

A new species of *Adelpharctos* (Mammalia, Carnivora, Ursidae) from the late Oligocene of the “Phosphorites du Quercy” (France)

Una nueva especie de Adelpharctos (Mammalia, Carnivora, Ursidae) del Oligoceno Superior de las “Fosforitas de Quercy” (Francia)

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ABSTRACT

The genus *Adelpharctos* was known until now through the species *A. mirus* by a unique mandible (p2-m2) from the old collections of the Quercy whose geological age was unknown. New material coming from the locality of Pech-du-Fraysse completes our knowledge of the genus particularly for the maxilla and upper teeth. *Adelpharctos* belongs to the sub-family Hemicyoninae in the family Ursidae. It differs from the middle Miocene hemicyonines which have more massive molars and from the group *Cephalogale-Phoberogale* by some morphological characters. It seems to be a branch coming from the ancestral stem group of the sub-family.

Keywords: Late Oligocene, France, Quercy, Carnivora, Ursidae, Hemicyoninae.

RESUMEN

El género *Adelpharctos* era solo conocido por una especie *A. mirus* representada por una única mandibular (p2-m2) procedente de las colecciones antiguas del Quercy, cuya edad geológica es desconocida. Nuevo material procedente de la localidad de Pech-du-Fraysse completa nuestro conocimiento sobre el género, en particular para el maxilar y la dentición superior. *Adelpharctos* pertenece a la subfamilia Hemicyoninae, familia Ursidae. El género difiere de los hemicioninos del Mioceno medio, que tienen dentición más robusta, y de los del grupo *Cephalogale-Phoberogale* por algunos caracteres morfológicos. Se interpreta como perteneciente a una línea procedente del grupo ancestral primitivo de la subfamilia Hemicyoninae.

Palabras clave: Oligoceno superior, Francia, Quercy, Carnivora, Ursidae, Hemicyonidae.

Introduction

Although they were used from the last third of the 19th century to the beginning of the 20th to extract phosphate used as fertilizer for agricultural needs, the fissure, cave and chasm fillings of the “Phosphorites du Quercy” are essentially well known because the myriads of fossils which were mixed with the sediments. Among these fossils, thousands of vertebrate bones, particularly mammal bones, were unearthed and stored in number of

museums through the whole world. The sediments and the fossils were provided by many quarries dispersed over a large surface of hundreds of km². Several palaeontological studies of different mammals (Gervais 1872 a & b; Filhol 1872 a & b, 1874, 1876, 1877, 1880, 1882; Gaillard 1908; Schlosser 1888, 1889, 1891) led to the conclusion that the deposits may represent a large range of time from the late Eocene to late Oligocene but that, except in rare cases, the fossils were mixed in every locality. Other studies especially focused on Carnivora of

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the old collections (Teilhard 1915; Piveteau 1931, 1942/1943, 1962; Bonis 1966, 1971, 1981; Ginsburg 1966, 1979; Lange-Badré 1969, 1970; Peigné 2000, 2001, 2003; Peigné & Bonis 1999; Wolsan & Lange-Badré 1996) could not clear the problem of the fossil dating as well. In fact, the names sometimes labelled on the fossils (Mouillac, Lamandine, Saint Antonin, Prajoux, Mémerlin...) correspond to quite large areas containing many fillings whose geological ages may be very different. Thus the material of the old collections which was listed in a catalogue (Sigé *et al.* 1979) was a taxonomic melting pot without any indication of the chronology despite some very complete and nice specimens. Moreover, many people think that the works were stopped in the Quercy because all the fissures were empty without any phosphorite or fossil.

Nevertheless, a new phase of researches began before the second world war, when Gèze (1938 a, 1938 b) demonstrated that each of two fissure fillings quite close contained a homogeneous fauna. During the second half of the sixties, a scientific team coming from the universities of Montpellier II (USTL), Paris 6 (UPMC), Lyon 1 (Claude Bernard), the Muséum national d'Histoire naturelle Paris and later the University of Poitiers carried out several field campaigns in the Quercy which gave rise to a large number of general publications on the Quercy phosphorites faunas (Bonis *et al.* 1973; Bonis *et al.* 1974; Bonis *et al.* 1977; Crochet *et al.* 1975; Crochet *et al.* 1981; Hartenberger *et al.* 1974; Gèze *et al.* 1978; Remy *et al.* 1987) and many other ones showed that every fissure had an original fauna and of which two of them may precise the global geological age of the Phosphorites du Quercy which are now dated from the middle Eocene (Astruc *et al.* 2000) to the early Miocene (Sigé *et al.* 1991). In every site, the fossiliferous levels are quite shallow and deposited during a relatively short time. The amount of variation in every species is similar to that of extant species (Vianey-Liaud & Legendre 1986). Because the large number of sites and the possibilities of evolutionary studies, the Quercy phosphorites constitute a true open air laboratory of vertebrate evolution (Bonis *et al.* 1977).

There are several fossil bearing localities which are used as level markers in the frame of the continental Paleogene biochronology establishing a scale founded on the evolution of mammalian faunas as are the American "Ages of mammals". Some of the mammalian level markers are Quercy phosphorites localities (see Biochrom 1997).

Material and methods

The studied material comes from the locality of Pech-du-Fraysse (Saint Projet, Tarn-et-Garonne, France) in the military camp of Caylus (Crochet 1971). It comprises a right hemimandible with the alveolus of i3 and c, p1, broken p2, p3-m2, alveolus of m3 and a right maxilla with an alveolus of P1 and P2-M2. The two specimens have been found close together with a similar wear pattern and they clearly belong to the same individual. The fauna contains many species of small and large vertebrates which allow a precise biochronological dating and thus the locality is the reference biochronological level MP 28 (see Remy *et al.* Biochrom 97 p. 792-793) about 25-26 Ma old.

The order Carnivora is well represented in the old collections as well as in the new ones (Bonis 1974, 1976, 1978; Bonis & Cirot 1995; Cirot & Bonis 1992, 1993; Peigné & Bonis 1999, 2003) and the genus *Adelpharctos* as well as the type-species *A. mirus* were described from a well preserved but unique mandible of the old collections (Bonis 1971). The new material completes our knowledge on the anatomy and biostratigraphic position of this genus. The measurements were taken with an electronic calliper to 1/100° and given to 1/10°.

Systematics

Order Carnivora Bodwich, 1821

Family Ursidae Fischer de Waldheim, 1817

Sub-family Hemicyoninae Frick, 1926

Genus: *Adelpharctos* Bonis, 1971

Type species: *Adelpharctos mirus* Bonis, 1971

Other species: *A. ginsburgi* n.sp.

Emended diagnosis: Dental formula: 3/3 I, 1/1 C, 4/4 P, 2/3 M. Hemicyoninae with a more cutting dentition than the other genera of the sub-family, m1 shorter relative to the premolar row with a less reduced metaconid and a talonid tapering backward. P2-3 with three roots, P4 short and robust, triangular shaped M1 with a metaconule more buccal than the protocone, a hypometacrista joining the base of the metacone and with a modest linguo-distal cingulum.

Adelpharctos ginsburgi n. sp.

Holotype: right mandible with alveolus of i3, c-m2, alveolus of m3 and right maxilla with alveolus of C-P1 and P2-M2 (PFRA 34).

Locality: Pech-du-Fraysse, Lot (France)

Dating: Late Oligocene (MP 28)

Origin of the name: dedicated to my colleague the late Léonard Ginsburg for his numerous works on the carnivorans.

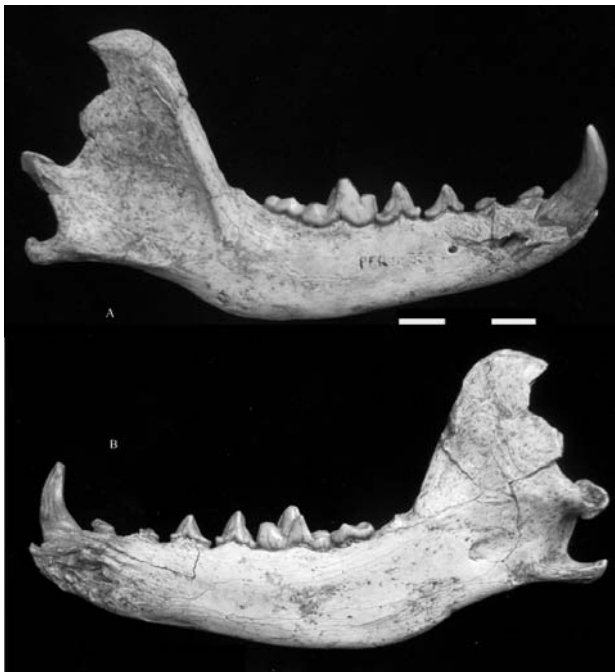
Diagnosis: *Adelpharctos* smaller than the type-species *A. mirus*, p4 slightly less robust with a minute posterior accessory cuspid, metaconid of m1 slightly less posterior, talonid basin of m1 slightly less reduced.

Description

Mandible (Fig. 1-2; Table 2): The ramus is complete except a small portion of the coronoid process. The *corpus mandibu-*

Table 1.—l = length; w = width; trL = trigonid length; trw = trigonid width; talw = talonid width

Lower teeth	cL	cw	p1L	p1w	p2L	p2w	p3L	p3w	p4L	p4w	m1L	m1trL	m1trw	m1talw	m2L	m2trw	m2talw
<i>A. mirus</i>					9,9	4,6			12,3	6,8	19,3	14,2	8	7,7	10,8	7,2	6,3
<i>A. ginsburgi</i>	9,3	6,1	5,7	3,9			9,8	3,7	10,5	5,4	17,2	12,7	7,5	7,3	9,9	6,5	5,4

Fig. 1.—*Adelpharctos ginsburgi* n. sp. Right mandible (PFRA 35); A: buccal view, B: lingual view (Scale bar = 3 cm).

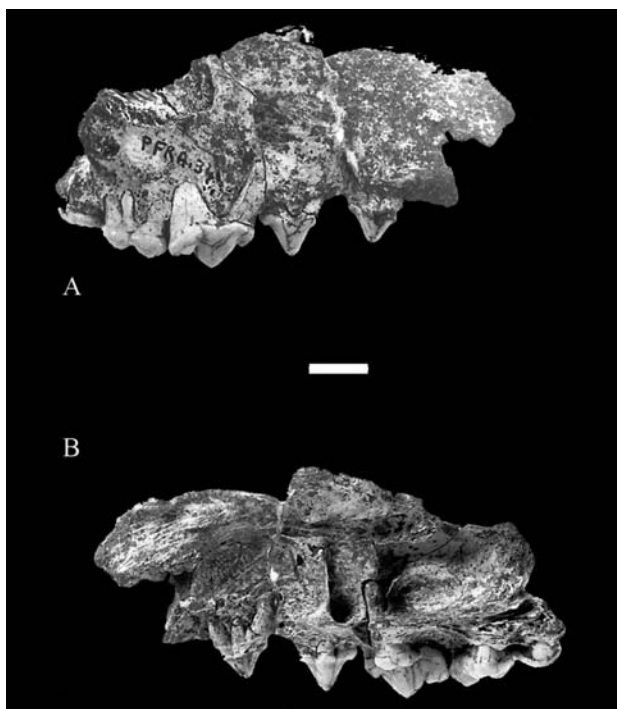
lae is slightly elongate with a quite short symphysis; there are two small mental foramina, one anterior and situated beneath the mesial root of p2, another one posterior beneath the mesial root of p3, both at midheight of the ramus. In the lingual surface, the *foramen mandibulare* is relatively small and opens 21 mm in front of the condyle. The ventral border is slightly convex under the tooth row, the deeper part being under m2, and it turns upward under the coronoid process. The latter is high with a deep masseteric fossa limited downward by a rough crest and extending to the alveolus of m3. The condyle is slightly oblique relative to the coronoid process and level with the tooth row. The angular process, long and robust is backward and downward directed; its dorsal surface is relatively wide and its posterior-most part turns upward like a hook.

Lower teeth (Fig. 1; Table 1): The incisors are lost and the remaining i3 alveolus is small and oval shaped with a vertical great axis. The canine is relatively thin and long. The buccal surface is convex but the lingual one is partially concave with, at the mesio-lingual corner, a faint ridge which extends from the tip to the basis and runs to the distal end. There is a 1 mm diastema from the canine to p1 which is one-rooted, small, elongate and narrow with an anteriorly situated main cuspid. The other premolars have two roots; p2 is partially broken off,

Fig. 2.—*Adelpharctos ginsburgi* n. sp. Right mandible (PFRA 35); occlusal view (Scale bar = 1 cm).

Table 2.—Height md = height of the mandible beneath

Height md	p1-p2	p2-p3	p3-p4	p4-m1	m1-m2
<i>A. mirus</i>		19,1	19,3	20,6	22,5
<i>A. ginsburgi</i>	16,8	17,7	18,9	20,6	23,1

Fig. 3.—*Adelpharctos ginsburgi* n. sp. Right maxilla (PFRA 36); A: buccal view, B: lingual view (Scale bar = 1 cm).

while p3 and p4 are complete; both are higher than the paraconid of m1, especially p4; the latter has a small but distinct pad at midheight. The carnassial is moderately elongate; the paraconid is low, short and oblique relative to the tooth row; the protoconid is tall and relatively short; the lingual surface of the protoconid is a vertical semi-pillar with two vertical mesial and distal strips; the metaconid, quite well developed, is clearly separated from the paraconid and slightly posteriorly situated; the talonid is short for a hemicyonine with a high, quite large and sub-conical hypoconid and a low crest surrounding the talonid basin until the distal basis of the metaconid. The trigonid of m2 is essentially composed by the protoconid and metaconid which have quite the same volume and are situated at the same level; a small anterior bump corresponds to a vestigial paraconid; the protoconid is separated by a notch from the hypoconid while an entoconid ridge runs without notch from the metaconid and joins the mesial face of the hypoconid, the talonid basin being very small and narrow. An oval alveolus indicates a slightly elongate small one-rooted m3.

Maxilla (Fig. 3): The premaxilla is absent and only the lower part of the maxilla is preserved. A large infraorbital foramen is situated just above the top of the mesio-buccal root of P4, at 10.8 mm of the lingual margin.

Fig. 4.—*Adelpharctos ginsburgi* n. sp. Right maxilla (PFRA 36); occlusal view (Scale bar = 1 cm).

Table 3.—**pcl = paracone length; msl = metastyle length; msw = metastyle width; mw = mesial width; dw = distal width**

Upper teeth	P2L	P2w	P3L	P3w	P4L	P4w	P4pcl	P4msL	P4msw	M1L	M1mew	M1dsw	M2L	M2w
<i>A. ginsburgi</i>	8,2	5,5	10,5	5,9	15,4	11,4	6,6	6	5,8	11,9	16,7	14,9	7,3	12,3

Upper teeth (Fig. 3-4; Table 3): There a large but not very deep alveolus for the root of the canine; the maxilla is preserved on 9.4 mm in front of this alveolus without any trace of an incisor alveolus; thus the diastema was larger. There is only a 1.5 mm diastema between the canine and the alveolus of a one-rooted P1. P2 is separated from P1 by less than 3 mm; it has a simple asymmetric crown, the mesial part being smaller than the distal one, without any posterior accessory cusp (pac), but with a small anterior bulging at the basis of the crown and a slightly larger distal one, and a thin crest running in the mesial and distal edges of the crown; there are three roots lined mesio-distally, the central one being shorter than the others. P3 is separated from P2 by a 5.4 mm diastema: the shape of the crown is similar to that of P2 but it is less asymmetrical with more developed bulging at the base and it is as tall as the paracone of P4; it has also three roots but the central one is more lingually situated, corresponding to a lingual bulging of the crown. The short P4 is separated from P3 by 2 mm; there is a moderate and bulbous parastyle; the sub-conical paracone is asymmetrical, the mesial part being longer than the distal one; it is followed by a short metastyle blade; the protocone is well developed but without cusp, composed by a hollow basin surrounded by a blunt cingular ridge which continues along the metastyle blade; a faint cingulum runs along the buccal side. M1 is triangular, the metacone is more lingually situated and smaller than the paracone and the mesial face is wider than the distal one, thus the buccal face is oblique; the protocone, small and low, is far from the lingual corner; the protocrista is short and vanishes when contacts the paracone, the metacrista is thin but slightly longer with a small but well distinct metaconule situated more buccally than the protocone; there is no mesial cingulum but a swelling in the disto-lingual corner; a faint cingulum is present along the buccal surface. M2 is smaller than M1 and less asymmetrical; it is oval shaped, the buccal length being slightly smaller than the lingual one; the paracone is the larger buccal cusp, the metacone being minute, both are slow and quite fused; the protocone is small with two delicate trigone crests in which it is impossible to distinguish any conule; both crests vanish at the base of the buccal cusps; there is a moderate cingulum surrounding the protocone along the lingual surface and a very faint along the buccal one.

Comparisons

There are some small differences between *Adelpharctos ginsburgi* and *A. mirus*, thus the comparisons are made from the genus *Adelpharctos* as a whole. The Amphicyonidae essentially differ from *Adelpharctos* by the presence of M3, the double-rooted upper premolars P2 and P3, the longer upper carnassial with a reduced protocone, the more trenchant m1 and more developed protoconid of m2. The overall morphology of *Adelpharctos* leads to compare to the Ursidae. *Adelpharctos* shows some features found in the Amphicyonodontidae, the probably polyphyletic stem group in which the Ursidae are rooted, like the lack of developed

pacd and particularly the shape of m2 with a metaconid as developed as or more developed than the protoconid. *Adelpharctos* is nevertheless clearly distinct from the Amphicyonodontidae by the longer m1 relative to the whole tooth row (see Teilhard 1915, p. 50). Most Ursinae have less tall premolars and more elongate molars than those of *Adelpharctos*. The oldest ursine genus *Bal-lusia* (MN 3, Lower Miocene) differs from *Adelpharctos* by, in addition to the double rooted upper P2 and P3, the less tall and less trenchant premolars, less tall m1 with a longer and flat talonid, shorter P4 and more elongate sub-quadrate M1 with a metaconule level with the protocone (Ginsburg & Morales 1998). The Pech-du-Fraysse carnivore shows more similarities with the Hemicyoninae whose dentition is less hypocarnivore than that of the Ursinae. *Zaragocyon* Ginsburg & Morales, 1995 is slightly larger (m1 = 19.8 mm) and differs from *Adelpharctos* by the upper carnassial without parastyle, shorter relative to the molars, with a more distally situated protocone, the elongated and sub-quadrate M1 whose metaconule is level to the paracone, the more developed M2 with a larger lingual cingulum; the low lower premolars, low protoconid, inflated and distally situated metaconid and larger talonid of m1; the relatively longer m2.

Phoberocyon differs by the larger size (m1 = 24.6 to 35 mm. depending on the species), the more distally situated protocone and the lack of parastyle of P4, the larger M1 and M2 with larger lingual cingulum, the less tall lower p3 and p4 with a more developed pacd, the lower protoconid, reduced metaconid and wider talonid of m1, the longer m2. The close genus *Hemicyon* differs from *Adelpharctos* by quite the same characters, as do *Plithocyon* and *Dinocyon*.

Other Hemicyoninae fit better the Pech-du-Fraysse carnivore and have been attributed to the with genera *Cephalogale* Jourdan, 1862 or *Phoberogale* Ginsburg & Morales, 1995. Representatives of this group are known from the early Oligocene (MP 21) to the early Miocene (MN 1-2). The geological oldest species are quite small (m1 = about 12 mm.) but the size increases through the time and the younger species are middle sized hemicyonines (m1 = 21 to 23 mm.) with larger m1 relative to the pre-carnassial premolars and longer m2. All these species differ by less tall pre-carnassial premolars, absence of parastyle in P4, more sub-quadrate M1 whose lingual cingulum is more anteriorly developed, absence of hypometacrista, postprotocone crista joining directly the distal cingulum with or without distinct metaconule, and generally more reduced m1 metaconid. Nevertheless *Adelpharctos*, by its overall morphology, is closer to *Cephalogale* than to another genus and belongs to a group different from the other hemicyonines which appeared in Europe in the limit early-middle Miocene (MN 3) with a more massive dentition.

Conclusions

The new material of Pech-du-Fraysse allows the description of a new species of a primitive ursid,

Adelpharctos ginsburgi n. sp.. It is smaller than *A. mirus*, type species of the genus and different by some characters (p4 slightly relatively less robust with a minute posterior accessory cuspid, metaconid of m1 slightly less posterior, talonid basin of m1 slightly less reduced). Closer relationships do exist with the genera *Cephalogale* and *Phoberogale*. The size was increasing in several lineages of *Cephalogale* during the Oligocene and early Miocene (Bonis 1973). If the same did occur in the genus *Adelpharctos*, *A. mirus* would be geologically younger than *A. ginsburgi* n.sp.

If we look for the place of *Adelpharctos*, *Cephalogale* and *Phoberogale* in the guild of Oligocene carnivorans, we see that their overall dental characteristics are quite similar to those of extant Canidae with quite large lower carnassials and close proportions between trigonid and talonid. Their size, based on m1 length, vary from those of small foxes like *Vulpes rueppeli* or *V. corsac* to that of the coyote, *Canis latrans*. As far as we know the limb skeleton of this group, "It is characterized by its cursorial adaptations, such as digitigrade posture..." (Wang & al. 2009), thus the *Adelpharctos-Cephalogale-Phoberogale* group probably occupied during the Oligocene and part of the early Miocene some ecological niches close to those of extant canids, foxes, jackals or coyotes. The high number of *Cephalogale* found in some quarries could indicate that they were living in packs of several individuals. Other contestant carnivorans could have been small amphicyonids (*Cynelos* or *Goupilictis*) which were less abundant and fully plantigrades or the primitive felid *Proailurus* whose way of hunting certainly was very different. The large amphicyonids were certainly feeding on larger preys. The favourite preys of this group could have been large theridomyid rodents, cainotheriids and primitive cervoids of the sheep-sized genera *Dremotherium* and *Bedomeryx* which are generally very abundant in the fossiliferous localities. We may notice that the disappearance of this group of carnivorans corresponds to the disappearance or rarefaction of these preys.

The fauna from the locality of Pech-du-Fraysse contains until now 8 species of Carnivora. *Adelpharctos ginsburgi*, *Cephalogale* sp., *Amphictis ambigua*, *Amphictis* cf. *nana*, "*Plesictis*" *stenogalinus*, Amphicyonidae sp., *Stenoplesictis cayluxi*, *Stenoplesictis crocheti*. Amphicyonidae are common in the European Oligocene, *Cephalogale* was present from the early Oligocene (Mas de Got MP 22) as was *Stenoplesictis cayluxi* (Itardies MP 23), and thus

these taxa may be considered as belonging to the bulk of the whole oligocene local fauna. But *Amphictis* and *Stenoplesictis crocheti* seem to be new immigrants in the European late Oligocene as is *Adelpharctos*. They rapidly were followed (MP 29) by the amphicyonids *Haplocyon* and *Haplocyonopsis* as well as the small anthracotheriid *Microbunodon*. All these taxa may belong to "the late travellers of the big Stampian migration" (Viret 1929) which changed the core of the European fauna after the "Grande Coupure" of Stehlin (1909). We don't know the roots of this late Oligocene migration but its origin is probably in Asia although we don't know any direct ancestor in this area for many of the taxa.

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