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**A NEW SPECIES OF *ELAPHURUS* FROM THE
AKASHI FORMATION IN HYOGO
PREFECTURE, JAPAN**

By

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Introduction

The Akashi formation referred to the lower part of the Ôsaka group (early Pleistocene) in the Kinki region has long been known as one of the most important mammalian fossil-bearing strata in Japan.

According to the previous authors, number of mammalian remains identified to *Parastegodon akashiensis* TAKAI, *Parastegodon aurorae* MATSUMOTO, *Parastegodon shodoensis* (MATSUMOTO), *Parastegodon sugiyamai* TOKUNAGA, *Elaphurus davidianus* MILNE-EDWARDS, *Metaplatyceros sequoiae* SHIKAMA have occurred from this formation accompanied by *Metasequoia* and many other remains of the flora of rather warm climate.

In 1966 I had an opportunity to examine antler of *Elaphurus*-type deer stored in the Akashi Astronomical Museum. It was supplied for my study by courtesy of Mr. INOUÉ, Curator of the Museum. I wish to express my hearty thanks to Mr. INOUÉ and all the staffs of the Museum. Acknowledgements are also due to Mr. Yoshikazu HASEGAWA of the National Science Museum, Tokyo, for his valuable advice concerning the Cenozoic Cervidae, Dr. Tatsuro MATSUMOTO of the Kyushu University and Dr. Shozo HAYASAKA of the Kagoshima University for kindly reading the manuscript, and Dr. Hiroshi OZAKI of the National Science Museum for their kind help in obtaining gypsum models of some important fossil specimens of *Elaphurus*.

Systematic Description

Order Artiodactyla

Family Cervidae GRAY, 1821

Subfamily Cervinae GRAY, 1821

Genus *Elaphurus* Milne-Edwards, 1866

Type-species.—*Elaphurus davidianus* MILNE-EDWARDS, 1866

Generic Diagnosis.—See SHIKAMA, 1941, p. 1160

Elaphurus shikamai sp. nov.

Pl. 1, Figures 1-2; Text-figure 1

Material.—Holotype (Pl. 1, Fig. 2, Text-fig. 1), a right adult antler. The specimens

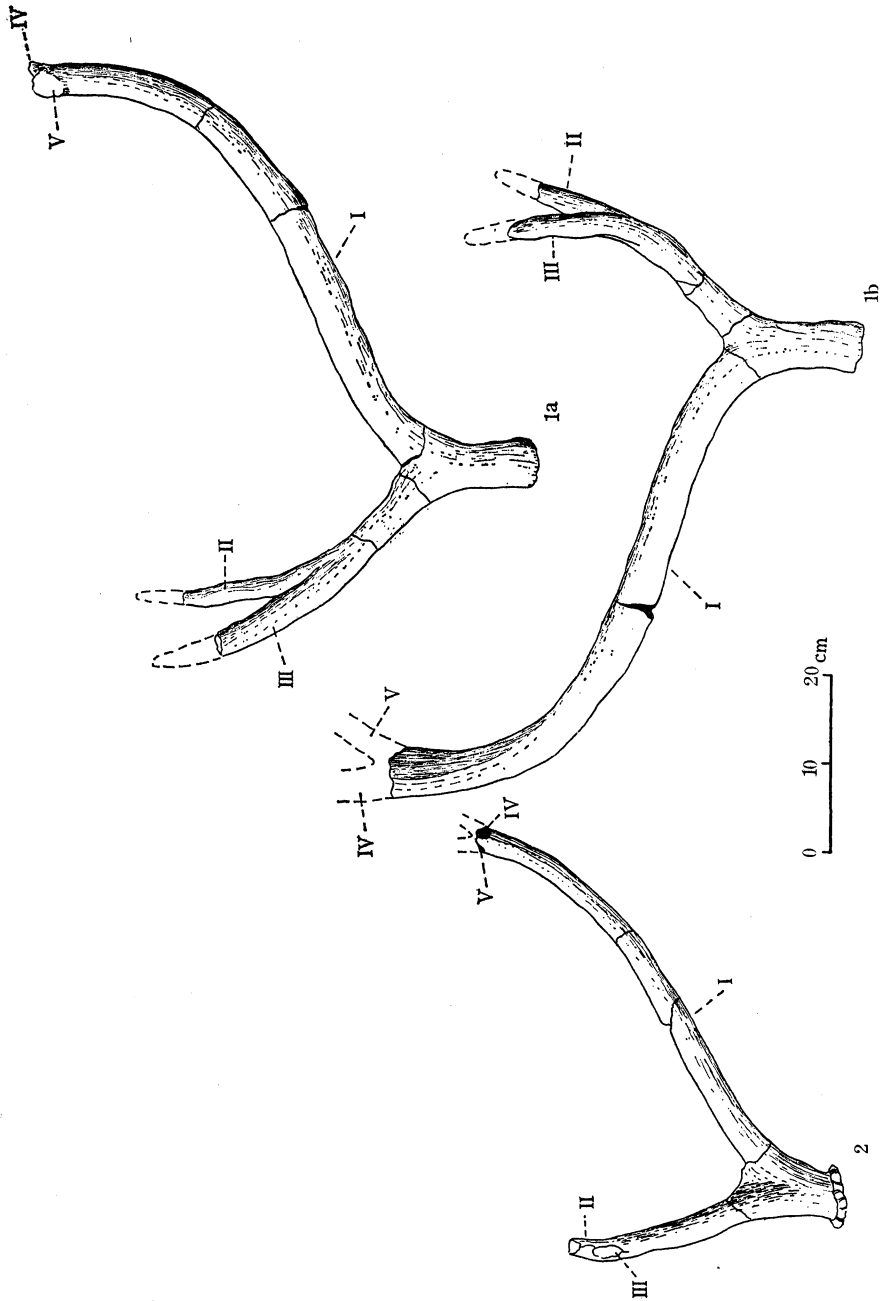
were collected from the Hayashizaki clay bed, belonging to the Akashi formation (Villafranchian) of the Ôsaka group, exposed at Hayashizaki, Akashi City, Hyogo Prefecture, Japan.

Specific diagnosis.—Antler is large, stout and strongly constructed; somewhat stretches outwards in anterior view. The anterior prong is bifurcated at a position very high above the burr, making a very wide angle (80 to 100, according to the growth-stage) with the beam, projected forwards and somewhat upward, and then bifurcated into two lateral prongs with a short distance from the first bifurcation. Of these prongs, one is projected inwards and the other outwards, making an acute angles (about 40 to 45) with each other; the plane of this bifurcation is almost parallel with that of the second bifurcation. In general, the angle and the height of the first bifurcation become wider and higher with growth. The beam above the first bifurcation is long and much lyrated with gentle curvature and finally it is bifurcated into two lateral prongs.

Description of the type specimens.—Holotype (Pl. 1, Figs. 2a-2b; Text-fig. 1), a right antler, is large and thick. The pedestal is lost. The burr rather thick and its transverse section is subcircular. The beam below the first bifurcation is stout and circular in outline. The anterior prong is bifurcated at a position very high (about 109 mm) above the burr. It is stout, moderately long and projected strongly forward, somewhat upward, making an angle of about 100 degrees with the beam. At the position 217 mm apart from the first bifurcation, it is bifurcated into two lateral prongs (Text-fig. 1, II and III), of which the internal prong (prong III) of about 170 mm in preserved length is cylindrical and projected strongly inward, while the external one (prong II), preserved 168 mm long, is also cylindrical and projected obliquely upward with a weak, irregular curvature.

The beam above the first bifurcation (I) is stout, long and circular. It is much lyrated in the lower part, then gently curved upward in the middle part and finally bifurcated into two lateral prongs (IV and V) in the distal part. But the apical part of the prongs of the second bifurcation is missing. The beam is irregularly oval in the lower part but is somewhat flattened antero-posteriorly in the distal part; the surface of the basal part is rather smooth, but a few weak grooves are recognized near the distal part.

Paratype (Pl. 1, Figs. 1a-1b; Text-fig. 1), a young, right antler, considerably differs in outline from the holotype. It is much slender than the holotype and measured about 460 mm from the burr to the second bifurcation in straight line. The burr is rather thick, rugose and oval in outline. The pedestal is lost. The anterior prong is bifurcated at a rather lower position (about 50 mm high above the burr). The beam below the first bifurcation is oval in section. The anterior prong is rather short (about 230 mm in length), rugose and projected straight upward from the bifurcation, making an angle of about 80 degrees with the beam. At the position about 160 mm high above the bifurcation, the anterior prong is bifurcated again into two prongs, making about 40 degrees with each other. A plane of this bifurcation of the anterior prong is nearly parallel with that of the second bifurcation of the beam and nearly perpendicular to that of the first bifurcation. But the main part of these prongs are missing. In this



Text-fig. 1. Two antlers of *Elaphurus shikamai* Otsuka sp. nov. 1, a right antler of holotype from outer (a) and inner (b) views. 2, a left antler of young specimen from outer view.

specimen the beam above the first bifurcation is less lyrated than in holotype. The beam has a rather smooth surface, but with weak and shallow grooves. In transverse section, it is subrectangular in the basal part and become ellipsoidal toward the distal part.

Measurements in mm or degrees.—

	Adult antler	Immature antler
Fore-and-aft diameter of the burr	58.5 (+)	59.1
Side-to-side diameter of the burr	60 (+)	48.9
Maximum thickness of the burr	—	9.2
Fore-and-aft diameter of the beam below the first bifurcation	54.8	50.3
Side-to-side diameter of the beam below the first bifurcation	35.0	29.5
Height of the first bifurcation (burr included)	35.0	29.5
Fore-and-aft diameter of the anterior prong above the first bifurcation	42.9	32.4
Side-to-side diameter of the anterior prong above the first bifurcation	42.6	31.5
Length of the anterior prong in straight line	286 (+)	217.5
Fore-and-aft diameter of the beam at middle	43.0	24.1
Length of the beam in straight line	600 (+)	431.0
Angle of the first bifurcation	100	80
Angle of the second bifurcation	35	40
Length of the prong II	168	—
Length of the prong III	170	—

Ontogenic variation of the antler.—As stated above, the form and the ornamentation of the present species are fairly variable with growth.

1) The height of the first bifurcation, for instance, ranges from 35.0 to 29.5 mm, so far as the present specimens are concerned.

2) The angle of the first bifurcation ranges from 80 to 100 degrees in the measured specimens.

3) In the young specimen the anterior prong is prolonged directly from the main beam without any peculiar curvature, while in the adult specimen it is projected forward, making an acute angle with the axis of the main beam. These tendency of the change in growth stages closely resembles the case of *Cervus (Axis) japonicus* OTSUKA (OTSUKA, 1967).

Observations and Comparisons.—The present species is safely distinguishable from *Elaphurus davidianus* MILNE-EDWARDS, the type-species of *Elaphurus* by its wider angle of the first bifurcation, more curved beam above the first bifurcation with distal bifurcation and the direction of the anterior prong.

Much lyrated beam and wide angle of the first bifurcation of the present species suggest an alliance to the *Axis* group. But the present species differs fundamentally

from the latter in its much higher position of the first bifurcation and the anterior prong dichotomously forked at the distal end. In *Axis* group, the present species is most closely related to *Cervus (Axis) japonicus* OTSUKA (OTSUKA, 1967), and I cannot distinguish both species without the bifurcated anterior prong. Therefore I think that these two species may be derived from a common ancestral form, and has migrated from the Chinese continent to the Japanese island at the same geological age.

The present species closely resembles *Elaphurus bifurcatus* TEILHARD and PIVETEAU from the Nihowan of north China in dichotomously forked and gently curved features of the beam above the first bifurcation. However the present species differs from *E. bifurcatus* in having less lyrated feature of the beam above the first bifurcation and the direction of the anterior prong.

The present species is also different from *E. menziesianus* (SOWERBY) from the archeological site of Anyang, China in its gently curved anterior prong without complex forking at distal part and curved beam above the first bifurcation. But the young specimen of *E. menziesianus* which was illustrated by TEILHARD & YOUNG in their text-figure 11 is similar to the immature specimen of *E. shikamai*, excepting the slight differences in the angle of the first bifurcation and curvature of the beam.

The most species of *Elaphurus* from the Japanese Pleistocene have been identified to *E. davidianus* MILNE-EDWARDS and regarded as one of the index fossils in the early Pleistocene. But these specimens are too fragmental to decide the precise systematic position. Therefore I have had a slight doubt about the identification of the Japanese *Elaphurus* deer described by the previous authors. If we compare the antler specimens hitherto reported with *E. shikamai*, we cannot find the obvious morphological differences between them. I think that most specimens of *Elaphurus* described by the previous authors can be regarded as the variations of *E. shikamai* OTSUKA, which is here described based on the quite well-preserved antler specimens. The precise comparisons between them are as follows:

WATASE (1913, 1922) first reported a basal portion of the antler of *Elaphurus* under the name of *E. davidianus* MILNE-EDWARDS from the Umegase formation in the Bôshô Peninsula, Kwanto region. It much resembles *E. shikamai* in general outline, but slightly differs from *E. shikamai* in rather lower position of the first prong.

Two fragmental antlers reported by NAGASAWA (1932) from the Taniyagi of the Akashi Province under the name of *E. davidianus* MILNE-EDWARDS seem to be closely allied to *E. shikamai* in general outline but can be scarcely discriminated from *E. shikamai* by differences concerning the curvature of the beam above the first bifurcation and the outline of the section of the beam.

SHIKAMA (1936, 1941) reported a fragmental, basal portion of a right antler under the name of *Elaphurus* cf. *davidianus* MILNE-EDWARDS, which was collected from the Akashi formation at the locality where the present specimens were collected. Shikama's specimen closely resembles the better preserved specimens of *E. shikamai* in several characters, such as the direction of the anterior prong, rather high position of the first bifurcation and stout and cylindrical beam above the first bifurcation and a slight difference in the detailed position of the first bifurcation can be regarded as a variation.

Concluding Remarks.—The species, living and fossil, of *Elaphurus* have been exclusively reported from Northeastern Asia. *Elaphurus davidianus* MILNE-EDWARDS, commonly called Pére DAVID deer, is a single living species of this genus which has been kept in the garden of the Summer Place, Pekin. The fossil example of this genus was first described by WATASE (1913, 1922) from the early Pleistocene Umegase formation of the Bôsô Peninsula, Kwanto region under the name of *Elaphurus davidianus* MILNE-EDWARDS. In Japan the following two species have been known as fossil from the Pleistocene deposits of the Kwanto and Kwansai regions.

E. davidianus MILNE-EDWARDS: Hayashizaki clay bed of the Akashi formation, Ôsaka group [Villafranchian] (NAGASAWA, 1932); (2) Umegase formation [Villafranchian?] (WATASE, 1913, 1922).

E. cf. davidianus MILNE-EDWARDS: Hayashizaki clay bed of the Akashi formation, Ôsaka group [Villafranchian] (SHIKAMA, 1941).

E. akashiensis (SHIKAMA): (1) Akashi formation of the Ôsaka group [Villafranchian] (SHIKAMA, 1941); (2) Minamitama group of the Kwanto region (SHIKAMA, 1962).

In the continental area of China, the following two species have been reported from the Pleistocene deposits of Nihowan and Anyang.

E. bifurcatus TEILHARD & PIVETEAU: Villafranchian deposits of Nihowan, north China (TEILHARD & PIVETEAU, 1930).

E. menziesianus (SOWERBY): Archeological site of Anyang, China (TEILHARD & YOUNG, 1930).

The distribution of *Elaphurus* seems to have been restricted geographically to Eastern Asia and geologically to a rather short period ranging from the Villafranchian to Recent. For some reason records of their occurrence in the middle Pleistocene have known neither in the Chinese continent nor in the Japanese islands.

It is noticeable that the present new species of *Elaphurus* is closely related to the species from the Nihowan.

This suggests the existence of the faunal and geographical connection between the Nihowan vertebrate fauna in China and *Parastegodon* vertebrate fauna in Japan at that time.

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Fig. 1-2: *Elaphurus shikamai* OTSUKA, sp. nov.

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1. left antler of immature specimen.
2. left antler of adult specimen.

Outer (a) and inner (b) view, $\times 0.3$.

Both specimens are collected from the Hayashizaki clay bed of the Akashi formation, Hyogo Prefecture.

