Pleistpcene Vertebrate Fauna from the Kuchinotsu Group of West Kyushu : Part Ⅰ. A New Species of Cervus (Rusa)

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Pleistocene Vertebrate Fauna from the Kuchinotsu Group of West Kyushu

Part I. A New Species of *Cervus* (*Rusa*)

By

Hiroyuki OTSUKA

Abstract

The Kuchinotsu group of west Kyushu is one of the important Lower Pleistocene strata in Japan for its geographic position near the western extremity of the Japanese islands and for the mammalian fossils therein.

Some molars of elephants were reported from this area, but their exact localities are uncertain. A remarkable bone bed was recently discovered in the upper part of the Kazusa formation of the Kuchinotsu group on the coast of Tsubami, northwest of Kazusa, Shimabara peninsula. It contains various bones of mammals, reptiles and pisces, of which many well-preserved antlers and bones belonging to three species of the Cervidae are recognized. As the first report of the palaeontological study of these fossils, this paper gives the general account of the stratigraphy of the Kuchinotsu group with special reference to the fossil bed and the description of a new species of *Cervus* (*Rusa*).

Living species of *Rusa* are distributed mainly in various areas of southeastern Asia, and some fossil species are known to occur in the Villafranchian of northeast China and Java. The new occurrence of this subgenus from the Kuchinotsu group may imply the presence of a faunal connection between Japan and the continent at that time.

Introduction

Thick early Pleistocene deposits called the Kuchinotsu group are extensively distributed in the southern part of the Shimabara peninsula of west Kyushu. As was listed by previous authors (SHIKAMA 1937; TAKAI 1939; INOUE 1952; INOUE and TAKAI 1953; KAMEI 1964), some Proboscidean remains, such as *Parastegodon akashiensis* TAKAI, *Palaeoloxodon namadicus naumanni* MAKIYAMA and *Stegodon orientalis* OWEN, were discovered from the distributed area of the Kuchinotsu group. Most of them were, however, collected from the sea bottom around this area by fishingnets or accidently picked up on the coast. Because they are neither described palaeontologically nor allocated stratigraphically, they are scientifically little evaluated.

At the suggestion of Prof. T. MATSUMOTO, I have been engaged in the stratigraphical study of this group. In the summer of 1964, a vertebrate fossils bed was discovered in the upper part of the Kazusa formation of this group on the coast of Tsubami, northwest of Kazusa. As the result of repeated excava-

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tions during 1964–1966, more than 350 specimens including various bones of mammals, reptiles and pisces were obtained. Of these specimens, fossil deer are most abundant and best preserved. The deer bones are morphologically referable to three species. One is a new species of *Cervus* (*Rusa*), and the others are new species which seems to belong to an undescribed genus of the Cervidae.

The mammalian fauna of the Kuchinotsu group appears to be important for the correlation of the Pleistocene between Japan and the Continent and the palaeogeographic consideration, because this group is situated near the western extremity of the Japanese islands. It needs further investigation from the standpoints of palaeozoology, palynology and stratigraphy to obtain an adequate conclusion about the age and palaeogeographic status of the Kuchinotsu group.

Acknowledgements

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General stratigraphy of the Kuchinotsu group

The Kuchinotsu group and overlying strata are divided into the following rock stratigraphic units in descending order:

dune sand and fluvial deposits
.... unconformity ....
Ôe formation (ca. 9 m)
.... unconformity ....
Aso welded tuff
.... unconformity ....
terrase deposits (0–6 m)
.... unconformity ....

	Tatsuishi formation (150–200 m)	
	unconformity	
Kuchinotsu group	Minamikushiyama formation (200–300 m)	Kitaarima formation (250–300 m)
	Kazusa formation (90–150 m)	upper member middle member lower member
	Ôya formation (ca. 550 m)	upper member lower member
	unconformity	
	Basement rock (Palaeogene)	

The Ôya formation crops out widely in the southern part of the Shimabara peninsula. It covers the Palaeogene basement with a clino-unconformity, and is divided into two members by a dark grey pumiceous tuff in the middle part. The lower member is mainly composed of medium-grained sand, gravels of various coarseness, massive grey mud, and tuff, occasionally containing also layers of olivine basalt and hornblende andesite in the lower part. The sediments of this formation show a remarkable lateral change in lithology. The upper member is lithologically not much different from the lower member, though poorly sorted coarse-grained clastics are generally predominant.

The Kazusa formation is exposed mainly in the northwestern part of this area. It consist of gravels, fine and medium sands and a small amount of silt.

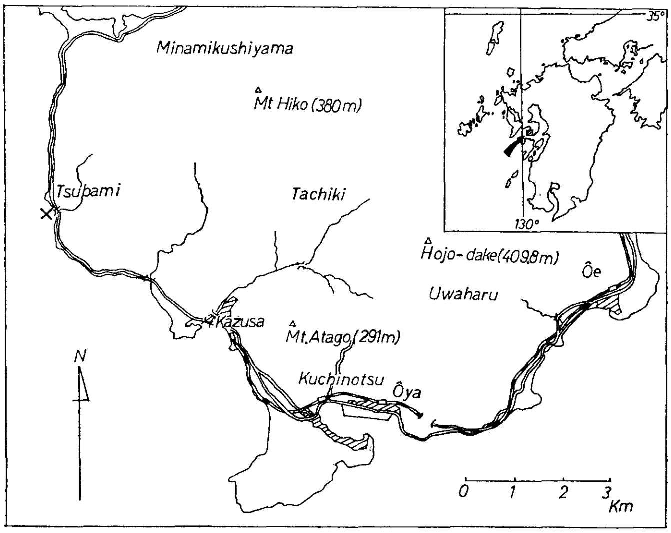


Fig. 1. Map showing the locality of Tsubami.

The Ôya formation is overlain by the Kazusa formation with a gradual lithological change in the western part and with an abrupt change of lithology in the eastern part. It is divisible into three members, of which the middle one is a thick layer of tuff breccia of two pyroxene andesite. In the uppermost part there is a characteristic marine shell bed, which is well treceable throughout this field from west to east.

The Minamikushiyama formation, which is exposed in the western and northern parts, is characterized by two pyroxene andesitic lava and tuff breccia. Toward the east it interfingers with marine clastic sediments of the Kitaarima formation.

Stratigraphic position of the newly discovered bone bed

The upper member of the Kazusa formation outcrops in a narrow area along the coast of Tsubami, about 2 km northwest of Kazusa, about 300 m long and 80 m wide, forming a tidal flat and a sea cliff. Its northwestern end is cut by

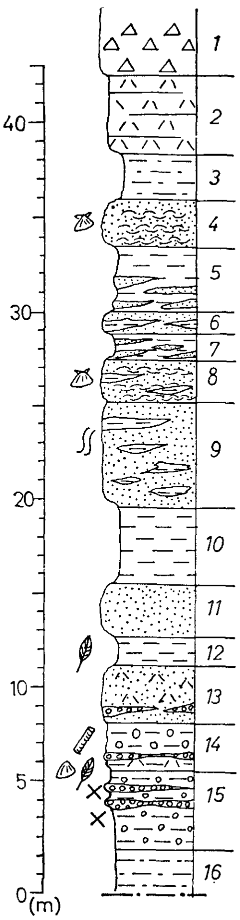


Fig. 2. Columnar section showing the stratigraphic sequence of the Kazusa formation on the coast of Tsubami, Kazusa-machi. 1. tuff breccia and volcanic agglomerate (Minamikushiyama formation), 2. white tuff, light brown silt, 4, 8. medium- to coarse-grained sand containing many marine shells, 5, 7. light brown silt including patches of fine-grained sand, 6. fine- to medium-grained sand including patches of silt, 9. medium- to coarse-grained sand including many sand pipes, 10, 12. light blue massive mud including many plant remains, 11. coarse-grained sand, 13. light brown tuffaceous sand, 14. light blue mud containing numerous vertebrates, brackish-water shells and plant remains, (Kazusa formation).

a fault of E-W trend and its southeastern part is covered by beach gravels. It is as thick as 40 meters, inclines slightly (3–5 degrees) to the southeast, and is covered with tuff breccia and volcanic breccia belong to the Minamikushiyama formation. The lower limit is not exposed.

As shown in Fig. 2, the vertebrate fossil beds, which 1 discovered, are situated in the lower part of the sequence. They are covered with plant-bearing bluish mud and cross-laminated sandstone. In the upper part of this sequence there are two gregarious molluscan beds, which contain *Anadara* (*Scapharca*) *subcrenata* (LISCHKE), *Striarca* (*Striarca*) *interplicata* (BRAUN and KING), *Chlamys yagurai* (YOKOYAMA) and some other marine shells. The faunule indicates that this part is correlated to the upper part of the Kazusa formation in the type area. Five bone beds are distinguishable in the lower part. The details of the ascending sequence of this part is as follows:

The first bed, about 2 m thick, is composed of bluish massive grey mud containing a considerable amount of pumice and two-pyroxene andesitic breccia of various size. Brackish-water shells such as *Corbicula japonica* PRIME and plant remains such as *Metasequoia* sp., *Fagus* sp., *Picea* sp., *Melia azedarach* LINNAEUS, *Styrax japonica* SIEBOLD and ZUCARINI, *Sapium sebiferum* ROXBURGH, *Pterocarya* cf. *pariurus* BATAL, *Quercus* sp., etc. are common. The vertebrate bones occur abundantly from the upper part of this bed.

The second bed, about 30 cm thick, irregularly contains pumice and andesitic tuff breccia. The constituent of the matrix is volcanic sand and bluish grey mud.

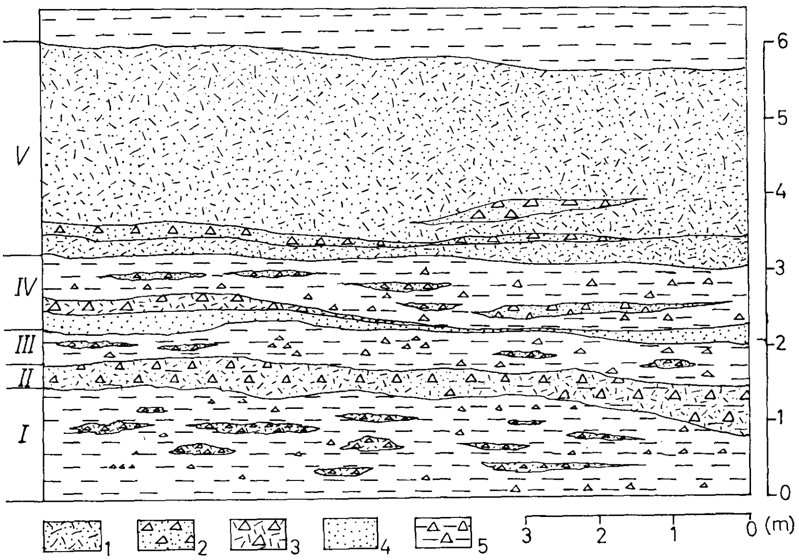
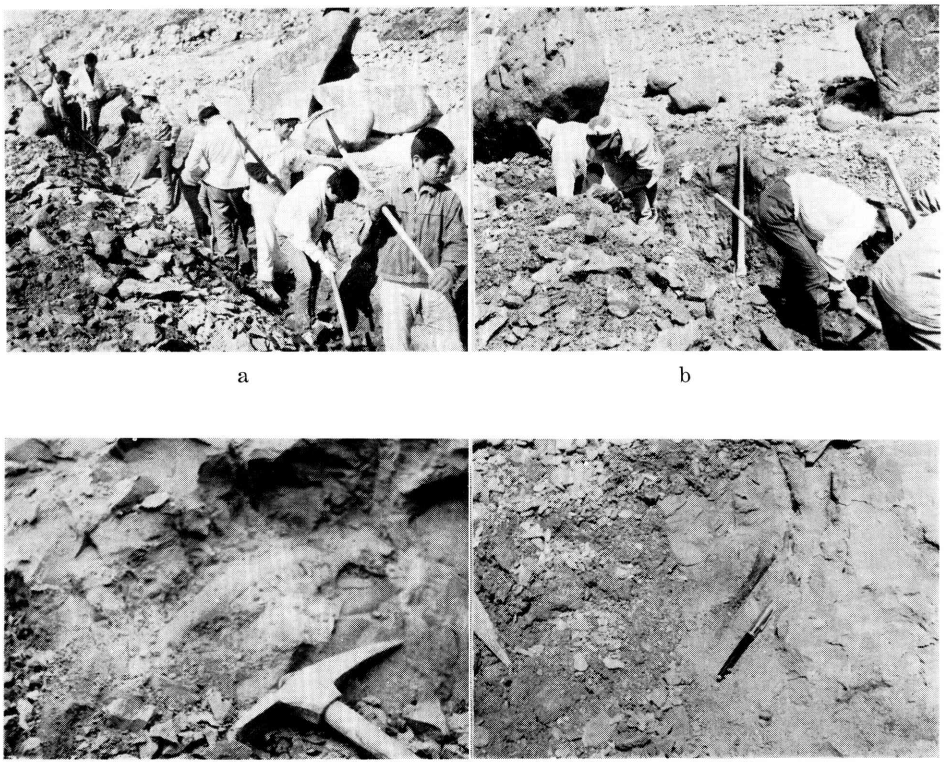


Fig. 3. Bone bed of the Kazusa formation on the coast of Tsubami, Kazusa-machi. 1. tuffaceous sand, 2. tuffaceous sand containing numerous andesitic gravels, 3. dark greyish tuff breccia, 4. medium to coarse sand, 5. light bluish grey mud containing andesitic gravels. I. first bed, II. second bed, III. third bed, IV. fourth bed, V. fifth bed.



a b

c d

Fig. 4. Excavating fossil deer from the Kuchinotsu group at the coast of Tsubami.
a, b. Sight of excavation.
c. Partly exposed lower jaw of *Cervus* (*Rusa*) *kyushuensis* sp. nov.
d. Partly exposed cannon bone of *Cervus* (*Rusa*) *kyushuensis* sp. nov.

Vertebrate bones occur most abundantly in this bed.

The third bed, about 40 cm thick, is mainly composed of bluish grey mud including andesitic tuff breccia and irregular patches of tuffaceous sand. Drift woods of conifers are common there. Vertebrate bones are found also in this bed together with andesitic tuff breccia.

The fourth bed, about 1 m thick, is composed of light bluish grey mud in the upper part and of andesitic tuff breccia in the lower part. Plant leaves and cones are accumulated in the upper part. Vertebrate bones are rare in this bed.

The fifth bed, about 3 m thick, is composed of medium-grained light greyish tuffaceous sand. Drift woods are common in this bed. Vertebrate bones are also scarce in this bed.

Judging from the lithology and existence of numerous brackish-water shells, the bone beds are probably fluvial deposits which were accumulated in certain swamps near an estuary.

Systematic Description

Family Cervidae

Subfamily Cervinae

Genus *Cervus* LINNAEUS, 1758

Subgenus *Rusa* SMITH, 1827

Type-species.—*Cervus unicolar* BECHSTEIN, 1799.

Remarks.—The *Rusa* deer have a faunal province in the Oriental region. Seven living species, including 14 subspecies have been known. They are distributed in the greater part of the Oriental region, extending from the South Sea

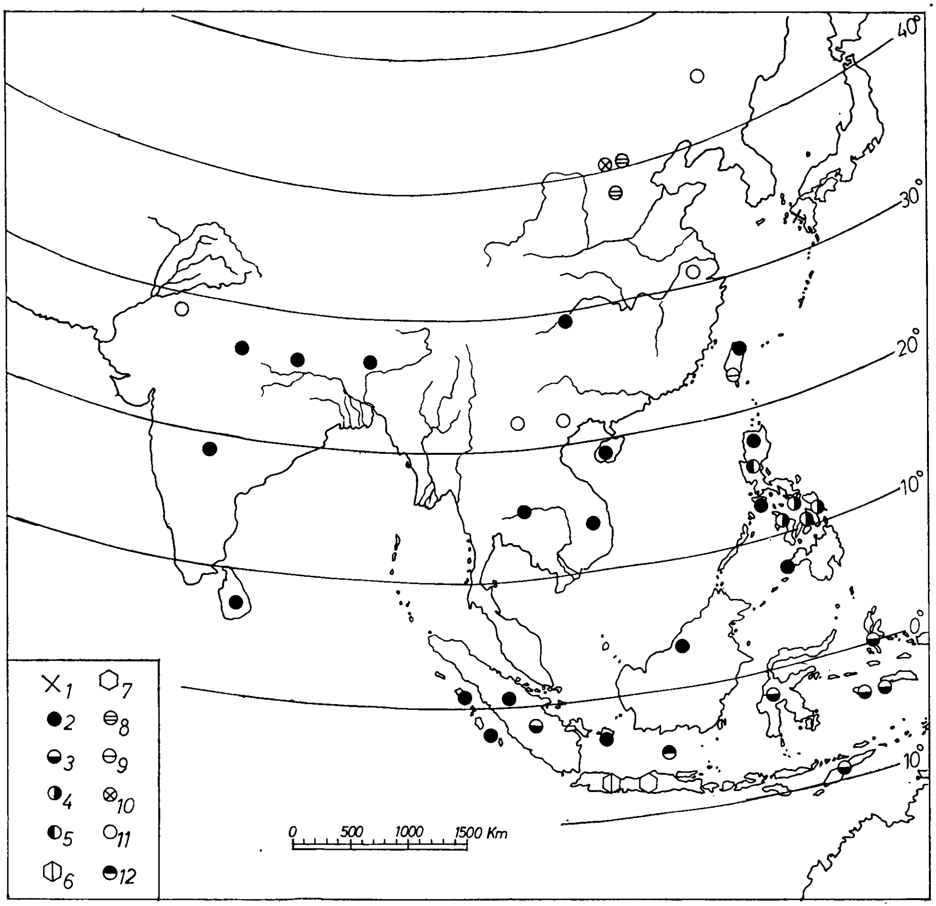


Fig. 5. Map showing the distribution of living and fossil species of *Cervus* (*Rusa*). 1. *C.* (*R.*) *kyushuensis*, 2. *C.* (*R.*) *unicolar*, 3. *C.* (*R.*) *timoriensis*, 4. *C.* (*R.*) *alfredi*, 5. *C.* (*R.*) *tavistocki*, 6. *C.* (*R.*) *oppenorthi*, 7. *C.* (*R.*) *stehlini*, 8. *C.* (*R.*) *pachygnathus*, 9. *C.* (*R.*) *timoriensis*, 10. *C.* (*R.*) *elegans*, 11. *C.* (*R.*) sp. 12. *C.* (*R.*) *kuhli*. Species indicated by the numbers 1, 6-11 are extinct.

Islands northward into Szechuan of China, that is to say, a tropical to subtropical area between latitude 10°S. and 30°N.

The fossil species of *Rusa* have been reported from the Plio-Pleistocene formations of the same area, of which 5 are from China, 1 from Formosa, 2 from Java, and 1 (?) from India.

In the Chinese species, *C.* (*R.*) *elegans* was reported from the Villafranchian of Nihowan, northwest China (TEILHARD and PIVETEAU, 1930), *C.* (*R.*) *pachygnathus* from Shansi and Hopei (ZDANSKY, 1925), and *C.* (*R.*) sp. from the lower Pleistocene of Kwangi, Yunan and Kiangsu, south China (PEI, 1935, 1940; BIEN and CHIA, 1938). *C.* (*R.*) *orientalis* and *C.* (*R.*) *leptodus* were reported from China (KOKEN, 1885) without records of exact locality. As a fossil species from Tainan of Formosa SHIKAMA (1937) reported a doubtful example of *C.* (*R.*) *timoriensis* BLAINVILLE, which is now living in Timor.

In Java *C.* (*R.*) *oppenorthi* and *C.* (*R.*) *stehlini* were reported from the Semboegan and lower Boemiajoe formations (KOENIGSWALD, 1933), respectively.

As above mentioned, the distribution area of *Rusa* deer in the Plio-Pleistocene age was beyond the northern limit of the distribution of living species.

Cervus (*Rusa*) *kyushuensis* sp. nov.

Pl. 27, Figs. 1–7; Pl. 28, Figs. 1–4; Pl. 29, Figs. 1–2; Figs. 9–10.

Material.—Holotype; GK. M1080 (Pl. 27, Fig. 1; Gig. 6), a frontal bone with both antlers. Paratypes: GK M1055, M1056, M1089 (Pl. 28, Figs. 1–3; Pl. 29, Figs. 1–2; Fig. 7), lower jaws; GK. M1080–GK. M1084, GK. M1089, GK. M1020 (Pl. 27, Figs. 2–6, Fig. 8, first tine; GK. M1095 (Pl. 28, Fig. 4), upper molar (M1); GK. M1090 (Pl. 27, Fig. 7; Fig. 10), cannon bone (metatarsus); GK. M1069 (Fig. 9), pelvic bone—all specimens from loc. KS3920, Tsubami of Kazusa-machi, Minamitakaki-gun, Nagasaki Prefecture. The exact locality is indicated in the index map (Fig. 1).

Specific diagnosis.—The antler is large but rather slender. The pedicle on the skull is comparatively long, extending widely outward, making an acute angle of approximately 60 degrees with each other. The angle between the pedicle and a line of the cranial profile is smaller than 30 degrees. The beam below the second bifurcation is long and curves gradually inward in anterior view, but almost straight in lateral view. Two antlers describe a longitudinal spindle. The first tine is long and stout, stretched strongly outward from the main beam, making an acute angle of about 38 degrees with the beam. The second tine is slender, not so long, and projected upward making an acute angle of about 40 degrees with the beam. Lower teeth are moderately thick and strongly constructed with a well developed enamel wall. Lower premolars are relatively long and molars still longer. Accessory columns exist usually in M1, M2 and the median lobe of M3, and always in the third lobe of M3.

Description of the type-specimens.—Holotype (GK. M1018). This antler is large but generally slender, not stout. The pedicle on the skull is relatively long (about 32.5 mm in length) and expanded outward with an acute angle of about

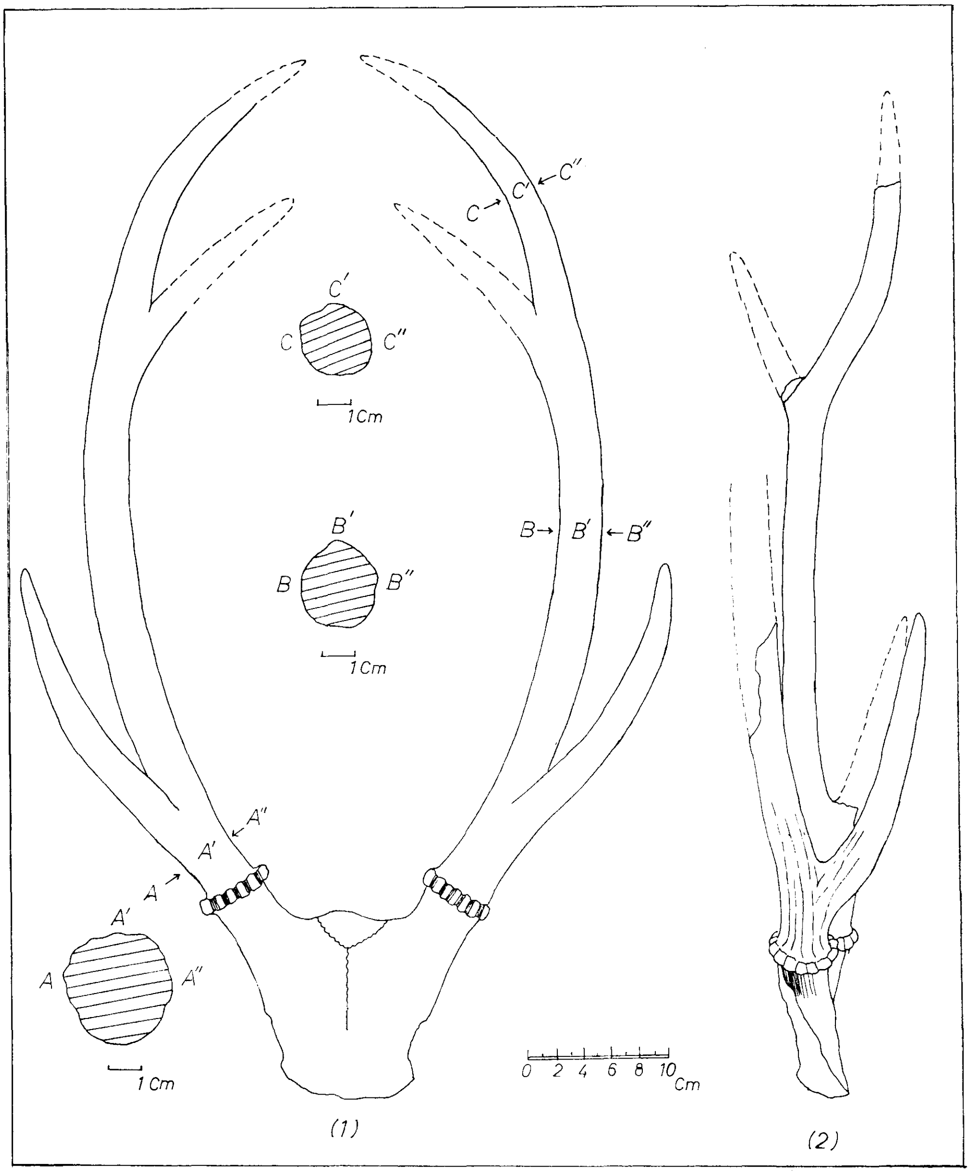


Fig. 6. Restored figures and transverse sections of antlers of *Cervus* (*Rusa*) *kyushuensis* sp. nov. [holotype (GK. M1018)]. Anterior (1) and lateral (2) views.

60 degrees to each other. The burr is rather thin, rugose and subcircular in transverse section. The basal part of the beam is extended straightly from the pedicle. The beam below the second bifurcation is very long, and curves slightly inward in anterior view, but almost straight in lateral view. The two antlers form a longitudinal spindle if restored. The surface is rather smooth. The first tine is bifurcated at a short distance above the burr. The first tine is long,

stout, moderately rugose, and stretched strongly upward and somewhat outward from the main beam, making an acute angle (of 38 degrees) with the beam. The transverse section of its basal part is subcircular. The lower part of the first tine and the main beam above the first bifurcation have noticeable projections. The grooves on the main beam are wide and relatively shallow, but somewhat conspicuous on the anterior and posterior sides, although they become obscure toward the second bifurcation. The second tine extends inward but slightly bent backward. It has an almost smooth surface and almost circular transverse section. The third tine projects also inward, making an acute angle with the second tine.

Paratype (GK. M1019), first tine of right antler, preserved above the first bifurcation, 230 mm long in straight line. It is larger and stouter than the holotype and curves slightly inward. The angle between the first tine and the beam is almost equal to that of the holotype, about 39 degrees. Wide and deep longitudinal grooves are remarkably developed on the anterior surface. The transverse section of the basal part shows undulated oval shape (Fig. 7).

Paratype (GK. M1020), the first tine of right antler, preserved just above the first bifurcation, 303.3 mm long in straight line. This specimen is very stout and larger than other specimens in lentgh and diameter. Remarkable longitudinal

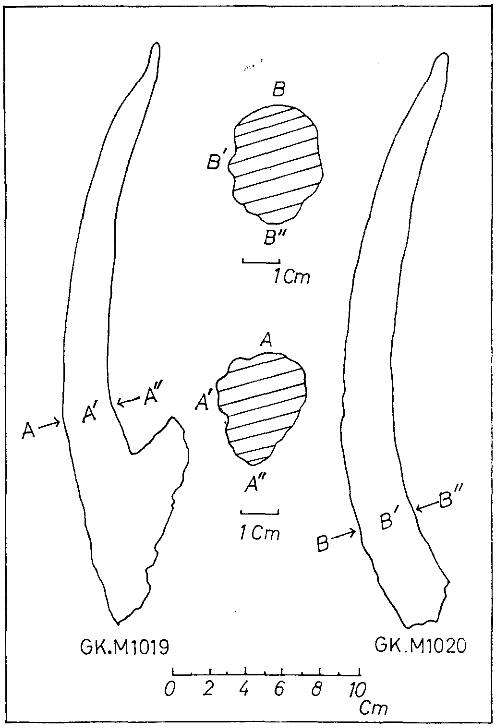


Fig. 7. First tine and its transverse section of *C.* (*R.*) *kyushuensis* sp. nov.

grooves and tubercles are developed on the anterior surface. The basal part is oval in transverse section (Fig. 7).

Paratype (GK. M1080), fragment of first tine, preserved 165.5 mm long in straight line. It is much slender for length, irregularly curved and almost circular in transverse section. The anterior surface has a few grooves but has not tubercles.

Paratype (GK. M1081), fragment of first tine, preserved 159 mm in length. It is rather slender, slightly curved inward and oval in transverse section. A few grooves are observable on the surface, but they are indistinct by the weathering.

Measurements in mm or degrees:

	GK. M 1018	GK. M 1019	GK. M 1020	GK. M 1080	GK. M 1081
Length of pedicle	32.5	—	—	—	—
Maximum diameter of pedicles	35.1	—	—	—	—
Angle between two pedicles	60	—	—	—	—
Circumference of burr	161.0	—	—	—	—
Maximum diameter of burr	54.1	—	—	—	—
Maximum thickness of burr	7.5	—	—	—	—
Distance between both burrs at external margin	195.3	—	—	—	—
Distnace between both burrs at internal margin	107.0	—	—	—	—
Maximum diameter of beam above burr	31.7	—	—	—	—
Height of first bifurcation	46.5	—	—	—	—
Length of first tine (along outer margin)	108.8	235.0	320(+)	170(+)	157(+)
Length of first tine in straight line	170.6	217.0	303.3	165.5	155(+)
Maximum diameter of first tine above first bifurcation	24.3	31.5	29.7	—	28.0
Distance between first and second bifurcation (along outer margin)	320.5	—	—	—	—
Maximum diameter of main beam between first and second tines	24.3	—	—	—	—
Length of second tine in straight line	173(+)	—	—	—	—
Maximum diameter of second tine	26.6	—	—	—	—
Maximum diameter of third tine	24.5	—	—	—	—
Angle of first bifurcation	38	39	—	—	—
Angle of second bifurcation	40	—	—	—	—
Total length from burr to tip of antler	530(+)	—	—	—	—
Distance between distal end of frontal bone and ethomoid foramen	58.3	—	—	—	—
Distance between two supraobical foramens at internal margin	65.5	—	—	—	—
Diameter of basis cranii externa as preserved	96.8	—	—	—	—

Upper tooth. Paratype (GK. M1095). M1 is broader than long, nearly quadrate in outline in upper view. The anterior and posterior margins are both almost straight and nearly parallel to each other; the para- and metastyle rather indistinct; the accessory column absent; the enamel wall of the crown moderately thin. In the inner crescent, the anterior crescent projects more upward than the posterior one. The outer crescents show a similar tendency. The posterior valley is somewhat larger than the anterior. Measurements of the tooth are as follows (in mm).

height: 10.6, width: 20.1, length: 17.7.

Lower teeth. Paratype (GK. M1055, M1056, M1089). The lower teeth are preserved in the three jaws i.e. paired specimens (GK. M1055, M1089) and unpaired one (GK. M1056). In general, the premolar series is long, and the molar series still longer. The enamell wall of the crown is thick and rather rugose. Accessory columns exist usually in M1, M2, median lobe of M3, and always third lobe of M3, but are sometimes lacking in some teeth. The incisor tooth is unknown.

P2 is relatively large and subquadrate with indistinct folding in upper view. P3 is also large and markedly folded. The outer wall of crown is gently curved inward. In upper view there are distinct fossette in the inner side wall, in which the prefossette is large, deep and wide; the posterior fossette is divided into two fossettes, of which the anterior one is larger than the posterior.

P4 remarkably large and massive and shows a subquadrate shape in upper view. The inner margin is almost straight with distinct post-fossette, while the outer margin distends outward with smooth surface and indistinct posterior-external wall.

M1 is subquadrate in upper view, with stout and infrated lobes. The accessory column of outer fold is broad and high in paired M1 but lacked in unpaired M1. The inner wall is rather smooth with a weak costa and folds, which are almost vertical to the grinding surface; the outer wall is moderately inflated outward. The outer crescent is lower and longitudinally longer than inner crescent in paired M1, and also the anterior crescent higher than the posterior in paired M1, though the crescent is broad and well developed in unpaired M1. The valley is not deep and indistinct.

M2 is longer than M1. The accessory column of the outer fold is broad and low in paired M2 and unpaired M2. In upper view the anterior-inner wall is more strongly undurated than the posterior-inner wall. The outer crescent projects strongly outward, and is lower and broader than the inner crescent. The valley is rather distinct and deep in paired M2 than unpaired M2. The inner crescent of the anterior lobe is eminently projected upward. The inner sides of the anterior and posterior lobes are slightly folded.

M3 is large and strongly constructed. The accessory column is indistinct in the outer wall of the median lobe, but very distinct and almost cylindrical in the outer wall of the third lobe. It is also developed in the anterior-outer wall of the costa and inner wall of the third lobe. The third lobe is nearly circular and rather small in upper view. In upper view, the outer crescent is broader than the inner crescent; the inner wall is more eminently undulated on the costa than the median lobe.

Measurements in mm:

		GK. M1055	GK. M1056	GK. M1089
PM2	width	7.3	—	—
	length	14.3	—	—
PM3	width	9.6	9.3	9.5
	length	19.3	17.8	19.5
PM4	width	11.0	11.4	10.8
	length	17.6	20.4	19.1
M1	width	13.6	13.8	14.2
	length	22.2	21.1	21.1
M2	width	15.8	14.2	14.8
	length	15.8	26.2	26.0
M3	width	16.6	14.8	14.7
	length	35.1	36.6	35.1

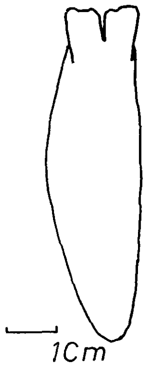


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Fig. 8. Transverse section of lower jaw of *C.* (*R.*) *kyushuensis* sp. nov.

Lower jaws. Paratypes (GK. M1055, M1056, M1089). The lower jaws are represented by three specimens. Right and left rami of the same individual and an unpaired right ramus are preserved. The jaw is large, rather strong for cervids; the horizontal ramus is relatively high, long and rather thin, and its lower border is slightly curved in the paired rami but not in the unpaired ramus. The symphysis is relatively narrow and short; the mental foramen is large, suboval, 12.3×7.4 mm in the paired right jaw, while it is spindle-shape, 17×7.4 mm in the unpaired right jaw. In lateral view, the ascending ramus is relatively broad, high and bent moderately backward. A row of mandibular teeth (P2-M3) is comparatively longer for cervids.

Measurements in mm:

	GK. M1055	GK. M1056	GK. M1089
Length of ramus as preserved	—	285(+)	309.0
Distance between anterior end and tip of cronoid process	—	282(+)	306.4
Length of symphysis as preserved	—	40.7	34.3
Thickness of region of mandibular angle	—	—	2.5
Width of ascending ramus just above mandibular angle	—	—	67(+)
Transverse length of condicle	—	—	24.1
Vertical thickness of condicle	—	—	7.5
Height of ascending ramus	—	—	110(+)
Depth of ramus at posterior end of symphysis	—	25.1	—

Depth of ramus at anterior of P2 on outer side	—	37.9	—
Depth of ramus at anterior of P2 on inner side	—	37.5	—
Depth of ramus at posterior of P4 on outer side	—	46.0	43.2
Depth of ramus at posterior of P4 on inner side	—	46.6	42.6
Depth of ramus at posterior of M1 on outer side	—	52.1	45.1
Depth of ramus at posterior of M1 on inner side	—	56.1	46.9
Depth of ramus at posterior of M2 on outer side	—	55.8	50.6
Depth of ramus at posterior of M2 on inner side	—	55.8	52.5
Depth of ramus at posterior of M3 on outer side	—	58.1	53.7
Depth of ramus at posterior of M3 on inner side	—	57.6	52.8
Maximum thickness of ramus below P2	—	12.9	10.7
Maximum thickness of ramus below P3	—	14.3	12.7
Maximum thickness of ramus below P4	—	14.8	13.3
Maximum thickness of ramus below M1	—	18.0	13.3
Maximum thickness of ramus below M2	—	20.3	20.4
Maximum thickness of ramus below M3	—	21.8	21.9
Length of three premolars	51.4	52.3	51.0
Length of three molars	80.8	80.2	78.9
Length of mandibular tooth row (P2–M3)	127.8	134.4	130.0
Maximum thickness of ramus posterior to symphysis	—	11.7	—

Pelvic bone. Paratype (GK. M1069). A right pelvic bone is preserved. The bone is relatively large, long and wide, flattened laterally, irregulary distorted. In lateral view, the axis of the ilium is bent upward and oblique to the horizontal plain. In ventral view, the inner border of ilium curves more strongly inward than the lateral border. The gluteal surface of ilium is rather broad and slightly convex upward. The rounded gluteal line is continuous and oblique to the ischiatic spine. The articular surface of the acetabulum is ridged and thick, and its border shows an elliptical form with rugose surface. The ischiatic spine is low, rather flattened. The acetabular branches of ischium are wide with rather smooth surface.

Fig. 9. Right pelvic bone of *Cervus* (*Rusa*) *kyushuensis* sp. nov. Ventral (a), dorsal (b) and anterior (c) views, $\times 0.5$.

Measurements in mm:

	GK. M1069
Maximum length of pelvic bone as preserved	230.5
Minimum width of ilium	35.7
Thickness at minimum width of ilium	13.0
Diameter of acetabulum	60.3×25.9
Direct length from acetabulum to ischiatic spine	48.4

Metatarsus. Paratype (GK. M1090). A right metatarsus is preserved. The bone is moderately large, rather stout. The transverse section of the shaft subtriangular. The proximal part is moderately expanded. The median longitudinal groove of the anterior side is rather broad and relatively deep, but its width and depth are decreased toward the central part. Except for this main grooves there is a short and shallow groove on the outer part of the proximalis. The inner side of the shaft inclines more steeply than the outer side, and makes almost a flat plane near to the median part. The posterior surface has a longitudinal, wide, rounded fullow, and it spreads widely and become deep near the proximal part. The outer side of the central fullow is more elavated than the inner side. The proximal extremity is subquadrate in upper view, of which inner margin rather straight but outer margin is moderately convex laterally. In upper view, facet for cuboid is elongate-triangular, and the surface is flat and a little convex downward. The facet for cuneiform is subrectangular with the longest margin. The surface is smooth but a little convex downward in the anterior part and a little concave in the posterior part. The median foramen is deep and of elliptical outline. Distinct fossae is situated posterior to the two facets and shows irregular shape. The outer part of posterior margin shows lunutte and projected proximalward.

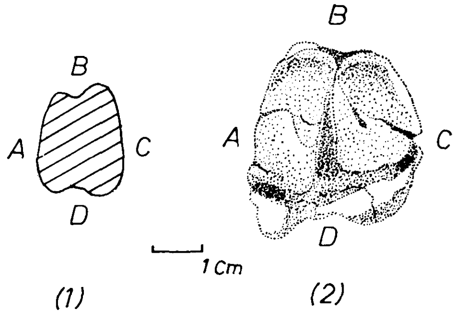

Fig. 10. (1) Profile of metatarsus in middle part, (2) articular surface. A: out side, B: anterior side, C: inn side, D: posterior side.

Measurements in mm:

	GK. M1090
Length of shaft as preserved (anterior side)	129.3
Diameter of shaft at middle	17.6×22.7
Diameter of shaft at proximal end	33.5×35.9

Comparisons.—The specimen GK. M1018 (Holotype) shows the general character in detail. Only the distal part of the frontal bone is preserved. In the right antler, the first tine is almost complete, but its main beam is broken away near the first branching. In the left antler, the first and third tines are almost damaged. The second tine is preserved for a length of about 170.7 mm from the second bifurcation without apical part. Judging from the general size, especially from the size of the first tine, this deer is still immature. Specimens GK. M1019 and GK. M1020 are the first tines. They are larger and stouter than the holotype. Remarkable longitudinal grooves are developed on the surface but tubercles are lacking as in the holotype. The specimens GK. M1080–M1082 are fragments of the first tine. They are considerably worn, and considered to be immature.

M1 in upper jaw is more quadrate and distinctly larger than that of *Cervus (Sika) nippon nippon* TEMMINCK, but generally equal to or slightly larger than that of *C. (Deperetia) praenipponicus* SHIKAMA and *C. (S.) yesoensis* HEUDE. The vertical elements are not higher than those of *C. (S.) nippon nippon.*

Lower jaws are represented by three specimens: paired and unpaired right jaws. The ramus symphysis portion is almost broken away in the paired right jaw but the teeth are completely preserved except for the incisor. The left of the paired jaw is relatively well preserved but lacks the post-symphysis portion, the inner wall of the horizontal ramus and the angle of ascending ramus; P2 missing. An unpaired right jaw is fully grown but somewhat smaller than the paired ones. All teeth are much worn; incisor teeth and P2 are missing. The ascending ramus and the anterior portion of the horizontal ramus is broken away. Compared with the teeth of *C.* (*S.*) *yesoensis* and *C.* (*D.*) *praenipponicus*, premolars and molars of the present specimens are large and more strongly constructed, but generally equal to or somewhat smaller than those of *C.* (*Rusa*) *elegans* reported by TEILHARD de CHARDIN and PIVETEAU, 1930. The third molar of the present specimens are particularly longer and wider than in *C.* (*R.*) *elegans*.

The present species bears some affinities to the subgenus *Deperetia*, reported by SHIKAMA (1936) from the Pleistocene bed of Japan, especially in the slender, straight and irregularly cycrindrical beam, not tuberculated surface and the first tine which extends outward and makes an acute angle with the beam. But the present species cannot be referred to *Deperetia* for the following reasons. SHIKAMA distinguished the subgenus *Rusa* (Samber deer) by the shorter and smaller first tine which is bifurcated at the higher position above the burr. Compared with *C.* (*D.*) *praenipponicus* SHIKAMA, the type species of *Deperetia*, the present species are characterized by the larger dimensions, the lower and acute branching of the first tine, the more acute angle between the line of cranical profile. *C.* (*D.*) *borbonicus* DEPERET and CROIZET from the Villafranchian deposits of France, *C.* (*D.*) *naorai* SHIKAMA from the Inland Sea, and *C.* (*D.*) *syantinensis* SHIKAMA from Formosa are all distinguished in these points.

C. (*D.*) *trassaerti* SHIKAMA (=*Rusa* cf. *elegans* TEILHARD and PIVETEAU), from the Plio-Pleistocene formation of the Yushe series in southeastern Shansi, China has the same kind of antler as the present species; that is to say, they commonly have a long beam between the first and second bifurcations, long first tine and acute angle between it and the beam. But *C.* (*D.*) *trassaerti* is clearly distinguished from the present species by its distinctly high position of the first tine, by shorter and stouter first tine, by direction of the beam.

The present species is distinguishable from *Axis* by the acute angle of the first tine and gentler curvature of the beam below the second bifurcation. It is also allied to *Cervus* (*Hyelaphus*) *porcinus porcinus* ZIMMERMANN, named hog-deer, in the antlers supported on the long pedicle and the main beam stretched upward and curving gradually inward. It differs from *C.* (*H.*) *porcinus porcinus* in that the first tine is much longer and stouter in the former and the angle between the pedicles on the skull is rather larger than in latter. *C.* (*S.*) *nippon nippon* and *C.* (*S.*) *yesoensis*, now living in Japan are clearly distinct by much bent beam below the first bifurcation and shorter beam below the second bifurcation.

Species of *C.* (*Rusa*) are more closely related to the present species than the above mentioned cervid in having rather low position of the first bifurcation, the stout and long first tine and an acute angle of the first bifurcation. *C.* (*R.*) *unicolar swinhoei* SCLATER, now living in Formosa, is close to but also distinct from the present species by the following characters. In *C.* (*R.*) *unicolar swinhoei* the first tine is bifurcated at somewhat lower position, main beam is stout, rugose, and stretched linearly upward in the same direction as the pedicle. *C.* (*R.*) *unicolar unicolar* KERR, an Indian samber deer, differs in the direction of antler. Some other living species of *Rusa* are also distinguishable in the same respects.

The present species apparently differs from *C.* (*R.*) *elegans* TEILHARD and PIVETEAU from the Villafranchian deposits of Nihowan, north China, in the length and direction of the first tine and the beam. In other words, the Chinese species shows a wider angle of the first tine and wider angle of both antlers. *C.* (*R.*) *oppenorthi* KOENIGSWALD from the Semboegan, Java, is allied to the present species in a general form and dimensions, but distinguished from the latter by a large angle of the first bifurcation.

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Hiroyuki OTSUKA

Pleistocene Vertebrate Fauna from the Kuchinotsu Group of West Kyushu

Part I. A New Species of *Cervus* (*Rusa*)

Plates 27～29

Plate 27

Explanation of Plate 27

Fig. 1–7. *Cervus (Rusa) kyushuensis* sp. nov............................Page 258

1. GK. M1018, a frontal bone with both antlers of holotype. Frontal view, $\times 0.4$.
2. GK. M1019, a first tine of paratype. Anterior (a) and posterior (b) views, $\times 0.5$.
3. GK. M1020, a first tine of paratype. Anterior (a) and posterior (b) views, $\times 0.5$.
4. GK. M1080, a first tine of paratype. Anterior (?) view, $\times 0.5$. Immature specimen.
5. GK. M1082, a first tine of paratype. Anterior (?) view, $\times 0.5$. Immature specimen.
6. GK. M1020, a first tine of paratype. Posterior (?) view, $\times 0.5$. Immature specimen.
7. GK. M1090, a right metatarsus of paratype. Two lateral (c, d), anterior (a) and posterior (b) views, $\times 0.5$.

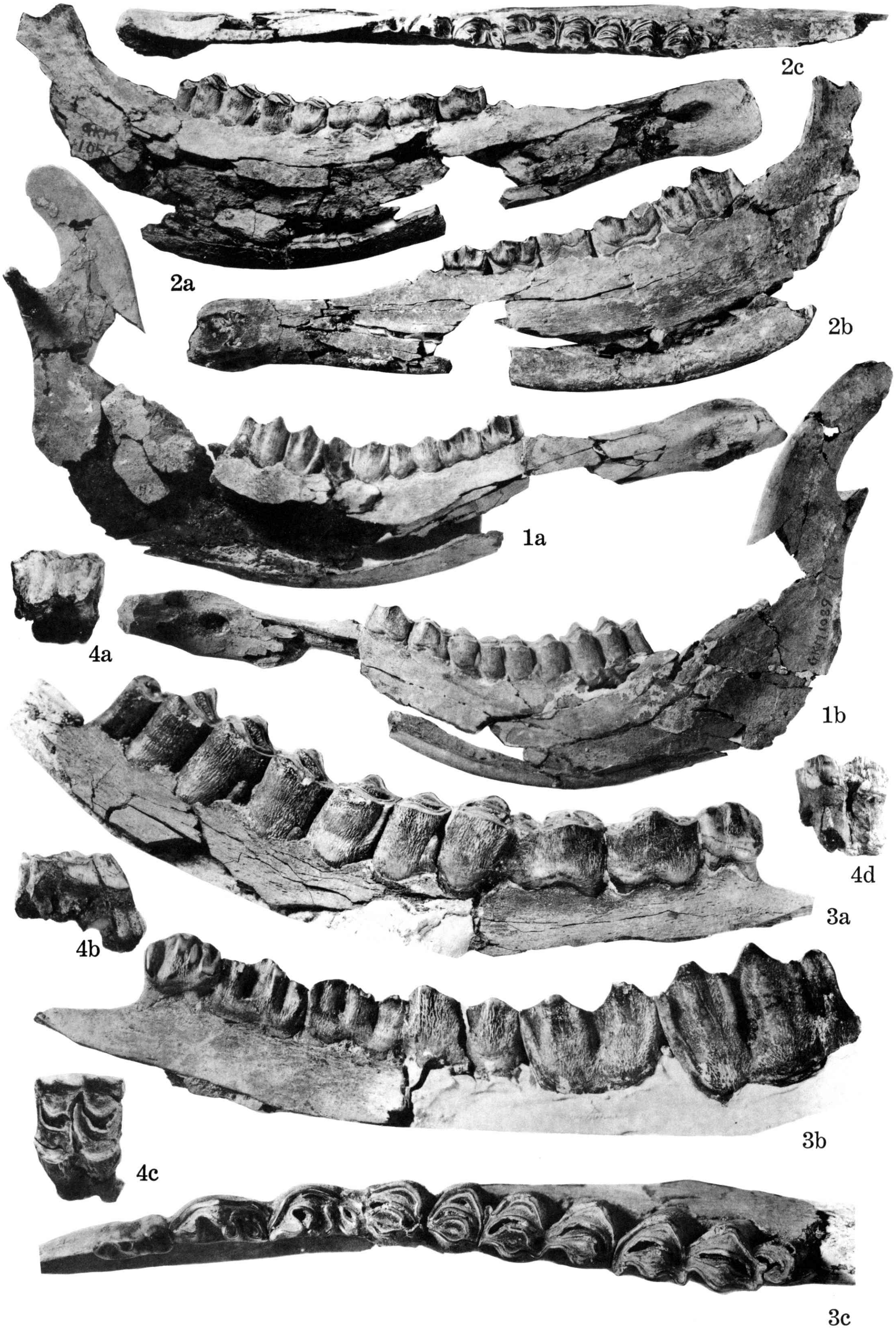
H. OTSUKA: Pleistocene *Cervus* (*Rusa*)

Plate 28

Explanation of Plate 28

Fig. 1–4. *Cervus (Rusa) kyushuensis* sp. nov............................Page 258

1. GK. M1089, left lower jaw of paratype. Inner (a) and outer (b) views, $\times 0.4$.
2. GK. M1056, right lower jaw of paratype. Outer (a), inner (b) and upper (c) views, $\times 0.4$.
3. GK. M1055, right lower jaw with teeth row of paratype. Outer (a), inner (b) and upper (c) views, $\times 0.8$.
4. GK. M1095, upper left M1 of paratype. Outer (a), anterior (b), upper (c) and inner (d) views, $\times 0.8$.



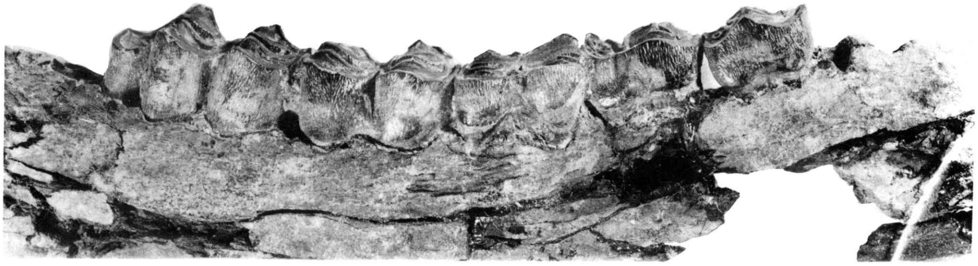
H. OTSUKA: Pleistocene *Cervus* (*Rusa*)

Plate 29

Explanation of Plate 29

Fig. 1–2. *Cervus (Rusa) kyushuensis* sp. nov. .... Page 258

1. GK. M1056, a right lower jaw with tooth row of paratype. Outer (a) and inner (b) views, $\times 0.8$.
2. GK. M1089, a left lower jaw with tooth row of paratype. Outer (a), inner (b) and upper (c) views, $\times 0.8$.



1a

1b

2a

2b

2c

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