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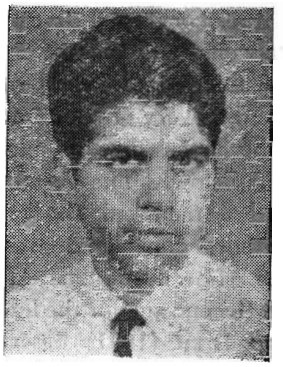
ON AN ANTHRACOTHERE UPPER MOLAR FROM LADAKH, KASHMIR



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ABSTRACT

The discovery of *Hyoboops palaeindicus* in the Ladakh Molasse Group (Kashmir and Jammu, India) is recorded and the stratigraphic and palaeogeographic implications discussed.

INTRODUCTION

Vertebrate fossils have long been known from the Transhimalayan regions of Hundes and Kailas in Tibet, but their precise location and horizon are unknown. Strachey (1851) referred to the sediments of Hundes as Tertiary and the fossils he collected are now in the collections of the British Museum (Natural History) ; they were identified by Waterhouse as rhinoceros, elephant and horse, but in the absence of teeth no more precise identification can be given. They have in our opinion all the appearances of being Pleistocene remains. From the Kargil basin (Ladakh, India) a tooth was discovered by one of us (P. C. D.) during an expedition organised by the Centre of Advanced Study in Geology, Panjab University, Chandigarh, India, in August 1970. After an intensive search some more fragments of a femur were collected from the same bed. The fragmentary nature of the limb bone does not permit any relationship to be established with the tooth.

The Kargil basin in the Ladakh district, Jammu and Kashmir, India, lies about 120 km northeast of the Vale of Kashmir and is traversed by the Srinagar-Leh highway. The tooth described in this paper comes from a 60 cm thick bed of red silty shales occurring in the lower part of the Ladakh Molasse Group about 125 metres south of Baroo colony in a section exposed along the Kargil-Shanko road. Plant fossils abound in beds above and below that containing the vertebrate remains.

Since the middle of the 19th century a number of explorers have traversed the Ladakh region. Prominent amongst the publications on the region are those of Stoliczka (1866), Lydekker (1883a), Dainelli (1922), De Terra (1935) and Bertelsen (1953). Lydekker (1883a) and De Terra (1935) referred to the sediments as 'Indus flysch' and assigned an Upper Cretaceous age to them. Sahni and Bhatnagar (1962), while working on the collection of G. Kohli, reported on fresh-water molluscs and plants from beds near Kargil village. The molluscs included *Unio kohlii* Sahni and Bhatnagar, *Melania kargilensis* Sahni and Bhatnagar, together with some species of palm. The plant beds were capped by a nummulitic limestone and so they assigned an Eocene age to the plant beds. It is to the credit of Tewari (1964) that he categorically contradicted what has long been referred to as Indus flysch and suggested that the post-Eocene beds represented in the Kargil basin are actually molasse facies *sensu stricto*. He correlated these with the sedimentary deposits of the Hundes region and the Kailas

Conglomerate Series of Transhimalayas (Tibet) ; he further concluded that the Kargil beds belong to the Mio-Pliocene, and recognised eight members which he named the Ladakh Molasse Group. Dixit *et al.* (1971) reported the discovery of vertebrates in the lower part of the Ladakh Molasse Group with plentiful plant fossils in beds above and below. The vertebrates comprised a bone fragment and a mammal cheek tooth ; this latter specimen the authors considered was comparable to *Hyoboops* from the Miocene of East Africa, and on this basis suggested a Miocene age for the lower part of the succession. Tewari and Dixit (1971) described a new species of terrestrial gastropod (*Subzebrinus gudei*) from the Wakka river section, ESE of Kargil and close to the Kargil-Shanko road. They named the sequence, some 1500 m thick, the Wakka River Formation, with the Wakka River section as the stratotype, and it is implicit that the new formation name is a more precise designation for the sediments formerly referred to as Ladakh Molasse Group. Tewari and Sharma (1972) while describing charophytes from the Wakka River Formation in a section near Kargil, observed that the mammal tooth recorded by Dixit *et al.* (1971) has close affinity to, if not identical with, *Ancodus* (*Hyopotamus*) *bovinus*, a species from the Early Oligocene of Hempstead, Isle of Wight, England, and added that similar forms have been described under the genus *Brachiodus* from the Lower Miocene Bugti Beds of Baluchistan. Tewari and Sharma concluded the Wakka River formation could be Oligocene-Miocene or Early Miocene in age.

Summarizing the somewhat confused and confusing literature, the nomenclature and age of the sediments has changed from Indus Flysch (Upper Cretaceous or Eocene age) to Ladakh Molasse Group or Wakka River Formation, with age estimates ranging from post-Middle Eocene to pre-Pleistocene. The mammal tooth (described in detail below) has been compared with *Hyoboops*, with *Brachiodus* and with *Ancodus* (*Hyopotamus*) *bovinus*. *Brachiodus* is a misspelling for *Brachyodus*. *Ancodus* is a junior synonym for *Ancodon*. *Hyopotamus* as explained below is an invalid name. *Ancodon bovinus* is at best a junior synonym of *Ancodon velaunus* (see Forster Cooper 1925). *Brachyodus* and *Ancodon* possess upper molars in which the protoconule is well developed and distinct from the protocone. In *Hyoboops* (and the Ladakh tooth) the protoconule is large but partially united with the protocone.

GEOLOGY

The sequence of rock types as observed between Kargil and Pashkyum along the Wakka river is as follows ;

Dras volcanics

Thrust

Pinkish to purple conglomerates with reworked Nummulites

Thrust

Ladakh Molasse Group (Wakka River Formation)

- Dark grey calcareous sandstones with intercalations of red gypsiferous shales and conglomerates.
- Green to greenish grey feebly calcareous sandstones intercalated with red gritty sandstones and red gypsiferous shales. Some black clayey limestone bands and a horizon of greenish black shales containing terrestrial gastropods.
- Greenish grey to dark grey feebly calcareous felspathic sandstones with intercalations of olive grey splintery shales. Lower parts highly calcareous with bands of marls and clayey limestones.
- Light grey to greenish grey and sometimes yellowish felspathic cross-laminated sandstones alternated by dark grey splintery shales with plant remains. Some lenticular bands of conglomerates present.
- Greyish green cross-laminated sandstones alternated by red or purple silty shales, and with lenticular bands of conglomerates. Ferruginous concretions with infilled calcitic material in some lower shale beds. Vertebrate and plant fossils occur in this unit.

Unconformity

Ladakh Granite Fundament

PALAEONTOLOGY

The tooth is patently an anthracothere, but assignment of an isolated molar to generic level is difficult. Subdivision of the family into subfamilies is not easy ; the family comprises about thirty genera and few have been adequately defined. By comparison of the Ladakh tooth with the type-species of almost all genera it is abundantly clear that *Hyoboops* is so close that the tooth can be considered to belong to that genus.

Family Anthracotheriidae Bonaparte 1850
Genus *Hyoboops* Trouessart 1904

Diagnosis: Anthracotheriid in which upper molars have five cusps ; their transverse width slightly exceeds the an-

teroposterior length; the protoconule is partially united to the protocone ; parastyle, mesostyle, and metastyle all present ; protocone, paracone and metacone crescentic ; hypocone crescentic or pyramidal.

Type Species: *Hyoboops palaeindicus*. From the Lower Siwalik, Laki Hills, Sind.

Remarks: The genus *Hyoboops* was proposed by Trouessart for the species *Hyopotamus palaeindicus* Lydekker, since this species differed considerably from other species of *Hyopotamus*. *Hyopotamus* was introduced by Kaup in 1844 for *Hippopotamus minutus* Cuvier 1824. Cuvier uses the specific name only in the résumé (Tome V, Pt. ii, p. 527) and there refers to the earlier text (Tome I, Pt. 1, pp. 322-331) ; throughout the text reference is made to "petit hippopotamus" and seven plates are captioned "Hippopotamus fossile". All the textual references to the plates show illustrations of genus *Hippopotamus*, but without scale, locality or age, identification to specific level is not easy. Cuvier (Tom III, p. 382) writes regarding the derivation of the small hippopotamus, that it came from Landes department, and its age is unknown. Thus Kaup's *Hyopotamus* is invalid and the name is not available for further usage. Therefore Owen (1848), when he used *Hyopotamus* for two new species of anthracothere from the Oligocene of the Isle of Wight, England, was using an invalid name. These and other species of '*Hyopotamus*' are now found under a series of genera, most frequently *Brachyodus* and *Bothriodon*.

In addition to the type species, *Hyoboops naricus* Pilgrim is recorded as the second species in the genus. Four other species have been attributed to the genus, but clearly belong to different genera. *H. longidentatus* is the type species of *Merycops* Pilgrim 1910, and comes from the Bugti Hills, Pakistan. In *Merycops* length exceeds width in the upper molars and all cusps are crescentic. *H. minor* Forster Cooper 1924, also from the Bugti Hills, is clearly a *Merycops* species. MacInnes (1951) placed *Merycops africanus* Andrews 1914 in the genus *Hyoboops*; the material comprises only lower dentitions and so no direct comparison can be made with *Hyoboops* from India, hence the transfer seems unjustified. Chow (1958) described from the Oligocene of Lunnan, China, a new species which he named *Hyoboops hui*. From the text and illustrations the specimens are not *Hyoboops*, but probably *Brachyodus*.

Thus *Hyoboops* s. s. can be considered to comprise at most two species, *H. palaeindicus* and *H. naricus*.

The lectotype of the type-species, *H. palaeindicus*, is an isolated upper molar B82 in the Geological Survey of India Museum Collection, recorded from the Laki Hills, Sind, ascribed to the Lower Siwaliks, and proposed by Lydekker (1883b ; p. 17 and Pl. 23, fig. 6). A further specimen is illustrated on the same plate, fig. 4 ; this also is an isolated upper molar. Forster Cooper (1924 ; p. 47 and Pl. 4, fig. 6) described and illustrated an isolated upper molar (M 12738 in B.M. (N.H.)) from the Lower Siwaliks of Dera Bugti, which he assigned to *H. palaeindicus*. This comprises all the described and illustrated material, but Lydekker (1885) mentions several other teeth, upper and lower, all from the Laki Hills and now in the G.S.I. collections in Calcutta.

The syntypes of *H. naricus* Pilgrim 1910 are described and figured in Pilgrim (1912 ; p. 66, and Pl. 22, figs. 6-7) ; they comprise two isolated upper molars. No other specimens have been referred to the species. In Table I are set out the measurements on *Hyoboops* specimens. In all cases the length slightly exceeds the breadth. All three specimens of *H. palaeindicus* are isolated and it is not known whether they are first, second, or third molars. In the case of *H. naricus*, the two isolated teeth are interpreted as M^{2-3} or M^{1-2} by Pilgrim.

H. naricus is considered by Pilgrim (1912) to differ from the type species in three characters.

(*a*) *smaller size :* considering the impossibility of placing the isolated teeth precisely in the maxilla, the table shows that smaller size is not necessarily a specific character.

Table 1

		Length	*Width*	100L/W
Ladakh Molar	Right Molar (M^3)	24	26	92.3
Hyoboops palaeindicus				
Lectotype (B82)	Left Molar..	22	25	88.0
Co-Type (B82)	Left Molar (?M^2)	20.5	22.5	91.1
M 12738	Left Molar (M^3)	24	25	96.0
Hyoboops naricus				
Syntype (B482)	Left Molar (?M^1)	19	20	95.0
Syntype (B482a)	Left Molar (?M^2)	21	22.5	93.3

(*b*) *lacks internal and external cingulum* : cast of type in the British Museum (M 11070) is difficult to interpret. The original tooth is broken and the cast poor. Nothing can be distinguished on the external border of the tooth. However a slight cingulum can be distinguished antero-internally and postero-internally, and medially between the hypocone and protocone. The protocone is broken and so it is unknown if the cingulum was continuous around that cusp ; it appears to disappear around the hypocone. Thus this character is not as clear cut as Pilgrim suggests and the condition, so far as it can be determined, is essentially similar to that found in *H. palaeindicus*.

(*c*) *have less concave external crescents* : the meaning of this is not clear : if true, it must mean that the crescents on the paracone and metacone of *H. naricus* are either flatter than in *H. palaeindicus* or narrower and hence more V-shaped. So far as we can determine, there is no discernible or measurable difference in the shape of the paracone and metacone in any of the specimens, attributed to either *H. palaeindicus* or *H. naricus*.

Thus on morphological grounds, Pilgrim's *H. naricus* does not stand up to rigorous diagnosis as a species different from *H. palaeindicus*, and we would regard them as synonymous.

Description: The Ladakh tooth (see text-fig. 1) is an upper right molar, possibly M^3 ; it has a fair amount of wear and is broken anteroexternally and posteroexternally. The transverse width slightly exceeds the anteroposterior length. The paracone is rather larger than the metacone, both are crescentic, their adjacent horns forming a broadly convex mesostyle. The protocone is crescentic and partially united to it is the protoconule, which fills most of the space between the protocone and the paracone. The hypocone is small and essentially pyramidal, which with further wear would produce a roughly crescentic cusp. A well marked cingulum runs almost continuously around the anterior, medial and posterior borders. The enamel is slightly crenulated. The tooth has three roots. The specimen is in the collections of the Museum of Geology, Panjab University, Chandigarh, registered number CASGF 1858.

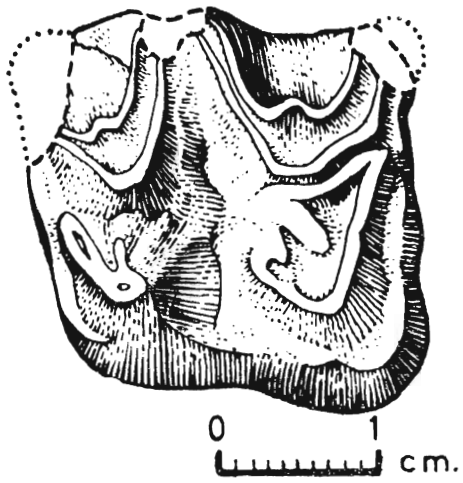

Fig. 1. Occlusal aspect of right upper molar (?M^3) CASGF 8558 *Hyoboops palaeindicus* Lydekker Wakka River Formation, near Kargil, Ladakh, Jammu and Kashmir.

Discussion: The Ladakh tooth compares so closely with the known specimens of *H. palaeindicus* that we feel justified in including it in that species. The size and ratios are of the same order, and the only slight difference is in the condition of the hypocone. In the Ladakh tooth the hypocone is less convincingly crescentic than in the other specimens, but this variation does not justify separation in the absence of other differences. The variation could be due to wear, geographic and/or time divergence. The Ladakh tooth is therefore identified as *Hyoboops palaeindicus*.

H. palaeindicus is known from Dera Bugti and Laki Hills in Sind, Pakistan. The Bugti deposits are the equivalent of Upper Nari, which is Lower Miocene, either Aquitanian or Burdigalian. The Laki Hills fauna is not rich and in the old literature there are no records of the levels of the finds. However it seems that the vertebrates came from a horizon equatable with the Bugti Bone Bed. Hence the Ladakh deposit can be referred to the Lower Miocene.

Interest attaches to the palaeogeographical implications of the Ladakh specimen. The immediate comparison is with Bugti, where the rich fauna of anthracotheres is accompanied by *Deinotherium*, *Gomphotherium* and *Paraceratherium*. The Paraceratheriinae (gigantic rhinoceroses) are known from the Early and Mid Oligocene of Mongolia; in the Late Oligocene and Early Miocene they spread to China in the east and to Kazakhstan in the west, with a doubtful record from Yugoslavia (Gromova 1959). The Bugti site in Sind province of Pakistan marks the most southerly record of the essentially central Asiatic stock. The Bugti proboscideans are almost certainly of African origin, and thus at Bugti we have a mixture of northern Tethyan immigrants from Asia and southern Tethyan immigrants from Africa. The origin of the anthracotheres at Bugti is less certain. The European record is marked by the appearance in Middle Oligocene deposits of France and England of the genus *Bothriodon*, possibly from Asia, where there is a report of the genus in the Early Oligocene of southeast China (Chow 1958). In Africa the only Oligocene site to yield anthracotheres is Fayum (Early to Mid Oligocene), and all the taxa are closely related species of *Bothriogenys*. Stratigraphically the next levels in Africa with anthracotheres are the Early Miocene sites of Moghara in Egypt, Gebel Zelten in Libya, and the Kavirondo area of Kenya. Moghara

has yielded three anthracothere species : *Masritherium depereti* (genus known only from Africa), '*Brachyodus*' *africanus* which is probably a *Bothriogenys* descendant (Black 1975) and '*Brachyodus*' *moneyi*, the latter known only from lower teeth and so any affinity with *Hyoboops* is indeterminable. The Gebel Zelten anthracotheres include *Merycops africanus* and '*B.*' *moneyi*. The Kavirondo anthracotheres comprise only '*Brachyodus*' *aequatorialis*, which Black (1975) places in *Masritherium*, and *Merycops africanus*. The nomenclature problem is vitiated by the absence of association of upper and lower dentitions. It is not clear whether the *Hyoboops-Merycops* stock originated in Asia or Africa, but the profusion of taxa in the Bugti deposits inclines towards an Asiatic origin, and the Ladakh record from the northern Himalayas strengthens this presumption.

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