus*

The protocone formula of *E. hemionus hemippus* is 667.787 and that of Hummal is - 46,675 as the P^2 is missing.

Overall, it seems that there are two groups of Equids that differ by the values of their protocone index. The protocone indexes are rather low in Zebrines, Asiniens and the forms of Plio-Pleistocene of Europe and Africa, the protocone indexes are high in Caballines, Hemiones and the forms of Pliocene and Plio-pleistocenes of Asia and North America (Eisenmann 1980).

Based on the morphology of the upper cheek teeth and the protocone indexes, the Equid of Hummal has clearly Hemionian affinities, and it is to this group it should belong. The small

Equid of Hummal is comparable to the Hemiones described by V. Eisenmann and others cited above. Its teeth are very small in size and can be attributed to the Hemippe of Syria (*E. hemionus hemippus*), described in 1855 by Isidore Geoffroy St. Hilaire (Ducos 1970, 1986). In the region of El Kowm (Central Syria), and more particularly at the site of Umm el Tlel, next to Hummal, C. Griggo (Griggo 1998, 2000) had already reported the presence of this subspecies in the Mousterian levels of the Middle Paleolithic, under the name of *E. hemionus syriacus*.

Relationship between the protocone index of M^1M^2 and P^3P4

Among the actual species, the protocone indexes of M^1M^2/P^3P4 permit a good distinction between the Asinids and Hemiones (105 to 108) on one hand, and on the other hand, the Zebrina and Caballins (112 to 118) (Eisenmann 1980). This observation could indicate a gradual increase of the index. Assuming this hypothesis, we note that the Equid of Hummal (112) may have given birth to *E.hemionus syriacus* of the site of Umm el Tlel (117) and to the *E. hemionus hemippus* (119). Based on the relationship between the protocone index of the M^1/M^2 and $P^3/P4$, the *Equus hemionus hemippus* of Hummal is more archaic than the *Equus hemionus syriacus* of Umm el Tlel and the *Equus hemionus hemippus* from the Muséum d'Histoire Naturelle, Paris.

Discussion

Based on the dental and cranial morphology and measurements, it seems that the Hummal Equid closely resembles *E. hemionus hemippus* described in 1855 by Isidore Geoffroy St. Hilaire. It will be helpful for the future to study more Equid remains (cranial and postcranial), to have a better idea about the different species of Equids in the Hummal and in the region of El Kowm, particularly about *E. hemionus hemmipus* whose systematic position is still unclear. While some scholars think that it belongs to the Asses, M. George and H. Milne-Edwards believe that this is not a new species but a variety from *E. hemionus*, and H. Milne-Edwards goes that far to suggest that the Hemippe of Syria is a result of hybridization of horses and Hemiones, which seem themselves an intermediate between horses and asses, but closer to asses than to horses (Eisenmann and Mashkour, 2000 and literature therein). It seems reasonable to agree with George's view and consider the Hemippe of Syria as a subspecies of *Equus hemionus* (Eisenmann & Tranier 1985).

Gromova (1955) mentions that the South-West of Asia was the meeting place of three lines of Equids: Northern (current Horses), South European (Otranto Asses) and East Asian (Half-asses). Further studies will provide a clear idea about the evolution of the Equids in this region, to which the site of Hummal and the region of El Kowm belong.

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