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Studies on Fossil Deer of the TAKAO Collection (Pleistocene Deer Fauna in the Seto Inland Sea, West Japan——Part I)

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Introduction

The present article deals with the results of the paleontological study of the fossil deers collected from the sea bottom off Shakagahana (or Jizozaki), Shodoshima Island in the Seto Inland Sea. They are associated with abundant specimens of NAUMANN's elephant (*Palaeoloxodon naumanni*). All the specimens including the elephants are named the TAKAO Collection after Mr. Hisamichi TAKAO who made effort, for a period of over 50 years, to collect these specimens dredged by fishermen of several villages in the Shodoshima Island. The paleontological study on NAUMANN's elephant in this collection has already been published by HASEGAWA (1972).

The Cervidae is important as the indicator of geological age, of palaeogeographical land connection and also of climatic condition during the Pleistocene in Japan like the Proboscidea. Nowadays, many species of fossil deer have been recorded from the Cenozoic of Japan by many authors. However, most of them were described based on a single specimen or rather few incomplete specimens with a few exceptions, and the precise phylogenetic relationships among them have long been remained fully unknown. Such being the case, the TAKAO Collection comprising a large quantity of deer specimens is regarded to be very valuable not only for the basic studies of the Japanese Pleistocene deer but also for the correlation between the Pleistocene faunae in Japan and those in the Asiatic Continent.

Although the specimens in this collection were picked up from the sea bottom during about 50 years, they were regarded as to represent the specimens of the same geologic age and from the same locality according to HASEGAWA (1972). The topography, geology and the associated vertebrate fossil fauna from off Shodoshima have already been discussed by HASEGAWA (1972).

Deer fossils in the TAKAO Collection is represented by more than 300 specimens including antlers and various bones, although most of them are much broken. The writers have been always faced with the difficulties to determine precise systematic

position of them, unless they have preserved some outstanding features.

As the result of the present study, eight species of the fossil deer belonged to the family Cervidae were discriminated. Two of them are regarded to be a new species of *Cervus* (*Sika*).

As listed by previous authors (TOKUNAGA and TAKAI, 1935; SHIKAMA, 1941; SHIKAMA and HASEGAWA, 1965; NAORA, 1970), many species of fossil deer have been reported from the sea bottom off the Shodo-shima Island. And the following eleven deer species have been listed or described from the Seto Inland Sea region: namely, *Cervus nippon* TEMMINCK (SHIKAMA, 1941; NAORA, 1970; HASEGAWA, 1972), *C. yesoensis* HEUDE (SHIKAMA, 1941), *C. taiouanus* BLYTH, *C. praenipponicus* SHIKAMA (SHIKAMA, 1941; NAORA, 1970; HASEGAWA, 1972), *C. kazusensis* (MATSUMOTO) (NAORA, 1970; HASEGAWA, 1972), *Alces* sp., *Sinomegaceros yabei* (SHIKAMA) (NAORA, 1970; HASEGAWA 1972), *Capreolus mayai* TOKUNAGA and TAKAI (TOKUNAGA and TAKAI, 1936; NAORA, 1970), *C.* cf. *hortulorum* SWINHOE (NAORA, 1970), and *Rusa* sp. (NAORA, 1970). Among these, however, the first three species are ambiguous in their paleontologic definition and the last two species seem to be merely of variation of the other species, as will be discussed in the final chapter of this paper.

Besides the TAKAO Collection, there are several noteworthy collections of deer fossils taken by fishing nets from the several places of the Seto Inland Sea. They are called (1) the DOI Collection, (2) the Hiroshima University Collection, (3) the Matsuyama Prefectural Museum Collection, (5) the YAMAMOTO Collection. The TAKAO Collection is far richer and more important than them. The results of the studies on them shall be published in a few separate papers, and the conclusive remarks on the Pleistocene deer fauna not only from off the Shodoshima Island but also from the other areas in the Seto Inland Sea shall be given at the final step of this serial study.

Acknowledgments

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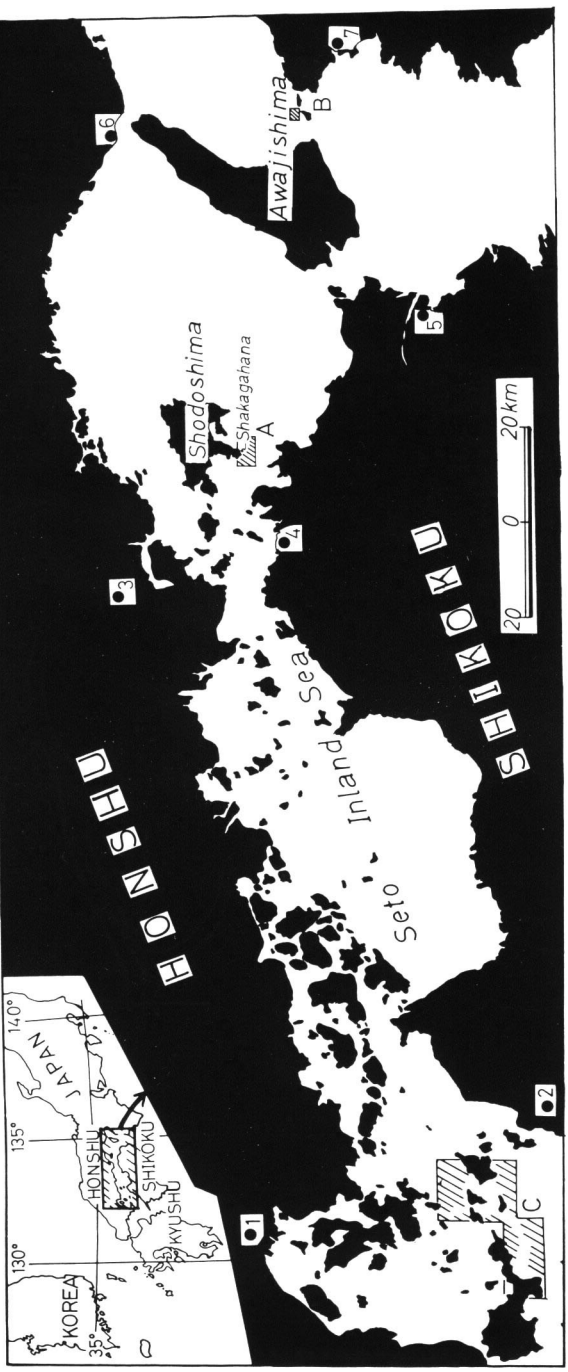


Fig. 1. Locality map of deer fossils and NAUMANN's elephants in the Seto Inland Sea (A~C). A: TAKAO Collection, B: DOI Collection, C: Collections of Hiroshima University, of the Matsuyama Prefectural Museum and of the Suzugamine Women's College. 1. Hiroshima, 2. Matsuyama, 3. Okayama, 4. Takamatsu, 5. Tokushima, 6. Akashi, 7. Wakayama.

Descriptive terms of the antler

In this paper are used the following descriptive terms (also see Fig. 2).

H: Height of the first fork, measured along the inner surface of beam between a point of the first fork and the lower border of burr. The point of the first fork is decided as a cross point of two straight lines drawn on the first tine and a median part of beam above the first fork.

DBu: Diameter of burr.

DBI: Minimum diameter of beam below the first fork.

DBII: Diameter of beam at middle point between the first and second forks.

DBIII: Diameter of beam at the middle point between the second and third forks.

LI: Length of the first tine, measured along the inner surface of the first tine.

LII: Length of the second tine, measured from the point of the second fork to the tip of the tine along the inner surface.

LIII: Length of the third tine. The method of measurement is same as LII.

LBI: Length of beam between the second and third forks.

LBII: Length of beam between the second and third forks.

LP: Length of pedicle along the posterior border.

α: Angle of the first fork.

β: Angle of the second fork.

γ: Angle of the third fork.

α': Degree of inclination of beam above the first fork.

δ: Pedicle diversion.

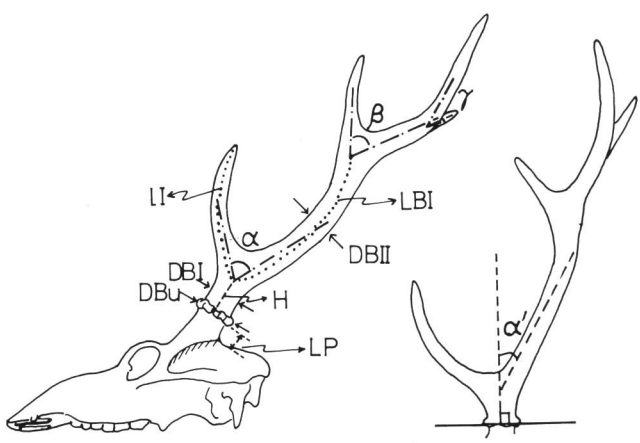


Fig. 2. Terminology of antler.

Deer Assemblage from off the Shodoshima Island

The deer assemblage of the TAKAO Collection from off the Shodoshima Island is composed of 9 species with the following frequencies, respectively.

Elaphurus menziesianus SOWERBY, 3 individuals 3%
Sinomegaceros (*Sinomegaceroides*) *yabei* (SHIKAMA), 1 individuals 1%
Cervus (*Sika*) *natsumei* MATSUMOTO, 4 individuals 4%
C. (*S.*) *paleoezoensis* n. sp., 13 individuals 33%
C. (*S.*) cf. *greyi* (ZDANSKY), 17 individuals 18%

C. (*Nipponicervus*) *praenipponicus* SHIKAMA, 20 individuals 21%
C. (*N.*) *kazusensis* MATSUMOTO, 9 individuals 9%
C. (*N.*?) *takaoi* n. sp., 7 individuals 7%
C. (*N.*?) sp., 1 individual 1%

Species *paleoezoensis* is most abundant, *praenipponicus* is next in occurrence, and cf. *greyi* is third; the others are much fewer in numbers. *Elaphurus* and *Sinomegaceros* may be noteworthy because of its large size and taxonomic characters, though they are fewer than the others. In this point the Shodoshima deer assemblage may be said as the *Sika-Nipponicervus* assemblage which comprises a complex consisting of such older elements of the early to middle Pleistocene faunae as *C.* (*N.*) *praenipponicus*, *C.* (*N.*) *kazusensis*, *C.* (*S.*) cf. *greyi* and of such younger one of the late Pleistocene as *C.* (*S.*) *paleoezoensis*. It may be significant that younger elements of *Sika* exceed older ones of *Nipponicervus* in individual numbers. Therefore the Shodoshima deer assemblage may be a new deer fauna belonging to the late Pleistocene vertebrate fauna of Japan. The appearance of *Elaphurus menziesianus*, an important element of the North Chinese Holocene, is very significant and important. The Shodoshima deer assemblage resembles those of the Upper Isa or Upper Kuzuü faunae in the dominancy of *Cervus* (*N.*) *praenipponicus*, *C.* (*N.*) *kazusensis* and the occurrence of *Sinomegaceros yabei*, but differs from them by the occurrence of *Elaphurus menziesianus* and rich number of *Sika*. This assemblage is very important as a representative deer community of lowland fauna of the Japanese late Pleistocene. In the point of existence of *Sinomegaceros yabei* and *C.* (*N.*) *natsumei*, the Hanaizumi fauna may be allied to but different from this assemblage by poor *Sika* and no *Elaphurus*.

Table 1. Pleistocene deer fauna in Japan

	Shodoshima	Hanaizumi	Isa	Kuzuü	Umegase Akashi Kuchinotsu
E. menziesianus	○				
S. yabei	○	○	○	○	
C. (*S.*) *natsumei*	○	○			
C. (*S.*) *paleoezoensis*	⊙				
C. (*S.*) cf. *greyi*	⊙				
C. (*N.*) *praenipponicus*	⊙		⊙	⊙	
C. (*N.*) *kazusensis*	⊙			○	○
C. (*N.*?) *takaoi*	○				

⊙ abundant ○ common

Such Villafranchian deer faunae as the Akashi, Kuchinotsu and Umegase Formations are most distant from this assemblage, although *C.* (*N.*) *kazusensis* occurs in all the faunae. The Kuzuü-Isa faunae (Riss-Würmian or early Würmian) may be rather close to this fauna than the Hanaizumi fauna (latest Würmian).

Systematic Description

Order Artiodactyla

Family Cervidae GRAY, 1821

Genus *Elaphurus* MILNE-EDWARDS, 1866

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

Elaphurus (*Elaphurus*) *menziesianus* (SOWERBY), 1933

Pl. 1, figs. 1–3; Fig. 3

Rucervus menziesianus SOWERBY, 1933, *China Jour.*, vol. 29, no. 3, p. 141–144.
Elaphurus menziesianus (SOWERBY), TEILHARD & YOUNG, 1936, *Pal. Sinica*, ser. C, no. 1, p. 30–36.
Elaphurus davidanus MILNE-EDWARDS, MATSUMOTO, 1915, *Sci. Rep. Tohoku Imp. Univ.*, vol. 3, no. 1, p. 31, 32.

Referred specimens.— Two fragments of fore tine (NSM* 14491 and 14492) and a fragment of posterior tine (NSM 14493), belonging to three individuals.

Descriptions.— A fragment of a left fore-tine (NSM 14491; Pl. 1, fig. 1; Fig. 3) is 170 mm in preserved length. It is rather thick, measuring 30.5 mm (fore-and-aft)× 47.5 mm (side-to-side) at the proximal broken end. In fore-and-aft view, the fore tine is slightly bend inwards. Two series of strong tinelets are attached on the posterio-inner surface of them. The basal part of the fore tine below the first series of tinelets (I, II and III in Fig. 3) distends antero-posteriorly and becomes thin laterally like a biconvex lens; the posterior corner is rounded; the anterior corner is somewhat keeled. Three rather large tinelets are attached on the posterio-inner surface of tine at 70 mm above the proximal broken end, showing a serial arrangement; one of the three tinelets is located at the anterio-outer corner (I), one at the inner-mesial (II) and another at the posterio-inner corner (III). Those tinelets run off the shaft from the anterio-inner corner to the posterio-outer one, being obliquely across the shaft. Those tinelets direct slightly upwards like a hook, and show almost circular outline.

Another series of tinelets is attached on the posterior surface of tine at distal end. Among these tinelets, each one is attached on the posterio-inner (VI), on the anterior (IV), on the posterio-inner (VII) and on the anterio-inner (V) surfaces. Tinelets IV and V are completely broken away near the base. Tinelets VI is 47 mm in preserved length. It is nearly circular in section and directs upwards like a hook. Tinelet VII is broken away from the base but it looks to taper upwards like others. The surface of the beam is rather smooth, except for some longitudinal shallow and wide furrows, and rather distinct grooves run on the lower part.

A fragment of a right fore tine (NSM 14492; Pl. 1, fig. 2; Fig. 3) is 183 mm in preserved length and 34.5 mm in width at the broken end. The surface of the tine is rather rugose in appearance due to many small and irregular depressions and due to some large obtuse nodules.

The distal end of the fore tine is forked into two lateral tinelets, posterior one of which was broken off from its base, while the anterior one is forked again into two

* Abbreviation for the National Science Museum, Tokyo

tinelets (VI, VII) at a point 20 mm above the lower fork. Tinelet VI projects posterio-inwards and then curves upwards like a hook, while the tinelet VII, which is 45 mm in preserved length, is bent backward at the same angles as in the former.

A fragment of a posterior (?) tine (NSM 14493; Pl. 1, fig. 3) is 163 mm in preserved length, 25 mm in width at thier distal end. The surface is rather smooth, but some small obtuse nodules are arranged on the regular lines across the posterior tine.

Comparisons.— From the size and forking mode, three specimens at hands are identified to front (or upper) or posterior tines of *Elaphurus menziesianus* (SOWERBY) which was recorded from the Archeological site of Anyang, North China (SOWERBY, 1933; TEILHARD and YOUNG, 1936). Specimens NSM 14492 and NSM 14491 correspond to parts of the fore tine of *E. menziesianus*, "prong III" and "prong II and III" of TEILHARD and YOUNG (1936), respectively.

The present species is distinguishable from *E. davidianus* MILNE-EDWARDS, by tuberculated antler with much depressed outline and by its forking mode.

General appearance of the specimens at hands is somewhat allied to that of *Capreolina mayai* (TOKUNAGA & TAKAI, 1936) from the sea bottom off the Shodoshima Island, although they are discriminated from the latter by different forking mode. There are still remained a possibility that the type specimen of *Capreolina mayai* belongs to an extreme variation of *E. menziesianus* (SOWERBY).

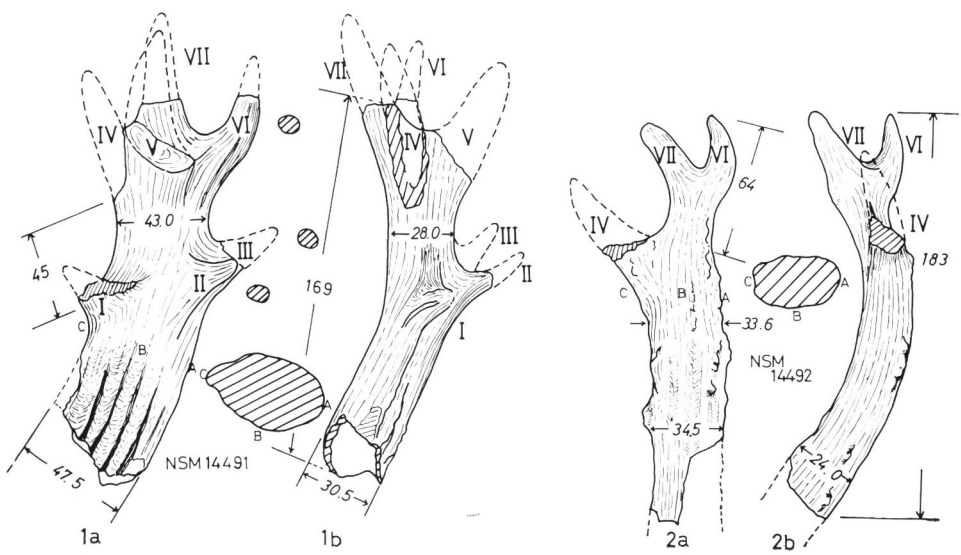


Fig. 3. Two fragments of fore tine of *Elaphurus menziesianus* (SOWERBY). Inner (1a, 2a), frontal (1b) and posterior (2b) views.

Genus *Sinomegaceros* DIETRICH, 1933

Type-species.— *Euryceros pachyosteus* YOUNG, 1932

Sinomegaceros (*Sinomegaceroides*) *yabei* (SHIKAMA, 1938)

Pl. 2, fig. 1

Cervus (*Sinomegaceros*) *yabei* SHIKAMA, 1938, *Jap. Jour. Geol. Geogr.*, vol. 16, nos. 1–2, p. 115–122.— SHIKAMA, 1941, *Jubl. Pub. Comm. Prof. Yabe's 60th Birthday*, vol. 2, p. 1157.

Cervus (*Sinomegaceroides*) *yabei* SHIKAMA, 1949, *Sci. Rep. Tohoku Univ., 2nd ser.*, vol. 23, p. 107–111.

Megaceros kinryuensis MATSUMOTO & MORI, 1956, *Dobutsugaku Zasshi*, vol. 65, no. 6, p. 17–21. —— MATSUMOTO, MORI & OZAKI, 1959, *Bull. Nat. Sci. Mus.*, vol. 4, no. 3, p. 301–305.

Megaceros sp., NAORA, 1954, Old Stone Age in Japan, p. 132–134.

Euryceros sp., NAORA, 1954, *Ibid.*, p. 55–96, 197–200.

Sinomegaceros (*Sinomegaceroides*) *yabei* (SHIKAMA), SHIKAMA & OKAFUJI, 1958, *Sci. Rep. Yok. Nat. Univ., sec. 2*, no. 7, p. 78–83.

Megaceros (*Sinomegaceros*) *ordosianus minor* KAMEI, 1958, *Jour. Fac. Lib. Art. Sci., Shinshu Univ.*, no. 8, p. 69–74.

Referred specimen.— NSM 14494, a right metatarsus.

Description.— A right metatarsus is well preserved (Pl. 2, fig. 1), although the anterior surface of shaft near distal end is partly worn. The bone is very large and thick; a median longitudinal furrow on the posterior surface is very broad and deep, and its distal extremity has a fossa of oval shape.

In anterior view, the bone is straight with distal expansion. A vascular groove on its mesial is very distinct and rather wide, and a foramen of its distal part is deeply depressed. In lateral view, the bone curves slightly backward and tapering toward the distal end. The posterio-outer margin of a shaft in the proximal part is more distended backward than the posterio-inner one.

Outline of the articular surface in the proximal end is nearly pentagonal in proximal view. The facet for cuboid is broad and rectangular, and its articular surface somewhat declines outward. Median foramen is large, deep and oval-shaped in outline. Two rather deep fossae of irregular shape are lying posteriorly to two facets.

Measurements (in *mm*):— Maximum length: 408.0; Diameter at proximal end: 62.0×56.8; Diameter of shaft at middle: 40.0×43.8; Diameter of shaft at distal end: 68.5×44.3.

Comparison.— The specimens from the Tomioka peat bed at Kamikuroiwa near Tomioka, Gunma Prefecture (latest Wurmian) (SHIKAMA and TSUGAWA, 1962) and from the Upper Isa Bed of Fusen-ana Cave of Akiyoshi-dai, Yamaguchi Prefecture (SHIKAMA and OKAFUJI, 1958) are much smaller and weakly constructed than the bone treated here.

A metatarsal bone of *Sinomegaceros* (?) sp. was recorded from the Shibikawa Formation (Middle to Upper Villafranchian), Akita Prefecture, northern Japan (SHIKAMA and TAKAYASU, 1971) as the oldest record of the Japanese megacerid. The bone at hand is much larger than that from the Shibikawa Formation.

Sinomegaceros yabei (SHIKAMA) is a representative fossil of the Würmian vertebrate fauna of Japan and is so frequently accompanied with *Palaeoloxodon naumanni*

(MAKIYAMA) that the fauna has been called "*Palaeoloxodon-Sinomegaceros* Complex (HASEGAWA, 1972)". The vertebrate fauna off the Shodoshima Island is also regarded to represent this complex, but the remains of *Sinomegaceros* rarely occur in the TAKAO Collection. Although the species has hitherto been recorded by some authors, very few specimens have been stored. Recently, many skeletons of *S. yabei* were discovered from the Pleistocene deposits at several areas in Japan, but they have not yet been described.

Genus *Cervus* LINNAEUS, 1785

Subgenus *Sika* SCLATER, 1870

Type-species.— *Cervus nippon* TEMMINCK, 1973

Remarks.— In the TAKAO Collection, antler specimens belonging to the subgenus *Sika* are most abundant and well-preserved. Three species such as *Cervus natsumei* MATSUMOTO, *Cervus* cf. *greyi* (ZDANSKY) and *Cervus paleoezoensis* n. sp. are discriminated. The general characters of the antler of those species are as follow:

Antler	Species		
	natsumei	cf. *greyi*	*paleoezoensis*
Size	very small and slender	small to moderate	small to large
Distance between first and second forks (LBI)	short	short	moderate
Length of first tine (LI)	very short	moderate	moderate to long
Height of first fork (H)	very low	low	low to high
Angle of first fork (α)	40°–60°	80°–100°	60°–90°
Ornamentation	very smooth	moderate to rugose	smooth to rugose

Cervus (*Sika*) *natsumei* MATSUMOTO

Pl. 1, figs. 4–8; Fig. 4

Cervus (cfr. *Sika*) *natsumei* MATSUMOTO, 1938, *Zool. Mag.*, vol. 50, no. 3, p. 113.

Cervus (*Sika*) *natsumei* MATSUMOTO, MATSUMOTO *et al.*, 1959, *Bull. Nat. Sci. Mus.*, vol. 4, no. 3, p. 299–301.

Referred specimens.— Three right shed antlers (NSM 14477, 14444–1 and 14444–3), a pedicle with a fragment of skull attached (NSM 14450) and a left metacarpal bone (NSM 14490).

Diagnosis.— Small deer with three-forked antler. Pedicle rather long and slender. First (or fore) tine very tiny and forked immediately above burr, making an acute angle with beam. Beam below second fork slightly declined backward and somewhat outward. Beam between first and second forks rather short and less lyrated. Third tine forked at short distance above second fork. Distance between second and third fork about a half length of beam below second fork. Surface of antler very smooth. Metacarpal bone short and broad with weaker constriction near distal part. Other osteological characters unknown.

Description.— *Antler.* A right, shed antler (NSM 14477; Pl. 1, fig. 4; Fig. 4) is 205 mm in preserved length. It is well-preserved, but the distal portion above the second fork and the pedicle are broken off. The burr is oval-shaped in section, thin and moderately rugose. The first tine projects upward directly from the base as seen in the Samber deer. It is very short, measuring 58 mm in straight line. Distance between the first and the second forks is very short, being 143 mm along the inner surface. Beam below the second fork is nearly circular in section and stands almost straight from the base. The tine is also short and projects forward or slightly inward, while the beam above the second fork projects upward and slightly bends backward. A distinct and rather wide longitudinal furrow runs on the inner or the posterior surface of the beam. In anterior view, the antler declines outward, making an acute angle of about 25 degrees with a vertical line on a frontal bone.

A right shed antler (NSM 14444–1; Pl. 1, fig. 5) is 220 mm long as preserved and is much worn. The burr and the distal tines are not preserved entirely. The specimen is somewhat larger than the foregoing one (NSM 14477). The first tine is very tiny and forked just above the burr, making an angle of 58 degrees with beam.

A distal portion of a right antler (NSM 14444–3; Pl. 1, fig. 8; Fig. 4) without the main part of beam below second fork. The second tine is short and projects anterio-upwards, making an angle of 50 degrees with the beam. The third tine is forked at short distance (105 mm) from the second fork, making an angle of more than 50 degrees with the outer one. Beam above the second fork is smooth, subcircular in section and declines backwards, making an angle of 50 degrees with the second tine.

Pedestal. A left pedestal with fragmental frontal bone (NSM 14450; Pl. 1, fig. 6). It is moderately long and slender, showing an oval outline in section. Burr nearly circular and is measured 20 mm in diameter. Judging from the size, it is regarded to be of an immature male.

Anterior limb bone. A left metacarpal bone (NSM 14490; Pl. 1, fig. 7). The bone is short compared to its width measuring 194 mm. The distal portion of shaft is weakly constricted than those of the living Japanese deers. The shaft is somewhat depressed anterio-posteriorly but an outline at its middle portion is more circular than the living Japanese deers. A rather prominent longitudinal ridge runs at the middle part of posterior surface near the distal part.

Relationship.— *Cervus* (cfr. *Sika*) *natsumei* MATSUMOTO was proposed by MATSUMOTO (1938) based on an incomplete antler specimen from a gravel bed of the Nagahama Formation (Middle Pleistocene) on the Boso Peninsula, Chiba Prefecture. He considered that *natsumei* is regarded to be an ancestor of the Japanese Pleistocene and Recent deers.

MATSUMOTO *et al.* (1959) recorded the second specimen of this species from the Late Pleistocene Hanaizumi Formation of northeastern Honshu, Japan, together with *Palaeoloxodon naumanni*, *Leptobison kinryuensis* and *Sinomegaceros yabei**. The

* The Hanaizumi Formation was dated 21,430 or 28,070 yrs B.P. by ^{14}C method, and its fauna represents the Late Würmian.

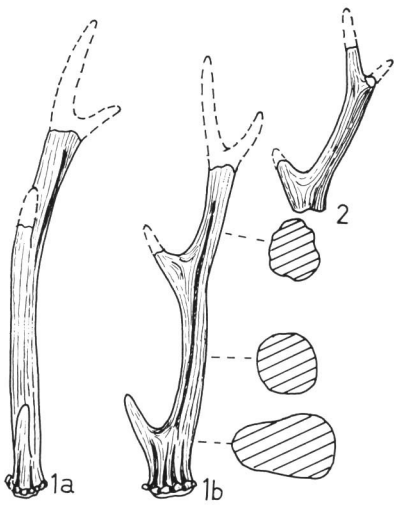


Fig. 4. A right antler (1a, 1b) and a distal portion of right antler (2) of *Cervus* (*Sika*) *natsumei* MATSUMOTO. Frontal (1a) and inner (1b, 2) view, ×0.3.

Hanaizumi material was a right shed antler of young male and is smaller than the type specimen from the Nagahama Formation.

Two antlers now on hand are of nearly the same size as those from the Nagahama and the Hahaizumi Formations but differ somewhat from the latter two by lower position of the first forking.

Antler of this species has the following characters.

(1) Antler of in adult male is very small and three-forked as seen in living Japanese deers, (2) pedicle rather long and slender as seen in *Muntjac* group, (3) burr and beam below the first forking thick anterio-posteriorly, (4) burr thin with its basal plane somewhat declines forward, (5) fore tine very short, projected anterio-upward making very acute angles with beam, (6) beam between first and second forks shorter and less lyrated than that of living Japanese deers, (7) distance of beam between second and third forks about a half of that between the first and second forks, and (8) pedicle longer and slender than that of *Nipponicervus* or living Japanese deer.

The junior writer (1941) once regarded that *C. natsumei* of MATSUMOTO (1938) from the Nagahama Formation shows juvenile *C. yesoensis*. Through the present study, however, the writers are inclined to consider that *natsumei* may be discriminated from the other fossil and living species of *Sika*.

Cervus (*Sika*) *paleoezoensis* n. sp.

Pl. 2, fig. 2; Pl. 3, figs. 1–12; Figs. 5–6.

Referred specimens.— Fifty four antler specimens including fourty one shed ones are recognized in the collection; twenty four are right antlers and twenty four

left antlers. They occupy about 31 % of total number of cervid specimens in the TAKAO Collection. Holotype.— A right shed antler (NSM 14476).

Diagnosis.— Antler moderate in size and triple-forked. Pedicle and antler expanded outward, making an angle of about 65 degrees from each other. First tine forked at more than 25 mm above burr, making an acute angles (more than 70 degrees) with beam. Space enclosed by beam and first fork rather wide. First tine relatively long, sometimes attaining to level of second fork. Beam below second fork moderately long and slightly lyrated backward. Second tine arisen from frontal surface of second fork.

Description.— The antler specimens referable to *C. paleoezoensis* n. sp. in the TAKAO Collection are classified roughly into two types (Types A and B) based upon slight differences of their forking mode. Type A is about three times abundant than Type B. In general, Type B differs from Type A by shorter and less lyrated beam, somewhat narrower angle of the first fork, and weakly constricted beam below the first fork.

1) *Type A*

Antler specimens referable to Type A show a wide range of variation. For instance, the height of the first fork ranges from 15 mm to 45 mm, suggesting the different growth stages.

A right shed antler (NSM 14444–5; Pl. 3, fig. 4) is 157 mm in preserved length. Beam between the first and second forks preserves about the four-fifth of the original length. Burr is thin and oval-shaped in outline, measuring 33.2×26.0 mm in diameter. Beam below the first fork is very short and shows suboval outline with nearly flat inner surface and concave outer one. The first tine is very tiny (37 mm long) and forked at a point 21 mm above burr, making an angle of 60 degrees with beam. In lateral view, the beam stretches upward from the base and then curves gently forward in the distal half, near the second forking. Distance between the first and the second forks would be 130 mm, if restored. In anterior view, an axis of the beam declines outward, making an angle of about 20 degrees with a line perpendicular to the plane of burr.

Another right shed antler (NSM 14479; Pl. 3, fig. 5) is 265 mm long from burr to the broken end of beam above the second fork. The burr is thin and moderately rugose, measuring 36.8×34.2 mm in diameter. The first tine is forked at a position 29 mm above burr and is rather long (149 mm). It projects anterio-upward at the basal part and then curves inward. Length of the first tine is about two-third of total length of the beam between the first and the second forks. The anterio-inner corner of the beam is squared, whereas the outer surface is rounded and distends outward. The second tine arises from frontal surface of the second fork and curves inward at its distal part, making an angle of 70 degrees with beam.

A fragment of a right shed antler (NSM 14459–4; Pl. 3, fig. 1) is 105 mm long from burr to the broken end of beam. The burr and the basal part of the beam below the first fork are depressed laterally and show nearly oval outline. The first tine is

forked at a position 29 mm above the burr and is 142 mm long as preserved, and projects anterio-inward, making an angle of 70 degrees with beam. It is depressed laterally and shows nearly tabular outline at its base with much keeled upper border.

A right shed antler (NSM 14476; holotype: Pl. 3, fig. 3; Fig. 6) is 315 mm long as preserved. A distal portion above the second fork is not preserved. The burr is moderately thick, circular in outline, measuring 39.8×37.7 mm in diameter. The first tine is forked at 44 mm above burr, making an angle of 90 degrees with beam. It is very long (260 mm along the outer border), depressed from side to side, and projects anterio-upward, somewhat outward, and finally inward. The beam between burr and a broken end of beam is lyrated posterio-outward, showing smooth curvature. It is almost the same in length as first tine. In anterior view, basal part of beam declines slightly outward. A space enclosed by the beam and the first tine is very wide.

A right antler with pedicle attached (NSM 14467–1; Pl. 3, fig. 12) is 295 mm long as preserved. This specimen is the largest one among the specimens treated in this paper. Pedicle is short, measuring 30 mm long along the posterior border. Burr is thick, nearly circular and rugose, measuring 48×49 mm in diameter. The first tine is broken off near the base and is forked at 43 mm above burr, making an angle of 85 degrees with beam. The anterio-inner side of beam is squared, while the outer one is much convex outward. In anterior view, antlers of the opposite sides would decline outward, making an angle of 60 degrees from each other, if restored.

A left shed antler (NSM 14442–1) is 70 mm long from the burr to the broken end of beam. It preserves no main part of beam above the first fork. Burr is thin, moderately rugose, oval-shaped in section, and 36.7×32.4 mm across. The first tine is slender and 101 mm long. It is forked at very low position (17 mm) above the burr, making an angle of 70 degrees with the beam. Surface of the beam is much smooth.

Another left shed antler (NSM 14438; Pl. 3, fig. 2; Fig. 5) is 240 mm long from the burr to the broken end of the third tine. The burr has nearly circular outline and is 38.5×36.2 mm in diameter. The first tine is forked at a position about 29 mm above the burr, making an angle of 72 degrees with beam. It is 77 mm in preserved length and projects anterio-upward. In frontal view, an axis of the beam declines outward making an angle of 25 degrees with a line perpendicular to a plane of burr. The beam above the second fork declines backward making an angle of 70 degrees with the second tine. Distance between the first and second forks is short, measuring 160 mm.

2) *Type B*

A right shed antler of young male (NSM 14444–4; Pl. 3, fig. 9) is 165 mm long as preserved. A distal portion of the first tine and beam are not preserved. The first tine is very tiny and is forked at 33 mm above the burr. The beam above the first fork is slightly lyrated and projects upward, making an angle of 60 degrees with the first tine. Distance between the first and the second forks may be about 140 mm, if restored.

A left antler with frontal bone attached (NSM 14443–2; Pl. 2, fig. 2; Fig. 5), is 365 mm long as preserved. The maximum width of frontal bone, from the outer border of pedicle to median suture line, is 48 mm. The pedicles and the antlers of

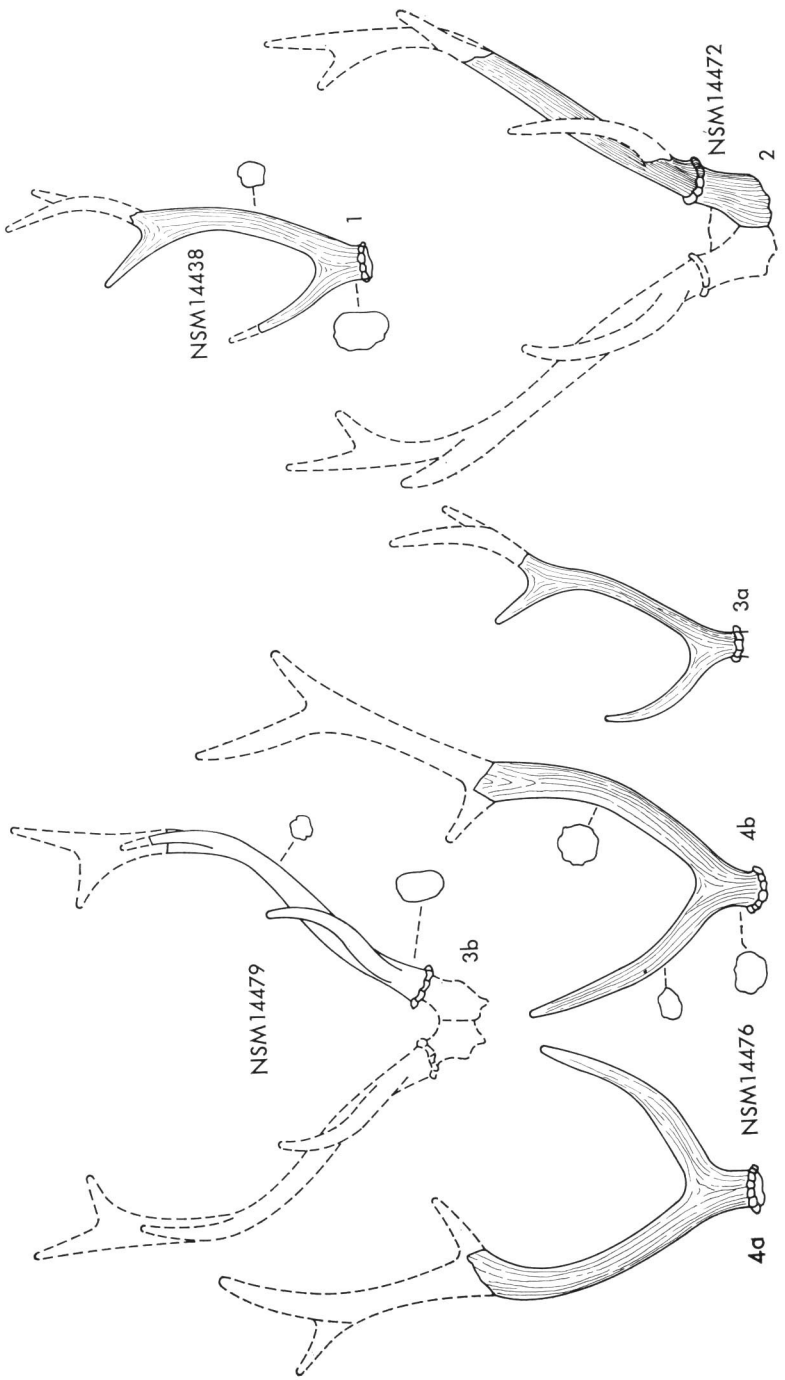


Fig. 5. Antlers of *Cervus (Sika) paleozoensis*, n. sp. (Type A). Outer (1, 4a, 3a), inner (4b) and frontal (2, 3b) views.

opposite sides would expand outward, making an angle of 65 degrees from each other, if restored. Burr is very thick, rugose. The first tine is 195 mm long along the inner border and is forked at 42 mm above burr, making an angle of 75 degrees with beam. It projects anterio-upward and somewhat outward and finally reaches the level near the second forking. Beam above the first fork stretches directly upward from the beam below the first fork with slight inclination. It is 185 mm long along the inner border. The second tine projects anterio-upward, making an angle of 80 degrees with beam. The surface of the antler is rather rugose with longitudinal furrows, ridges and small tubercles.

A right shed antler (NSM 14458–10; Pl. 3, fig. 11) is 285 mm long as preserved from the burr to the broken end of the beam. The first tine and the distal portion of the antler are entirely unpreserved. Burr is thin and rather smooth. In lateral view, the first tine is forked at 44 mm above the burr, making an angle of 73 degrees with beam. The beam is less lyrated and projects upward. In anterior view, the beam below the first fork stands almost straight. Beam is nearly circular in section.

3) *The other types*

A fragment of a right antler (NSM 14437; Pl. 3, fig. 6) is 283 mm long as preserved; namely, from the broken end of beam below the second fork to the broken end of the hind tine of the third fork. The interval between the second and the third forks is 143 mm. The second tine arises from the front-outer surface of the forking, making

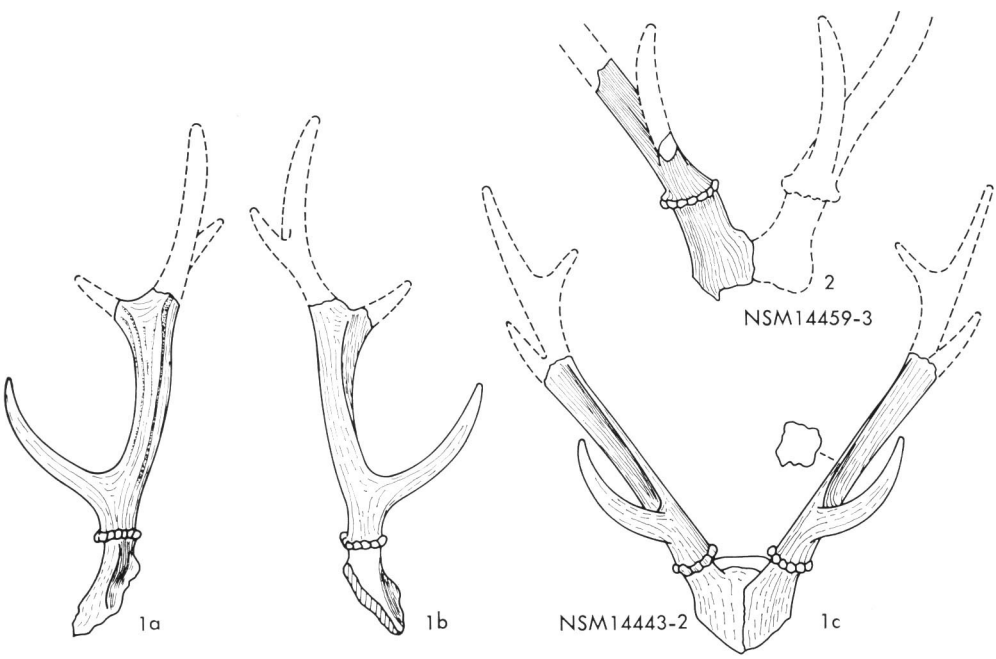


Fig. 6. Antlers of *Cervus* (*Sika*) *paleoezoensis*, n. sp. (Type B). Frontal (2, 1c), outer (1a) and inner (1b) views.

an angle of 80 degrees with beam, while the third (or inner) tine issues from the inner surface of the terminal fork. The terminal tine is 85 mm long as preserved. Surface of the antler carries rather wide, noticeable furrows and ridges.

A fragment of the first tine (NSM 14441-9; Pl. 3, fig. 8) curves gently with slight irregular undulation, being 300 mm long along lateral surface; surface is smooth but has shallow, wide furrows and ridges.

Comparisons.— As mentioned already, the antler of this species is classified into two types, A and B, based upon slight differences of their forking mode. The former is predominant to the latter. They are variable according to difierent growth stages.

Fig. 13 shows the relationships between the height and the first forking angle of the antler. The variation of that of living Japanese deer is also shown. This species seems to differ from the living Japanese deer by more lyrated beam, longer first tine and broader space enclosed by the first tine and beam. Among the antler specimens, Type B may resemble *C. nippon*, while Type A may be close to *C. yesoensis* in having wide angle of first forking, long first tine and large size. But the writers cannot recognize so sufficient differences in the two types as to separate them into different species. The present new species also differs from the Tsushima-deer (*C. pulchellus*) by having lower point of first forking, more lyrated beam and longer first tine. Other species referrable to subgenus *Sika* such as *C. hortulorum* and *C. taiouanus* are also distinguished from the present new species by the same characters.

Cervus (*Sika*) cf. *greyi* (ZDANSKY)

Pl. 4, figs. 6–15

cf. *Pseudaxis greyi* ZDANSKY, 1925, *Pal. Sinica, ser. C*, vol. 2, fasc. 3, p. 65–72, Taf. XIII, figs. 2–12.

Referred specimens.— Thirty three antler specimens including thirty shed antlers are treated; seventeen specimens are right antlers and sixteen left antlers. Most specimens are incomplete in preservation and preserve no main part of beam above the second fork. They occupy about 19% of the total number of cervid specimens in the TAKAO Collection.

Diagnosis.— Antler small or moderate in size. First tine forked at rather low position above burr, moderately long, and projected forward or slightly upward. Beam above first fork rather short and much lyrated backward in lower half, then curved upward in distal part, making very wide angle (more than 95 degrees) with first tine. First tine remarkably depressed laterally near base, showing an oval outline in section. In frontal view, antler expanded outward, making an angle of 60 degrees with the opposite one. Short second tine arisen from anterio-outer surface of second fork. Height, angle of first fork, and surface ornamentation considerably variable.

Description.— Antler specimens referable to this species in the Takao Collection are divided roughly into two types, A and B, based upon the different heights and angles of the first fork.

1) *Type A*

Antlers show a low first forking ranging from 18 mm to 40 mm in height and

angle of the first forking ranging from 80 to 90 degrees. Twenty two specimens are belonged to this type.

An incomplete, left shed antler (NSM 14448–10; Pl. 4, fig. 7) is 160 mm in preserved length. The first tine is forked at 25 mm above burr, and projects forward and somewhat outward, making an angle of 86 degrees with beam. It is depressed laterally and shows almost oval outline in section. Beam stretches directly from the base without any curving. Surface of the antler is rather smooth, though with shallow longitudinal furrow and grooves.

A fragment of right antler with pedicle attached (NSM 14459–1; Pl. 4, fig. 9). The first tine is forked at 40 mm above burr. The tine is short but thick and projects anterio-upward, making an angle of 90 degrees with beam. It is much depressed laterally in its lower half and shows nearly tabular outline in section.

An incomplete, right shed antler (NSM 14459–10; Pl. 4, fig. 11) preserves no main part of beam above the first fork. The size is near to the specimen NSM 14448–10. The first tine is about 83 mm in preserved length and forked at 38 mm above burr. It is remarkably and laterally depressed and shows tabular outline in section. A small obtuse nodule is recognized on the upper surface of the first tine.

A left shed antler (NSM 14474; Pl. 4, fig. 10) without a distal portion above the middle part of beam. Burr is rather thick, measuring 6.4 mm in maximum. The first tine is forked at 32.8 mm above the burr, making an angle of 90 degrees with the beam. It is more than 160 mm in length and much depressed laterally. In frontal view, an axis of beam above the first fork declines outward. Antler is provided with rather wide but shallow furrows and grooves. This ornamentation is more remarkable on the inner surface than on the outer one.

2) *Type B.* This comprises nine antlers having wider angles, more than 90 degrees, and moderate height of the first forking ranging from 25 mm to 35 mm.

A small, shed left antler (NSM 14447–1; Pl. 4, fig. 8) is 211 mm long as preserved from the burr to the broken end near the second fork. Beam below the first fork is very broad and short, measuring 39 mm in diameter. The first tine is rather short (about 102 mm), depressed laterally, and forked at a rather low position (31 mm) above the burr. Beam above the first fork is rather short, being measured 108 mm in preserved length. It is much lyrated backward in the lower half, then curves upward in the upper half, making an angle of 97 degrees with the first tine. In frontal view, a basal plane of the burr much declines outward.

A shed, right antler (NSM 14457–3; Pl. 4, fig. 15) is 244 mm long as preserved. Beam below the first fork is very short and broad in anterio-posteriorly. The first tine is forked at 30 mm above the burr, making an angle of 90 degrees with beam. Beam above the first fork is 210 mm in preserved length and 34 mm$\times$25 mm in diameter. Interval between the first and the second forks would be about 250 mm in original state, if restored.

3) *The other type*

A fragment of a distal portion of a right antler (NSM 14440–2; Pl. 4, fig. 13)

is 200 mm long, from the broken end of beam below the second fork to the broken end of the hind tine of the third fork. The second tine stretches up- and outward, making an angle of 65 degrees with beam. It is short and 55 mm in length. Distance between the second and third forks is measured 103 mm along the lateral border. The third tine is directed posterio-upward, making an angle of 60 degrees with the hind tine.

Comparisons.— The antler specimens referred to *Cervus* (*Sika*) cf. *greyi* (ZDANSKY) are characterized by three-forking, small-size, much lyrated short beam, and a low position of first fork.

In 1925, ZDANSKY described fossil deer under the name of *C. greyi* as a new species from the Middle Pleistocene of Shansi Province, North China, based on incomplete antlers and some lower jaws and a skull. Some specimens of this species were recorded from the Lower to Middle Pleistocene deposits of China by such authors as ZDANSKY (1927), YOUNG (1932), and TEILHARD and PEI (1941). So far as the feature of the antler is concerned, specimens from the Takao Collection are closely allied to *C. greyi*, although the TAKAO materials differ from the typical species in having wider angle and lower position of the first fork.

In Chinese Continent, *C.* (*Sika*) *hortlorum* SWINHOE, now living in the Ussuri district and Northeast China (Manchuria), was also recorded from the Upper Pleistocene deposits and the archeological sites. *C.* cf. *greyi* described here also differs from *hortlorum* in having wider angle and the lower position of the first forking.

The antler of *C.* cf. *greyi* differs from an allied species, *C. paleoezoensis* n. sp., by wider angle of the first forking and shorter beam above first forking.

As far as the features of antler are concerned, the present species may be more closely allied to *C.* (*Rucervus*) *katokiyomasai* SHIKAMA & HASEGAWA in the general appearance than any other species of *Cervus* (*Sika*). Fig 12 shows the relationship between the fore-and-aft diameter of burr and the angle of first fork of the antlers of *Cervus* in the TAKAO Collection. As shown in this figure, the antler specimens showing larger dimention and wider angle of the first fork are regarded as those of adult male. On the other hand, the type specimen of *C. katokiyomasai* is regarded to represent young male, if we pay attention to the diameter of the antler, although it shows very large angle more than 110 degrees; this value corresponds to that of adult male of *C. greyi*. For these reasons, the writers considered that *greyi* in question may be independent species from *katokiyomasai*.

The present species also allies to but differs from *C. nippon* by shorter beam above the first fork, wider angle of the first fork, and more lyrated beam, etc.

Subgenus *Nipponicervus* KREZOI, 1941

Type-species.— *Cervus praenipponicus* SHIKAMA, 1936

Subgeneric diagnosis.— Antler moderate in size, slender with two forking. Fore (or first) tine fairly large and forked at a very high position above burr, making acute angle with beam. Distance between first and second fork long and about four times of beam below first fork. Outer tine of terminal fork longer than the inner one, con-

tinuting to beam. A V-shaped space enclosed by antlers of both sides.

Taxa, distribution and nomenclature.— *Deperetia* was established by the junior author (1936b) as a subgenus of *Cervus*, based upon an antler of *Cervus praenipponicus* SHIKAMA from the Late Pleistocene Kuzuü Formation, central Japan. In the paper, he gave the following subgeneric diagnosis: "Antler moderate without a brow tine; surface rather smooth, lacking distinct tubercles or grooves. Distinguished from *Anoglochis* CROIZET and JOBERT by the beam which is straight below bifurcation and divided high above the burr and lacks distinct crown or frequently branching tines of tip portion". In the later paper (SHIKAMA, 1941), furthermore, he added the following supplementary remarks: "This subgenus is closely related to the Arde deer (*Anoglochis*) and is quite distinct from the subgenera *Sika*, *Rusa*, or *Axis* in the proportion and length of the first tine, branching of the inner tine of terminal fork . . .".

But the writers can not use the name *Depéretia* for the deer in question from a problem of nomenclature. As pointed by KREZOI (1941), the name *Depéretia* has already been used for the pectinid group by TEPPNER (1922) and for the antelope group by SHAUB (1923) so that the name *Depéretia* is invalid for the subgenus of deer. KREZOI (1941) proposed a new name *Nipponicervus* to replace *Depéretia* SHIKAMA. It seems to belong to *Axis* of the southeastern Asia because of two forkings with wide angles of the first fork and of the second tine which expends inward. Because many species of *Nipponicervus* including the type species have narrower angle of the first forking branched off at higher point and less lyrated beam compared to *Axis*, the writers regard *Nipponicervus* as an independent group from *Axis*.

The species of the subgenus *Nipponicervus* appeared first in the Early Pleistocene of northeastern Asia and distributed over central to western Japan during the Middle to Late Pleistocene. The age of their flourish is nearly contemporaneous with that of NAUMANN's elephant in the Japanese Islands. The distribution area extends from Taiwan to northwestern Honshu of central Japan, besides northeastern Asiatic Continent; that is approximately subtropical-temperate area between about 20°N and 40°N.

Following eight species of *Nipponicervus* have been hitherto recorded from northeastern Asia by the writers (SHIKAMA, 1936a, 1937, 1941, 1949; OTSUKA, 1967), although some species may be junior synonyms of *C. praenipponicus* or *kazusensis*.

A. *Cervus* (*Nipponicervus*) *praenipponicus* SHIKAMA: 1. Akiyoshi brown clay bed (Late Pleistocene), 2. Hayashizaki clay bed of the Akashi Formation of the Osaka Group (Lower Pleistocene, Middle to Upper Villafranchian), 3. Shimosueyoshi Formation (Middle Pleistocene), 5. Lower and Upper Kuzuü Formations (Middle to Upper Pleistocene). B. *C.* (*N.*) *naorai* SHIKAMA: The Hujie Bed of the Harima Group of SHIKAMA (Lower Pleistocene). C. *C.* (*N.*) *urbanus* SHIKAMA: The Carnivora bed of the Upper Kuzuü Formation (Upper Pleistocene). D. *C.* (*N.*) *kokubuni* SHIKAMA: Upper part of the Kicho Formation, Taiwan (Lower Pleistocene). E. *C.* (*N.*) *trassaerti* SHIKAMA: Yushê Series in the southeastern Shansi, North China. F. *C.* (*N.*) *syatinensis* SHIKAMA: Upper part of the Kicho Formation, Taiwan (Lower Pleistocene). G. *C.* (*N.*) *kazusensis* MATSUMOTO: Upper part of the Umegase For-

mation (Lower Pleistocene, Middle to Upper Villaranchian). H. *C.* (*N.*) *shimabarensis* OTSUKA: Ôya Formation of the Kuchinotsu Group (Lower Pleistocene).

Species belonging to Nipponicervus *in the* TAKAO *Collection*:— Antler specimens referable to the subgenus *Nipponicervus* are most abundant, occupying about 38% in the collection. They can be discriminated in the following four species based upon the height and the angle of the first fork.

	Height (mm)	Angle
C. (*N.*) *kazusensis*	very high (70–100)	60°–80°
C. (*N.*) *praenipponicus*	high (45–75)	60°–85°
C. (*N.*?) *takaoi* n. sp.	moderate (45–50)	60°–90°
C. (*N.*?) sp.	moderate (30–55)	

Cervus (*Nipponicervus*) *praenipponicus* SHIKAMA

Pl. 4, figs. 1–5; Pl. 5, figs. 1–7; Figs. 7 and 8.

Cervus (cfr. *Anoglochis*) *praenipponicus* SHIKAMA, 1936a, *Jour. Geol. Soc. Japan*, vol. 40, no. 482, p. 251–254, p. 9.

Cervus (*Depéretia*) *praenipponicus* SHIKAMA, 1937, *Sci. Rep. Tohoku Imp. Univ., 2nd. ser.*, vol. 19, no. 1, p. 2; —— SHIKAMA, 1941, *Jubl. Pub. Comm. Prof. Yabe*, vol. 2, p. 1142–1147; —— SHIKAMA, 1949, *Sci. Rep. Tohoku Univ., 2nd. ser.* vol. 23, p. 84–99.

Cervus (*Depéretia*) *naorai* SHIKAMA, 1936b, *Proc. Imp. Acad. Tokyo*, vol. 7, no. 8, p. 251–254.

Diagnosis.— SHIKAMA (1949) stated as follows: "Three tined antlers of almost inadaptive type*. Both right and left antlers extending over an angle of more than 90 degrees. Angle made by pedestal and cranial profile about 70 degrees. First forking high above the burr, nearly 100 mm above the burr observed in the present collection. The beam above the first forking relatively straight and the second tine exist very high position above the first forking".

Examination of the antlers from the TAKAO Collection and from various localities makes it clear that the height of the first forking ranges from 45 mm to 75 mm and its angle from 60 to 85 degrees. In general, these values and the inclination of beam (α') become larger with growth stage (Fig. 11).

Description.— The antlers from the TAKAO Collection are divided into three types, A, B, and C, based on the different heights and angles of the first forking.

1) *Type A* (Height: 45～55 mm; angle: 67°～75°)

A right shed antler (NSM 14446–9; Pl. 4, fig. 5) is 105 mm long as preserved. Beam above the forking and an apical part of the first tine are not preserved. The first tine is very tiny and forked at 49 mm above burr; this forking point is lowest among those of the antlers examined here. Beam above the first fork is less lyrated backward and a degree of inclination (α') is about 10 degrees.

A right shed antler (NSM 14471–3; Pl. 4, fig. 1; Fig. 12) is 128 mm long as preserved. Beam above the forking is not preserved. The first tine is forked at a rather

* Adaptive and inadaptive types are the terms applied by TEILHARD and TRASSAERT (1937) to three tined antlers with longer hind terminal tine and those with shorter one, respectively.

low position (52 mm) above the burr, making 80 degrees with beam. The area of webb is rather broad for this species.

2) *Type B* (Height: 55–65 mm; angle: 65°–80°)

A basal part of a right antler (NSM 14446–2; Pl. 4, fig. 2) is 230 mm long as preserved. Burr is nearly circular in outline. Beam below the first is subrectangular in section, measuring 32×22 mm in diameter at middle portion. The first tine is entirely preserved, measuring 130 mm long along the curved margin. It is forked at a point 46 mm above the burr, making 73 degrees with the beam.

A basal part of a right antler with pedicle attached (NSM 14468–5; Pl. 5, fig. 1; Fig. 7). In anterior view, antlers extends outward, making an angle of 80 degrees from each other. Pedicle is rather short, measuring 25 mm along the posterior border. Beam below the first fork shows tabular outline but is somewhat depressed laterally. The first tine is 102 mm long as preserved and forked at 57 mm above the burr.

Fig. 7. Antlers of *Cervus* (*Nipponicervus*) *praenipponicus* SHIKAMA.

3) *Type C* (Height: 65–75 mm; angle: 65°–80°)

A basal part of a left shed antler (NSM 14445–1; Pl. 4, fig. 3) is 190 mm long as preserved from the base to broken end of beam. Burr is moderately thick, with a circular outline in section, being measured 39×39 mm in diameter. The first tine is well preserved, measuring 163 mm from a point of the forking to a tip of the tine. This is forked at a position very high above the burr and projects anterio-upward in curving slightly. Beam above the first fork is lyrated making 70 degrees with the beam. Inner surface of the beam is nearly flat, while the outer one somewhat distends outward. There are some longitudinal furrows and ridges on the whole surface.

A basal part of a left antler with a fragmental, frontal bone attached (NSM 14481; Pl. 5, fig. 6). The two pedicles would extend outward, probably making an angle of 75 degrees from each other, if restored. The antler is also prolonged in the same direction as is in the pedicle. Burr is circular, less rugose and thin measuring 40×43 mm in diameter. The first tine is forked at more than 67 mm above the burr. This

extends more outward than the beam. Beam above the first fork is lyrated backward making an angle of 67 degrees with the first tine, but is broken off at 20 mm from the forking point.

A basal part of the left antler (NSM 14461; Pl. 5, fig. 4) is 315 mm long as preserved. This is the largest specimen of this species in the collection. Burr is almost circular, moderately thick, measuring 49×48 mm in diameter. Beam below the first fork is also circular in section, and its outer and inner surfaces are somewhat flat or slightly concaved. The first tine is 100 mm long as preserved and forked at more than 65 mm above the burr, making an angle of 77 degrees with the beam. Beam above the first fork is 265 mm long as preserved and declines backward from a point of forking. In anterior view, an axis of antler declines outward on the horizontal plane of burr.

Variation and taxonomic relationship.— The above-mentioned antler specimens show considerable variation in height and angle of the first forking. The species *praenipponicus* is discriminated from *kazusensis* by the lower forking point of the first fork and by different growth rates. As shown in Fig. 13, the antlers of *Nipponicervus* are separated into two types with a higher or lower position of the first forking.

Type C shows close alliance to Type A of *C. kazuensis*. The holotype (Reg. No. 58804) and paratypes (Reg. Nos. 58805 and 68804) of *praenipponicus* from the Kuzuü Formation (SHIKAMA, 1936) fall within the catagory of Type C.

C. ("*Depéretia*") *kokubuni* and *C.* ("*Depéretia*") *syatinensis* from the Villafranchian of Taiwan (SHIKAMA, 1937) and *C. naorai* from the Akashi Formation of the Osaka

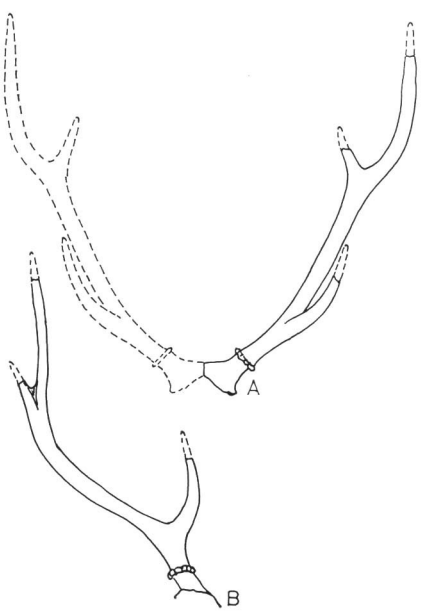


Fig. 8. Restored figures of antler of *Cervus* (*Nipponicervus*) *praenipponicus* SHIKAMA [Holotype] Frontal (a) and inner (b) views, ×0.0.

Group (SHIKAMA, 1936a) seem to fall within the catagory of Type A of *praenipponicus*, although *kokubuni* is distinguished from *praenipponicus* by more tabular outline of the beam with rugose surface. The type specimen of *syatinensis* is regarded as a shed antler of immature male of *kokubuni*.

Cervus (*Nipponicervus*) *kazusensis* MATSUMOTO

Pl. 5, figs. 7–12; Fig. 9

Cervus (cfr. *Sika*) *kazusensis* MATSUMOTO, 1926, *Sci. Rep. Tohoku Imp. Univ., 2nd. ser.*, vol. 10, no. 2, p. 58–60.

Cervus (*Depéretia*) *kazusensis* MATSUMOTO, SHIKAMA, 1941, *Jubl. Pub. Comm. Prof. Yabe*, vol. 2, p. 1148–1149.

Cervus (*Depéretia*) *urbanus* SHIKAMA, 1941, *Jub. Pub. Comm. Prof. Yabe's 60th Bisthday*, vol. 2, p. 1125–1170. —— SHIKAMA, 1949, *Sci. Rep. Tohoku Imp. Univ., 2nd. ser.*, vol. 23, p. 99–103.

Cervus (*Depéretia*) *trassaerti* SHIKAMA, 1941, *Jub. Pub. Comm. Prof. Yabe's 60th Birthday*, vol. 2, p. 1148.

Cervus (*Depéretia*) *shimabarensis* OTSUKA, 1967, *Mem. Fac. Sci. Kyushu Univ., ser. D*, vol. 28, no. 2, p. 306–310, pl. 9, fig. 1.

Referred specimens.— Nine right antlers and six left antlers showing various growth stages.

Diagnosis.— Antler moderate in size and slender with two forkings. First tine forked at high position (more than 45 mm) above burr, making an angle of more than 70 degrees with beam. Beam above first fork less lyrated than that in *praenipponicus*. Second tine forked at very high above first fork. Third tine longer than second one, projecting inward or somewhat backward, continuing to beam. Surface of antler rather smooth.

Description.— The antler specimens now on hand show considerable variation in size and ornamentation; they are divided into two types based on height and angle of the first fork.

1) *Type A* (Height: 75–90 mm; angle: 60°–90°; 11 specimens)

A basal part of left shed antler (NSM 14445–8; Pl. 5, fig. 11) is 150 mm long as preserved from burr to a broken end of beam. The first tine is forked at very high position (87 mm) above the burr. It is very tiny, measuring 68 mm long. Burr is nearly circular and its basal plane declines outward. Beam below the first fork is subrectangular outline in section and becomes broad upward. Surface of the antler is rather smooth.

2) *Type B* (Height: 90–100 mm; angle: 60°–75°; 5 specimens)

An incomplete right shed antler (NSM 14469–4; Pl. 5, fig. 12) is 240 mm long as preserved. Beam below the first fork is very long, subrectangular outline in section and declines outward. Burr is nearly circular, thin and less rugose. The first tine is forked at very high position above the burr. Beam above the first fork is almost circular in section and lyrated backward, making an angle of 73 degrees with the first tine, though it was completely broken off at 170 mm from the first fork.

A basal part of a left antler (NSM 14478; Pl. 5, fig. 8) is 195 mm long as preserved.

The first tine is forked at very high position (99 mm) above burr. Burr is thin and almost circular in outline. Surface of the antler carries broad but shallow longitudinal furrows, which are more noticeable.

A basal part of a right antler (NSM 14469–7; Pl. 5, fig. 10) is 260 mm long as preserved. An axis of the beam slightly declines outward. The first tine is forked at very high position (94 mm) above the burr. Burr is almost circular being measured 43×41 mm in diameter. Inner surface of the beam is nearly flat, while the outer one is much convex with rounded surface.

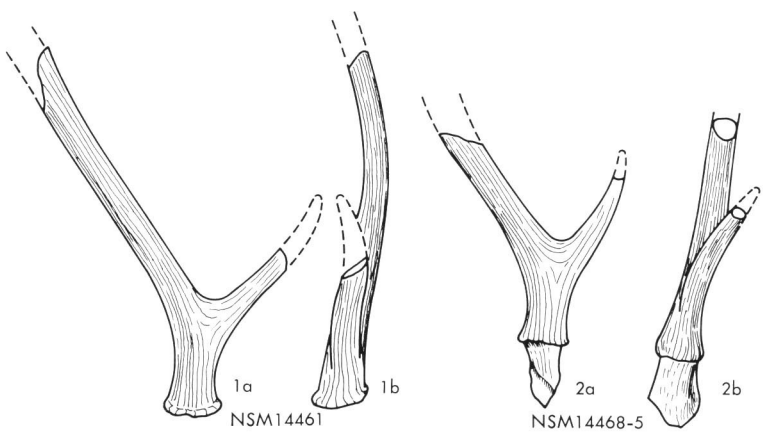


Fig. 9. Antlers of *Cervus* (*Nipponicervus*) *kazusensis* MATSUMOTO.

Taxonomic relationship.— Among the antlers of *Nipponicervus* now on hand, the specimens identified as *kazusensis* is safely discriminated from those of *praenipponicus* by higher position of the first forking.

The holotype of *C.* (*N.*) *kazusensis* (MATSUMOTO, 1926) fall within Type A. *C.* (*N.*) *urnanus* SHIKAMA, 1941 from the Upper Kuzuü Formation, which is characterized by very high position of the first forking and by remarkable ridges and furrows on the beam, may be regarded as a junior synonyum of *kazusensis*; for instance, the holotype (Reg. No. 61674) and paratype (Reg. No. 65561) of *urbanus* fall within the catagories of Types B and A of *kazusensis*, respectively. Very remarkable ornamentation of the antler of *urbanus* may indicates an unique variation of *kazusensis*.

C. (*N.*) *shimabarensis* (OTSUKA, 1967) and *C.* (*N.*) *trassaerti* SHIKAMA, 1941 are also included within *kazusensis* as variation.

Because all the specimens of *kazusensis* including the type specimens lacks main part of antler above second fork, the whole character of the antler are unknown. But the type specimens of *shimabarensis* and *trassaerti* possess almost complete antler with skull attached. In the foregoing diagnosis, therefore, the antler was figured out based on these type specimens instead of those of "*kazusensis*".

Cervus kazusensis was first described by MATSUMOTO (1926) from the Umegase Formation (lowest Pleistocene) which is widely distributed in the central part of the Boso Peninsula of Chiba Prefecture, central Japan. His description was based only on the basal part of an antler so that the characters of the other parts have been obscure. MATSUMOTO (1926) compared it with *Cervus cylindriceros* BRAVARD [=*C. borbonicus* (DEPÉRET & CROIZET)], including them into the subgenus *Sika*. From the proximal aspect of the antler, SHIKAMA (1941) tentatively placed *C. kazusensis* in the subgenus *Depéretia* (=*Nipponicervus*).

Cervus (*Nipponicervus*?) *takaoi* n. sp.

Pl. 6, figs. 1–9

Rusa sp., NAORA, 1970, *Sci. Rep. Inst. Min. Ind., Fac. Sci. Eng., Waseda Univ.*, no. 26, p. 55–61, fig. 3.

Referred specimens.— Six right antlers and seven left antlers; six specimens with pedicle attached. Holotype.— A left shed antler; NSM 14436.

Diagnosis.— Antler moderate in size, long and slender having two forkings. It extended widely outward and a V-shaped space enclosed by both antlers of the opposite. First tine moderately long and forked at high above burr, making more than 80 degrees with beam. Beam above the first fork longer, slender and less lyrated backward than in *Sika* but nearly the same as that of *praenipponicus*. Terminal front tine forked very high above first fork and projected forward and somewhat outward. Terminal hind tine longer than frontal one, forming a continuation of beam. A plane made by two terminal tines nearly parallel to that made by first tine and beam of first fork. Surface of antler rather smooth.

Description.— An incomplete, left shed antler (NSM 14436, Pl. 6, fig. 6; holotype) is 283 mm long as preserved from the burr to a point of the second fork. The apical part of the first tine, the second tine and the third tine are not preserved.

In frontal view, the antler is extending outward and a space enclosed by the antlers of opposite sides is V-shaped. Burr is nearly circular, less rugose and relatively thin, measuring 40×35 mm in diameter. An axis of the antler declines outward on the horizontal plane of burr. Beam below the first fork is subcircular outline in section. The first tine is forked at 47 mm above the burr and projects forward. Beam above the first fork is six times as long as beam below the first fork.

In lateral view, the first tine is slightly lyrated backward in the lower half, making an angle of 80 degrees with the first tine and then curves anterio-upwards in the distal half. An interval between the first and the second forks is long, measuring length of 294 mm along the inner surface. From the front or front-outer surface of the terminal fork, the front tine arises as an offshort, making an angle of 70 degrees with hind tine. Hind tine of the second fork is longer than the front (or outer) one, forming a continuation of beam. Surface of beam is relatively smooth but carries shallow furrows.

A right antler with pedicle attached (NSM 13456; Pl. 6, fig. 9; Fig. 10) is 400 mm long as preserved but an apical part of the first tine and a distal portion of the beam

above the terminal fork are not preserved. The antlers of the opposite sides would expand outward, making an angles of 60 degrees from each other, if restored.

A basal part of a right antler with pedicle attached (NSM 14462; Pl. 6, fig. 4) is 290 mm long as preserved. The pedicles and the antlers of the opposite sides would expand outward, making an angle of 45 degrees from each other, if restored. Burr is much worn but shows almost circular outline in cross section. The first tine is forked at 50 mm above burr, making 80 degrees with beam.

A right antler (NSM 14463; Pl. 6, fig. 3) is 330 mm long as preserved from the burr to the broken end of beam near the second fork. The first tine is oval-shaped and projects forward making an angle of 90 degrees with beam. The beam above the first fork is 300 mm long as preserved.

A shed, abnormal antler of adult male (NSM 14444–2; Pl. 6, fig. 5) is about 273-

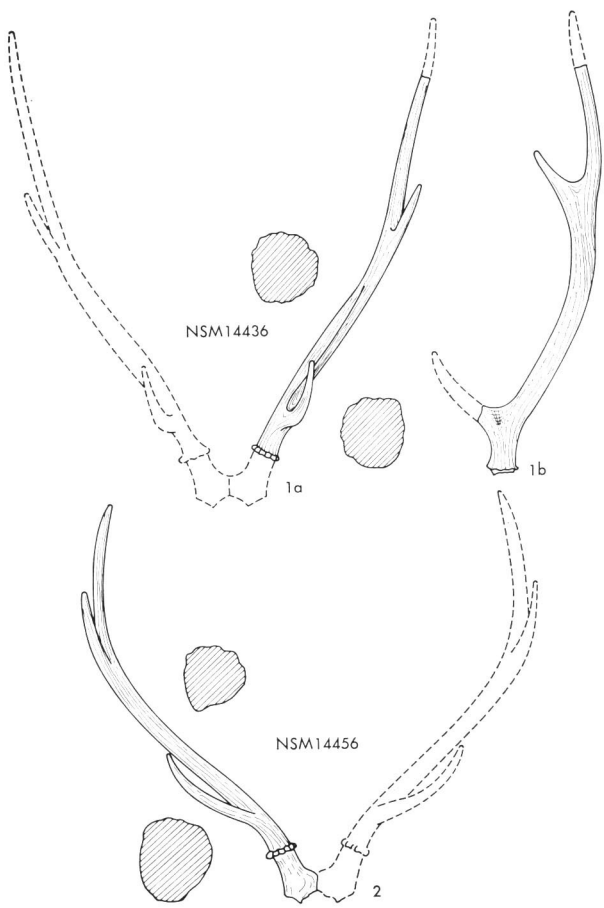


Fig. 10. Restored figures of antlers of *Cervus* (*Nipponicervus*?) *takaoi*, n. sp. Frontal (1a, 2) and outer (1b) views, ×0.3.

mm long as preserved. The antler does not fork and projects straight upward from the base, not being curved. Burr and the beam near the base are almost circular in section. Burr is moderately thick, measuring 37 mm in side-to-side diameter. Surface of the antler is relatively rugose with small tubercles and shallow, longitudinal furrows.

Comparisons.— The mode of the terminal fork of this species is allied to that of subgenus *Rusa* (=Samber deer). Especially, tha antler specimens on hand resembles those of the Javanese Samber, named *Cervus* (*Rusa*) *timoriensis* BLAINVILLE, which lives in the southeastern Asia, although they are distinguishable from the latter by higher position of the first forking, less rugose surface of the beam, and the mode of terminal forking.

Cervus (*Rusa*) *unicolor* KERR comprising five races and living in India and the southeastern Asia, is clearly discriminated from the present species by larger and thicker antler with low position of the first forking and by the mode of terminal fork, hind

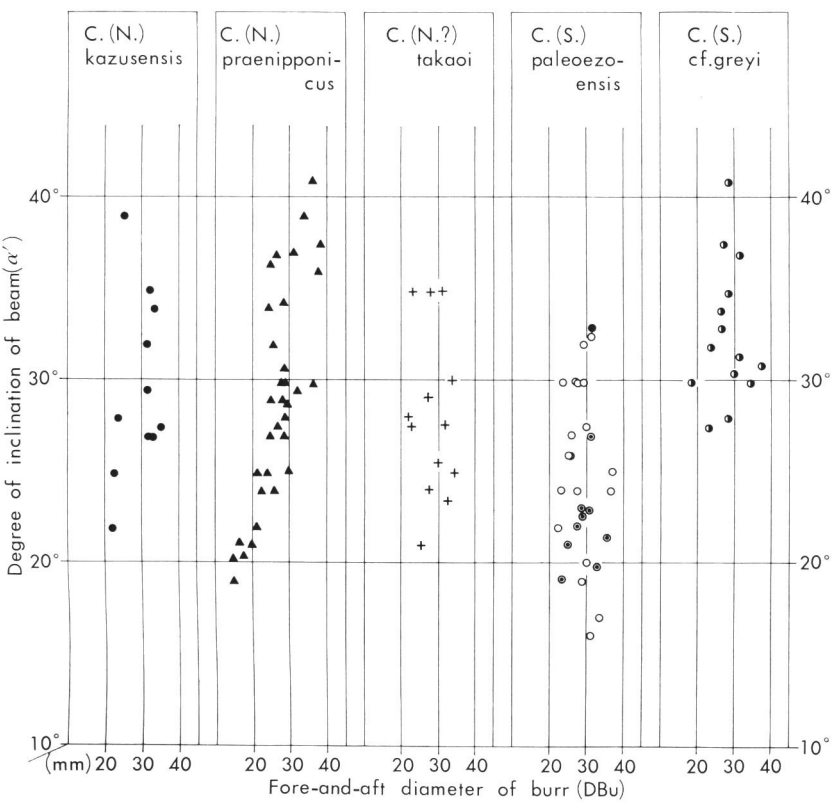


Fig. 11. Graph showing the relationship between the degree of inclination of the beam above the first fork (α) and the fore-and-aft diameter of the beam (DBu) of *Cervus* in the TAKAO Collection. See Fig. 13 for the explanation of the symbols.

(or inner) tine of which is shorter than the front (or outer) tine, excepting a special case having an equal length of the terminal tines.

The antlers of the present new species is allied to those of *C.* (*Nipponicervus*) *praenipponicus* except for different modes of the terminal forking and, moreover, their height-angle ratios fall in an area just beneath that of *praenipponicus* (See Fig. 13). Consequently, there still remains a possibility that this new species may become an extreme variation of *praenipponicus*.

Cervus (*Nipponicervus*?) sp.

Pl. 1, fig. 9

Referred specimen.— An incomplete right shed antler (NSM 14459–13).

Description.— A right shed antler (NSM 14459, Pl. fig. 9) is rather small, with almost smooth surface. In lateral view, the beam expands upward and shows much oval outline in section. The anterior, posterior, and inner surfaces are slightly convex, while the outer surface is slightly concave. The first tine is forked at 51 mm above the burr. Burr is moderately rugose and thin.

Diameter of burr: 42.7×45.5 mm; diameter of the first tine at base: 19.1×29.1 mm; height of the first fork: 51 mm; angle of first fork: 70°.

Comparisons.— The present incomplete specimen seems to be referred to a species of *Nipponicervus* but is distinguished from the species described in foregoing pages and also from many races of living Japanese deer by more depressed and broader beam with less remarkable ornamentation. More complete specimen is needed to clarify the precise systematic position.

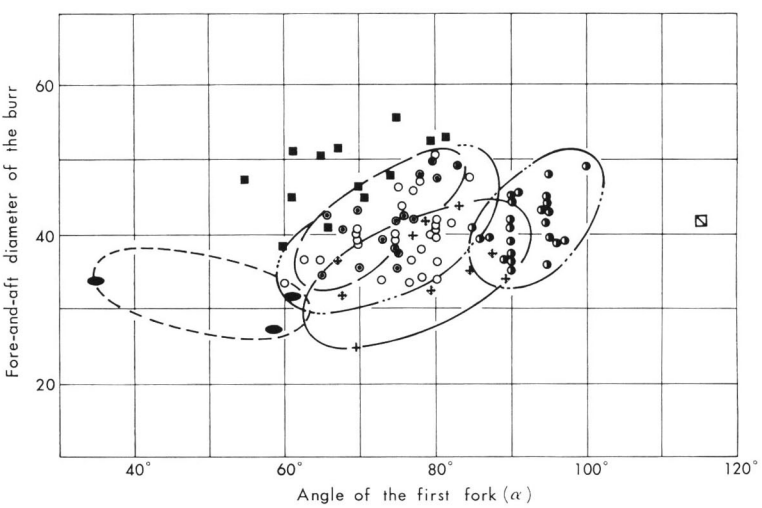


Fig. 12. Graph showing the relationship between the fore-and-aft diameter of burr (DBu) and the angle of the first fork (α). See Fig. 13 for the explanation of the symbols.

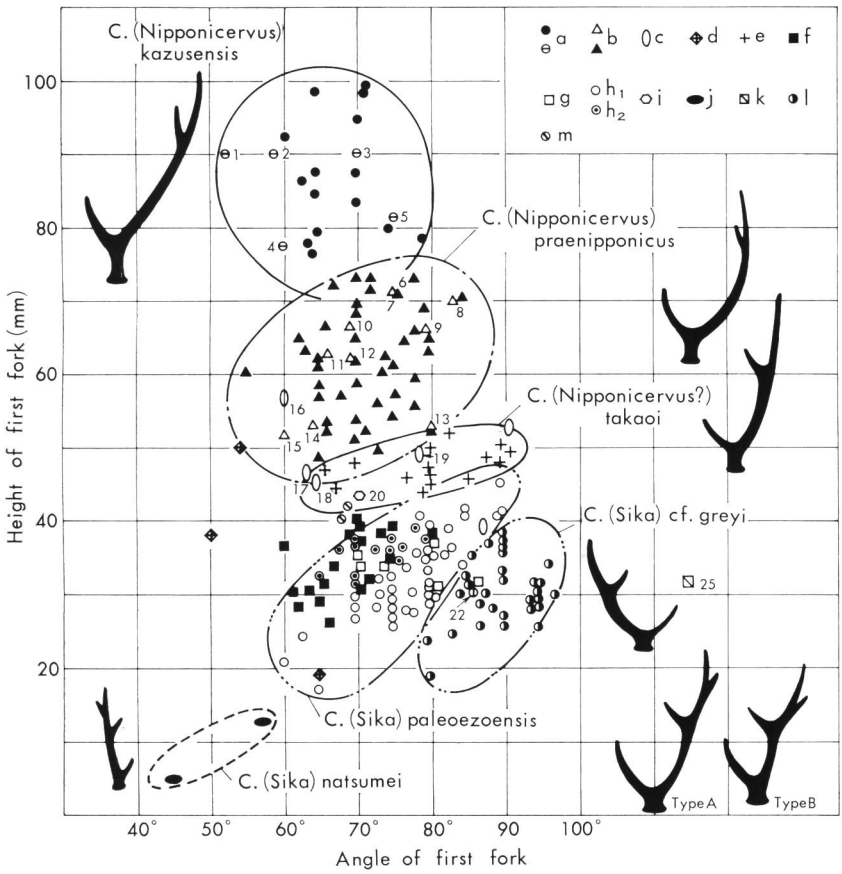


Fig. 13. Graph showing the relationship between the height (H) and the angle of the first fork (α) of the antler of *Cervus* in the TAKAO Collection. a: *C.* (*N.*) *kazusensis*, b: *C.* (*N.*) *praenipponicus*, c: *C.* (*S.*) *fortulorum*, d: *N.* (*S.*) *nippon taiouanus*, e: *C.* (*N.*?) *takaoi*, f: *C.* (*S.*) *nippon*, g: *C.* (*S.*) *yesoensis*, h: *C.* (*S.*) *paleoezoensis*, i: *C.* (*S.*) *magnus*, j: *C.* (*S.*) *natsumei*, k: *C.* (*R.*?) *katokiyomasai*, l: *C.* (*S.*) cf. *greyi*, m: *C.* (*S.*) *pulchellus*, 1: *C. N.*) *shimabarensis* (OTSUKA, 1967), 2. *C.* (*N.*) *trassaerti* (TEILHARD & TRASSAERT, 1937; SHIKAMA, 1941), 3–4. *C.* (*N.*) *urbanus* [SHIKAMA, 1941, 1949; Reg. No. 61647 (holotype) and No. 65561)], 5. *C.* (*N.*) *kazusensis* (MATSUMOTO, 1926), 7–9 and 13. *C.* (*N.*) *praenipponicus* (SHIKAMA, 1949; 7–8: paratypes; 9: holotype), 10–12. *C.* (*N.*) *praenipponicus* (SHIKAMA, 1936), 16, 18 and 19. *C. hortulorum* (Institute de Zoologie, Muséum Nationale d'Histoire Naturelle, Paris), 17. *C.* (*S.*) *hortulorum* (Department of Zoology, British Museum), 20. *C.* (*S.*) *magnus* (ZDANSKY, 1925, holotype), *C.* (*S.*) *taiouanus* (Department of Zoology, Museum of Natural History, Leiden), 22. *C.* (*S.*) *greyi* (ZDANSKY, 1925; holotype), 23. *C. nippon* (Department of Zoology, Museum of Natural History, Leiden), 25. *C.* (*Rucervus*?) *katokiyomasai* (SHIKAMA & HASEGAWA, 1965; holotype).

References

HASEGAWA, Y., 1972. The NAUMANN's elephant, *Paleoloxodon naumanni* (MAKIYAMA) from the Late Pleistocene off Shakagahama, Shodoshima Is., in Seto Inland Sea, Japan. *Bull. Nat. Sci. Mus.*, **15**: 513–591, 22 pls.

KAMEI, T., 1958. Discovery of megaceri deer from Totchu, Nagano-ken, central Japan. *Jour. Fac. Lib. Art. Sci., Shinshu Univ.*, (8): 69–74.

KREZOI, VON M., 1941. Präokupierte Namen im Saugetierssystem, *Földf. Kozl.* **71** (7–12): 349–350.

MATSUMOTO, H., 1915. On some fossil mammals from Szechuan, China. *Sci. Rep. Tohoku Imp. Univ., 2nd ser.*, **3** (1): 31–32, pl. 14.

———, 1926. On some new fossil cervicorn from Kazusa and Riukiu. *Ibid.*, **10** (2): 22–25.

——— & H. MORI, 1956. On the mammals of the very late Pliocene fossiliferous zone discovered at Kanamori at Nishi-iwai district, province of Rikuchu. *Dobutsugaku Zasshi*, **65** (6): 17–27.

———, H. MORI & H. OZAKI, 1959. On the discovery of the Upper Pliocene fossiliferous and culture-bearing bed at Kanamori, Hanaizumi Town, Province of Rikuchu. *Bull. Nat. Sci. Mus.*, **4** (3): 287–324.

NAORA, N., 1954. Old Stone Age in Japan. 1–298. [in Japanese].

———, 1970. Deer fossils found in the Inland Sea of Seto. *Sci. Rep. Inst. Min. Ind., Fac. Sci. Eng., Waseda Univ.*, (26): 55–61.

OTSUKA, H., 1967. Pleistocene vertebrate fauna from the Kuchinotsu Group of west Kyushu, Pt. II. *Mem. Fac. Sci., Kyushu Univ., Ser. D*, **18** (2): 277–312.

PEI, W., 1934. Report on the excavation of the locality 13 in choukoutien. *Bull. Geol. Soc. China*, **13** (3): 364–365

SCHAUB, S., 1923. Neue und wenig bekannte Cavicornier von Senèze. *Eclog. Geol. Helv.*, **18** (2): 281–295.

SHIKAMA, T., 1936a. On a new species of fossil deer, *Cervus* (cfr. *Anoglochis*) *praenipponicus* sp. nov., from Japan. *Jour. Geol. Soc. Tokyo*, **40** (482): 251–254.

———, 1936b. *Depéretia*, a new subgenus of *Cervus*, with a new species from the Pleistocene of Japan. *Proc. Imp. Acad. Tokyo*, **12** (1): 19–21.

———, 1937. Fossil cervifauna of Syatin near Tainan, southwestern Taiwan (Formosa). *Sci. Rep., Tohoku Imp. Univ., 2nd ser.* **19** (1): 80–83.

———, 1938. Discovery of giant fallow deer from the Pleistocene in Japan. *Jap. Jour. Geol. Geogr.*, **16** (1–2): 115–122.

———, 1941. Fossil deer from Japan. *Jubl. Pub. Comm. Prof. Yabe's 60th Birthday*, **2**: 1125–1170.

———, 1949. The Kuzuü ossuaries. Geological and paleontological study of the limestone fissure deposits in Kuzuü, Totigi Prefecture. *Sci. Rep., Tohoku Imp. Univ., 2nd. ser.* **23**: 1–201.

——— & Y. HASEGAWA, 1965. On a fossil cervid antler from western Japan. *Sci. Rep. Yokohama Nat. Univ., 2nd. ser* (12): 45–47.

——— & G. OKAFUJI, 1958. Quaternary cave and fissure deposits and their fossils in Akiyoshi district, Yamaguchi Prefecture. *Ibid.*, (7): 43–103.

——— & T. TAKAYASU, 1971. Fossil mammals from the Shibikawa Formation in Oga Peninsula, Akita Prefecture. *Ibid.*, (18): 43–47.

——— & S. TSUGAWA, 1962. Megacerid remains from Gunma Prefecture, Japan. *Bull. Nat. Sci. Mus.*, **50**: 1–11.

SOWERBY, A. DE C., 1933. Horns of a new deer and other relics from the waste of Yin, Honan, China. *China Jour.*, **19**: (3): 141–144.

——— & W. C. PEI, 1941. The fossil mammals of locality 13 in Choukoutien. *Ibid.*, (11): 10–20.

TEILHARD, P. DE C. & M. TRASSAERT, 1937. The Pliocene Camelidae, Giraffidae and Cervidae of southeastern Shansi. *Pal. Sinica, new ser. C*, (1): 42–50.

——— & C. C. YOUNG, 1936. Mammalian remains from Anyang. *Ibid.*, (1): 30–36.

TEPPNER, W. VON., 1922. Fossilium catalogus. I. Animalia, edit. C. DIENER. Pars 15, Lamellibranchiata tertiaria "Anisomyaria" II, 65–296.

TOKUNAGA, S. & F. TAKAI, 1935. A new roe-deer, *Capreolus* (*Capreolina*) *mayai* n. subgen. and n. sp. from the Inland Sea of Japan. *Jour. Geol. Soc. Japan*, **43**, (35): 642–645.

ZDANSKY, O., 1925. Fossil hirsche China. *Pal. Sinica, ser. C*, **2**: (3): 72–79.

———, 1927. Weitere Bemerkungen über fossile Cerviden aus China. *Ibid.*, **5** (1): 12–14.

YOUNG, C., 1932. On the Artiodactyla from the *Sinanthropus* Site at Chukoutien. *Ibid.*, **8** (2): 1–2.

Expalanation of Plates

Plate 1

Figs. 1–3 *Elaphurus menziesianus* (SOWERBY)

1. A fragment of fore tine (NSM14491). Outer (a) and posterior (b) views, ×0.46.
2. A fragment of left fore tine (NSM14492). Frontal (a) and posterior (b) views, ×0.46.
3. A fragment of posterior (?) tine (NSM14493). Lateral view, ×0.4.

Figs. 4–8. *Cervus* (*Sika*) *natsumei* MATSUMOTO

4. A right shed antler (NSM14477). Outer view, ×0.4.
5. A right shed antler (NSM14444–1). Outer view, ×0.35.
6. A fragment of skull with pedicle attached (NSM14450). Frontal view, ×0.3.
7. A left metacarpus (NSM14490). Frontal view, ×0.35.
8. A distal portion of right antler (NSM14444–3). Outer view, ×0.35.

Fig. 9. *Cervus* (*Nipponicervus*?) sp.
A right shed antler (NSM14459–13). Outer (a) and frontal (b) views, ×0.4.

Plate 2

Fig. 1. *Sinomegaceros yabei* (SHIKAMA)
A right metatarsus (NSM 14494). Frontal (a) and lateral (b) views, ×0.4.

Fig. 2. *Cervus* (*Sika*) *paleoezoensis* n. sp.
Left antler with a fragment of skull attached (NSM14443–2). Inner (a), outer (b) and frontal (c) views, ×0.25.

Plate 3

Figs. 1–12. *Cervus* (*Sika*) *paleoezoensis* n. sp.

1. A right, shed antler (NSM14459–4). Inner view, ×0.26.
2. A left, shed antler (NSM14438). Outer (a) and frontal (b) views, ×0.28.
3. A right, shed antler (NSM14476), holotype. Outer (a) and frontal (b) views, ×0.3.
4. A right, shed antler (NSM14444–5). Inner view, ×0.3.
5. A left, shed antler (NSM14479). Outer (a) and frontal (b) views, ×0.25.
6. A distal portion of right antler (NSM14437). Outer view, ×0.26.
7. A left, shed antler (NSM14447–10). Outer view, ×0.26.
8. A fragment of first tine (NSM14441–9). Lateral view, ×0.26.
9. A right, shed antler (NSM14444–4). Outer view, ×0.3.
10. A right, shed antler (NSM14458–14). Outer view, ×0.26.
11. A right, shed antler (NSM14458–10). Inner view, ×0.3.
12. A left antler (NSM14467–1). Outer view, ×0.26.

Plate 4

Figs. 1–5. *Cervus* (*Nipponicervus*) *praenipponicus* SHIKAMA

1. A right, shed antler (NSM14471–3). Outer view, ×0.26.
2. A right, shed antler (NSM14446–2). Outer (a) and frontal (b) views, ×0.23.
3. A left, shed antler (NSM14445–1). Outer view, ×0.25.
4. A right, shed antler (NSM14471–2). Inner view, ×0.3.
5. A right, shed antler (NSM14446–9). Outer viwe, ×0.25.

Figs. 6–15. *Cervus* (*Sika*) cf. *greyi* (ZDANSKY)

6. A right, shed antler (NSM14459–5). Inner view, ×0.25.
7. A left, shed antler (NSM14448–10). Outer view, ×0.22.
8. A left, shed antler (NSM14447–1). Inner (a) and frontal (b) views, ×0.27.
9. A right, shed antler (NSM14459–1). Inner view, ×0.25.
10. A left, shed antler (NSM14474). Inner view, ×0.25.
11. A right, shed antler (NSM14459–10). Inner view, ×0.26.
12. A left, shed antler (NSM14452). Outer view, ×0.24.
13. A distal portion of right antler (NSM14440–2). Lateral view, ×0.25.
14. A left, shed antler (NSM14457–6). Outer view, ×0.25.
15. A right, shed antler (NSM14457–3). Inner view, ×0.27.

Plate 5

Figs. 1–6. *Cervus* (*Nipponicervus*) *praenipponicus* SHIKAMA

1. A right antler with pedicle attached (NSM4468–5). Frontal (a) and inner (b) views, ×0.25.
2. A fragment of left antler (NSM14443–4). Frontal view, ×0.23.
3. A fragment of left antler (NSM14443–3). Frontal view, ×0.23.
4. A left, shed antler (NSM14461). Inner (a) and frontal (b) views, ×0.24.
5. A right, shed antler (NSM14460). Outer (a) and frontal (b) views, ×0.25.
6. A left antler with skull attached (NSM14481). Outer view, ×0.23.

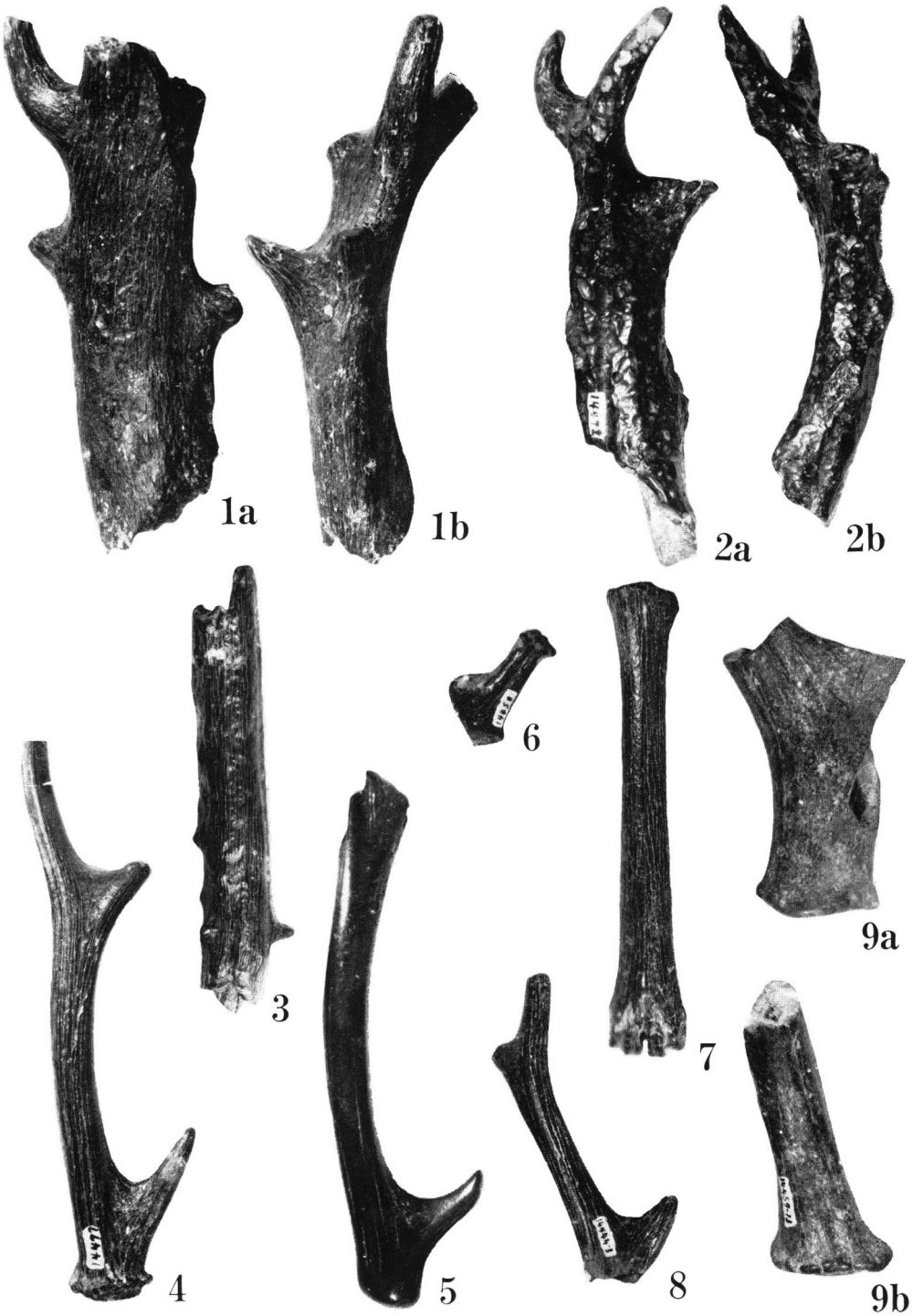
Figs. 7–12. *Cervus* (*Nipponicervus*) *kazusensis* MATSUMOTO

7. A left antler with pedicle attached (NSM14469–3). Outer view, ×0.22.
8. A left, shed antler (NSM14478). Outer view, ×0.22.
9. A right, shed antler (NSM14469–14). Outer view, ×0.24.
10. A right, shed antler (NSM14469–7). Outer view, ×0.22.
11. A right, shed antler (NSM14445–8). Outer view, ×0.24.
12. A right, shed antler (NSM14469–4). Outer (a) and frontal (b) views, ×0.22.

Plate 6

Figs. 1–8. *Cervus* (*Nipponicervus*?) *takaoi* n. sp.

1. A left, shed antler (NSM14466–2). Inner (a) and frontal (b) views, ×0.27.
2. A left, shed antler (NSM14442–1). Inner view, ×0.37.
3. A right antler with pedicle attached (NSM14463). Outer view, ×0.23.
4. A right antler with pedicle attached (NSM14462). Outer view, ×0.24.
5. A left, shed antler (NSM14444–2). Abnormal specimen. Frontal view, ×0.24.
6. A left, shed antler (NSM14436; holotype). Inner (a) and outer (b) views, ×0.27.
7. A left antler with pedicle attached (NSM14458–13). Outer view, ×0.26.
8. A right, shed antler (NSM14442–1). Outer view, ×0.31.
9. A right antler with pedicle attached (NSM14456). Inner view, ×0.29.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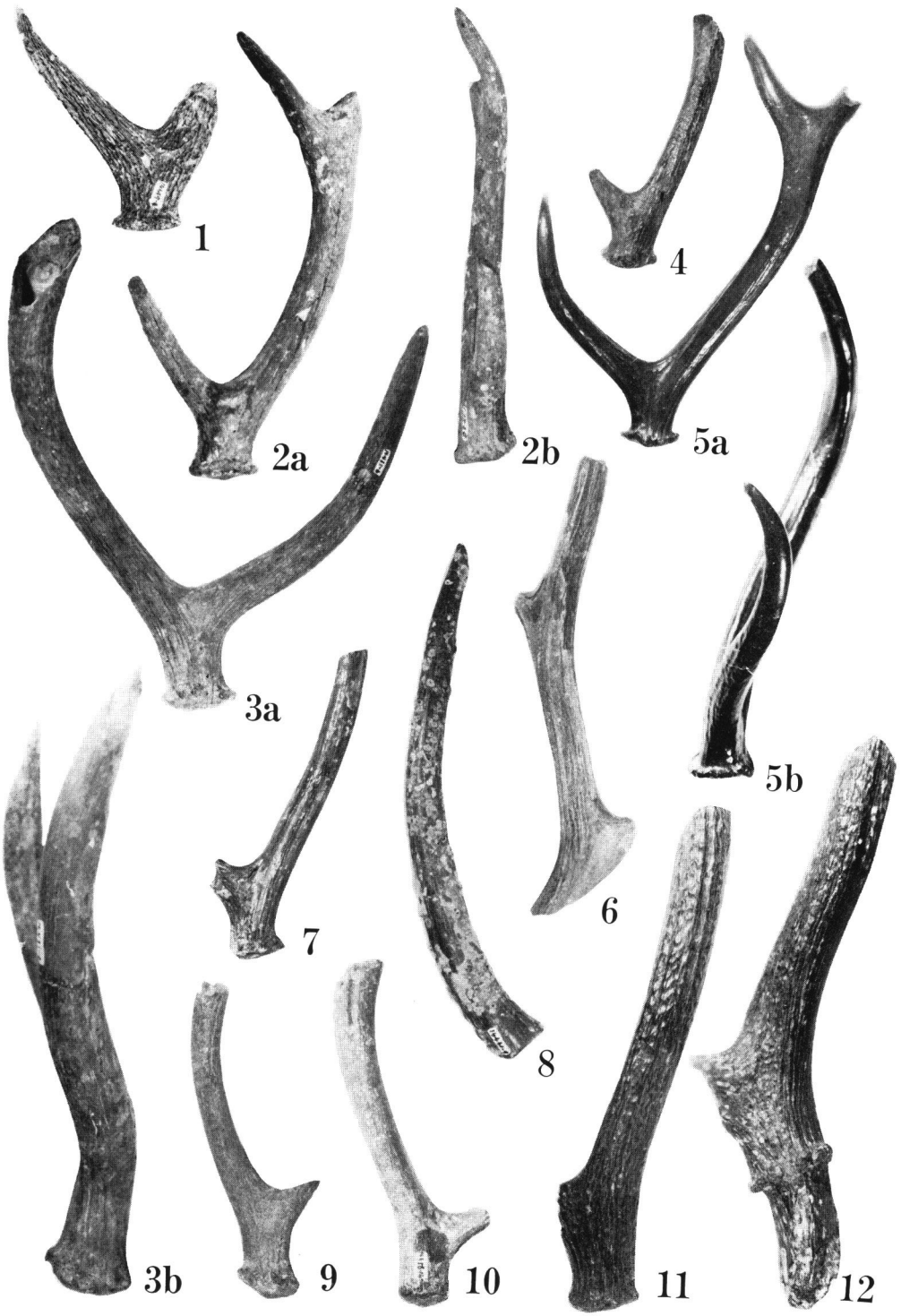
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5b
6
7
8
3b
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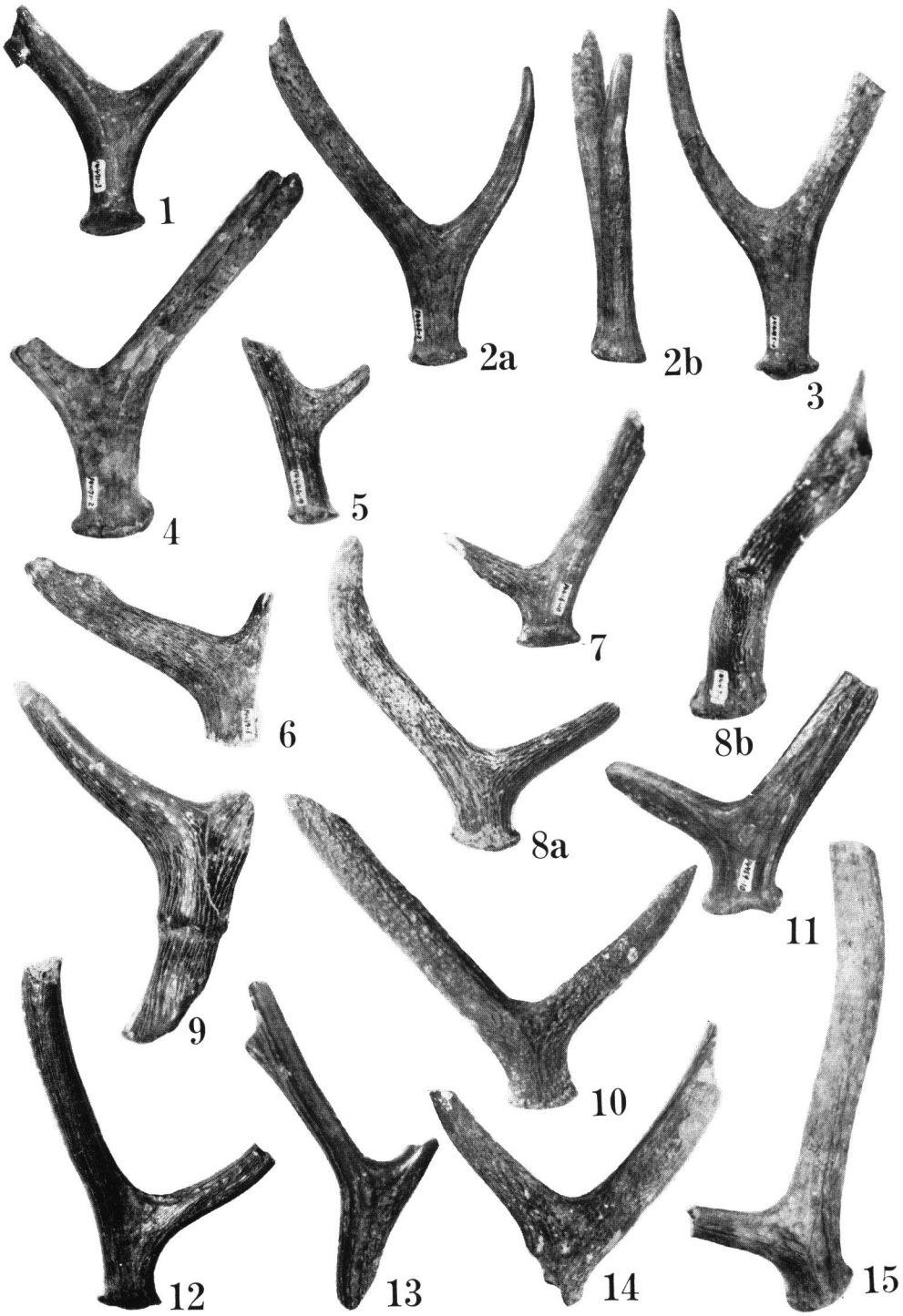
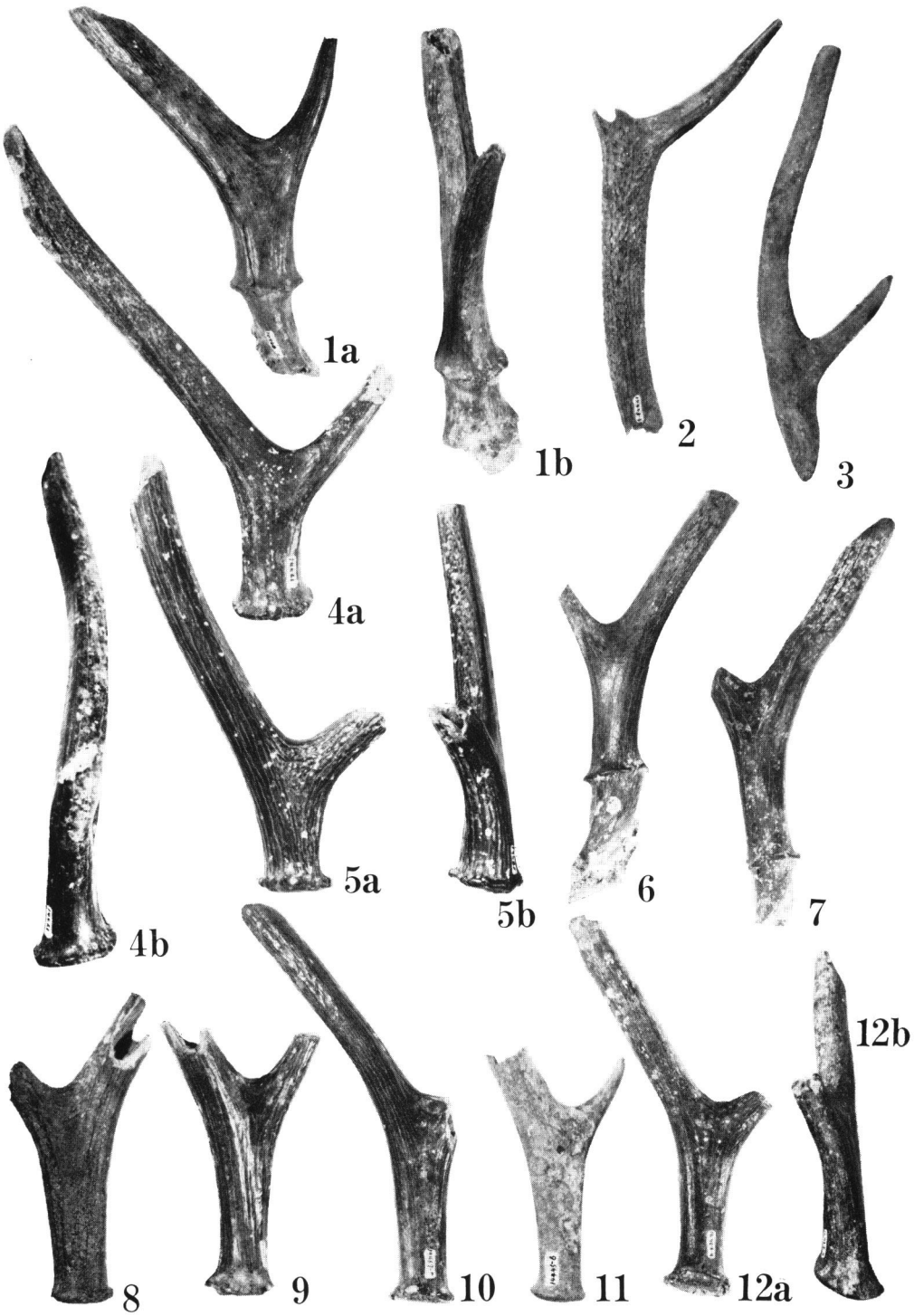
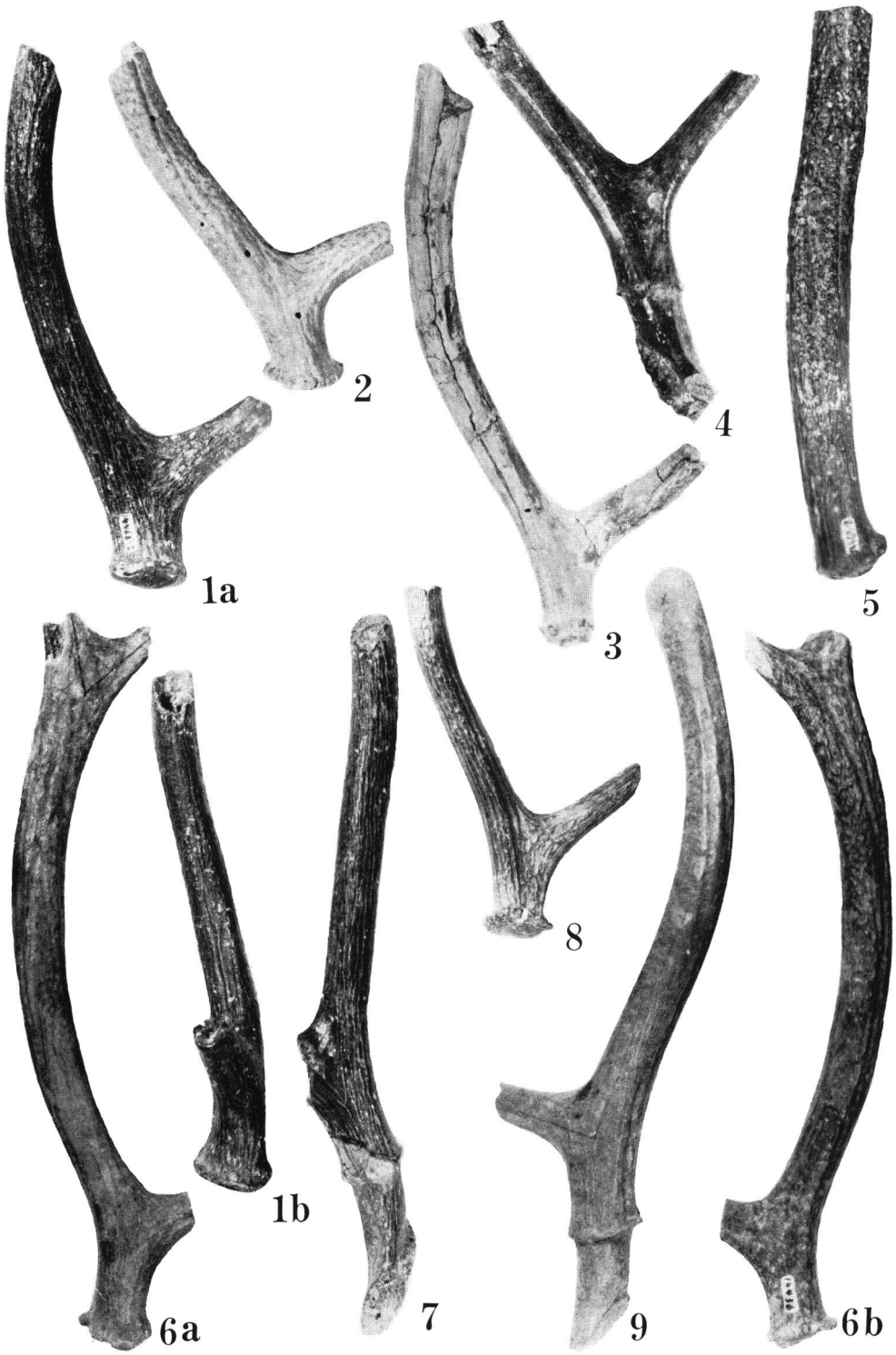
12


1
2a
2b
3
4
5
6
7
8a
8b
9
10
11
12
13
14
15


1a
1b
2
3
4a
4b
5a
5b
6
7
8
9
10
11
12a
12b


1a
2
3
4
5
1b
6a
7
8
9
6b