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By

Hiroyuki OTSUKA* and Tokio SHIKAMA**

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Introduction

The present article deals with the result of paleontological study of the fossil deer collected from the Chi-ting Formation of the Toú-kóu-shan Group distributed in the environs of Chái-liáo-hsi (Chai-liao River), Cho-chen district of Tainan Prefecture, southwest Taiwan.

Most of the specimens treated in this paper belong to the private collections of a few amateur fossil collecters such as Mrs. C.M. CHEN, T.L. KUO, C.W. PÁN and M.S.SU in Tainan, who made effort, after the Second World War, to collect these specimens from the environs of the Chái-liao-hsi of Cho-chen disctrict. The paleontological study of the fossil proboscidea in their collections and the result of stratigraphical survey in this district have already been published by the present writers (SHIKAMA *et al.*, 1975).

Deer fossils in their collection are represented by about 252 specimens including antlers and various bones, although most of them are much broken. As the result of the present study, six species of fossil deer belonging to the family Cervidae were discriminated. Three of them are hitherto known species, of which two species show close resemblance to the species reproted from the Early Pleistocene formations in Chinese Continent.

Aknowledgements

Here the writers express their deep gratitude to the following gentlemen living in Taiwan for thier kind help and collaboration during the course of this study: Professor C.C. LIN of the National Taiwan University, Mr. LIU-YEN, director of the Taiwan Provincial Museum, Taipei, the late Mr. L.C. CHEN, Mr. Y. H. LIU of the Museum, Mr. C.M. CHEN in Chái-liao of Cho-chen, Mr. T.L. KUO and Mr.C.W. PÁN in Tainan, Mr. M.M. CHENG in Taipei. Sincere thanks are also due to Dr. H. OZAKI, former curator of the National Science Museum of Tokyo and Professor Shozo HAYASAKA of the Kagoshima University for their valuable suggestions and continuous encouragements.

* Institute of Earth Sciences, Faculty of Science, Kagoshima University, Kagoshima, Japan
** Geological Institute, Faculty of Education, Yokohama National University, Yokohama, Japan (Died December 12, 1978).

Descriptive Term of Antler

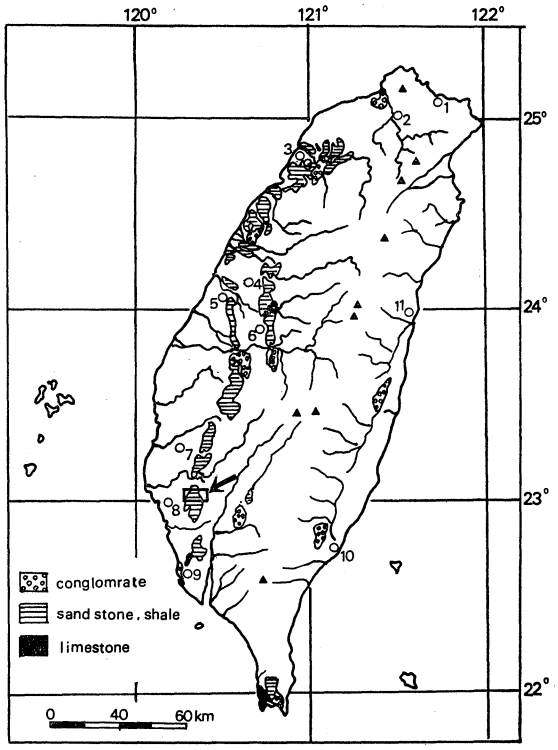
See OTSUKA and SHIKAMA (1977).

Remarks on the Toú-kóu-shan Group and the horizon of vertebrate fossils

1. Toú-kóu-shan Group

The Toú-kóu-shan Group, which represents an important Early to Middle Pleistocene succession in Taiwan, is developed along the western coastal area. It is mainly composed of gravel, sand, silt and thier alternation, and it attains to one thousand meters in maximum thickness. According to LIN (1963), this group unconformably overlies the Pliocene Miáo-li Group and is covered with the terrace gravel bed.

Nowadays the Toú-kóu-shan Group is divided into two formations: the lower Tung-hsiao and the upper Haoyánshan. The Tung-hsiao Formation, which is mainly composed of sand and silt and unconformably overlies the upper Pliocene Cho-lán Formation of the Miáo-li Group, is subdivided into three members, i.e. the Shian-san, the Takeng and the Yuchih based on their lithofacies (Lin, 1963).



Text-fig. 1. Map showing the distribution of the Toú-kóu-shan Group (after C.C. LIN, 1963)
Arrow indicates the studied area.
1: Chilung, 2: Taipei, 3: Hsinchu, 4: Taichung, 5: Changchua, 6: Nantou, 7: Chaiai, 8: Tainan, 9: Kaohsiung, 10: Taitung, 11: Hualien

The Ta-keng member, which is mainly distributed in Tahsi, Kansei, Chutung, the hillside of the eastern Taichu basin, Chusan, Touliu and Chishan, mainly consist of the alternation of dark grey sand and blue-greyish silt with thin layers of lignite bed. This member yields numerous marine molluscan and large vertebrate fossils.

The Yuchih member, which is distributed in the area between the Yuchih and Puli Basins of the Nantou Prefecture, is mainly composed of blue-grey sand, clay and brown

sand with thin layers of lignite, and it attains to 60 meters in thickness.

The Shian-san member, which shows the widest distribution among the three members, is distributed in the Taoyuan and Hsinchu Prefectures in the northwest Taiwan, the western coastal area of Miao-li Prefecture, vast hily land of Chiai, Tainan and the Kaoshiung Prefecture of the southwest Taiwan. This member is mainly composed of yellow-borwnish sand and occasionally intercalated with blue-greyish silt. From this member abundant marine molluscs and foraminifer fossils and land vertebrates have been recorded.

The Haoyánshan (Kaenzan) Formation, which gradually changes from the Tsung-hisao Formation in lithology, is typically distributed in the Nantou Prefecture in the western Taiwan. It is a terrestrial deposits mainly composed of boulder conglomerates and is correlated with the Chú-kŏu-shan Formation in the Taichung Prefecture.

2. The Chi-ting Formation of the Toú-kóu-shan Group in the Cho-chen district.

In the western hilly land of Tainan, southwest Taiwan, the Toú-kóu-shan Group called the Chi-ting Formation (Torii, 1932).

In the Tertiary sediments Torii (1932) recognzied are divided into the two formations: the Ku-ting-kéng (Koteiko) (lower) and the Chi-ting (Kicho) (upper). These two formations are folded with low dips and partly covered with the terrace deposits. The Chi-ting Formation conformably overlies the Ku-ting-keng Formation and is divided into the lower and the upper members*. The lower member, being 350–450 meters in thickness, is mainly composed of silty sandstone, while the upper member more than 2000 meters in thickness, is mainly composed of sandstone beds and yields abundant marine molluscan and vertebrate fossils.

At present, the Ku-ting-kéng Formation and the lower member of the Chi-ting Formation are believed to nearly correspond to the Miáo-li Group, a Pliocene complex prevailing in the northwest Taiwan, while the upper member of the Chi-ting Formation is correlated to the Koshan member of the Tung-hisao Formation of the Toú-kóu-shan Group.

The noteworthy elements of the Cho-chen vertebrate fauna are elephant, deer, wild oxen, wild boar and rhynoceros. The paleontological and stratigraphical studies of the Cho-chen vertebrate fauna have been carried out by Hayasaka (1930a, 1930b, 1932a, 1932b, 1942), Lin (1933), Tokunaga (1936), Kaneko (1941), Shikama (1937, 1972), Shikama *et al.* (1977). Historical review on the study of this fauna was recently given by the present writers (Shikama *et al.* (1977).

In 1973–4, the writers made a geological survey of the area along the Chai-liao River (Chái-liao-hsi) between east of Cho-chen and Wantan, and along the Yen-shui River (Yen-shu-hsi) near Cheng-shan-chun where the many beds are exposed showing the strike N10–35W and the dip 10–70W. Results of geological survey have already been

* Torii (1932) called the lower and the upper members of the Chi-ting Formation as the shelly sandstone and the sandstone Beds, respectively.

published (SHIKAMA *et al.*, 1975). In their paper, they called TORII's "shelly sandstone bed" and "the sandstone bed" of the Chi-ting Formation as the Lower and the Upper Chi-ting Formation, respectively.

According to SHIKAMA *et al.* (1975), the Lower and the Upper Chi-ting Formations are divided into 10 beds (KL1–KU5) by lithology, as shown in Text-fig. 2. The division (KL1–KU5) is useful for vertebrate biostratigraphy.

3. Mammal-bearing beds in the Chi-ting Formation

Fossil mammals are often found on the river floor of the Chái-liao River most commonly after flood mixed with the gravels of river floor. The fossils are all fragmentary and much water-worn, and the beds originaly bearing these fossils are hardly decided on the available evidence. The proboscidean fossils studied by SHIKAMA *et al.* (1975) and the cervids fossils treated in the present paper were mostly collected from the river floor of the Chái-liao or Yen-shui Rivers by Mrs. C.M. CHEN, T.L. KUO and C.W. PÁN in Tainan Prefecture. Some of the specimens, however, were directly picked-up from the degraded sand after eminent rain fall or excavated from the beds belonging to the Upper Chi-ting Formation.

Text-fig. 2 showing the generalized stratigraphic map of the Chi-ting Formation exposed along the coast of the Chái-liao and the Yen-shui Rivers in Cho-chen district. All the localities of fossil vertebrates are shown in this map. The fossil localities on the river floor are restricted in distribution to the area between the entrance of Niu-shih-keng and Chái-liao, where many beds of the Upper Chi-ting Formation are exposed. Therefore, it may be possible to supposed that the fossil vertebrates found among the river pebbles between the entrance of Niu-shih-keng and Chái-liao might have been washed out from the Upper Chi-ting Formation. Furthermore, this map makes clear that some of the vertebrate specimens were undoubtedly derived from the lower part (KU2–KU3) of the Upper Chi-ting Formation, while some specimens were distinctly derived from the upper part of the Chi-ting Formation (KU4–KU5).

Regarding the vertebrate fossil beds of the Chi-ting Formation, the following results were obtained as a conclusion:

1. *Stegodon* (*Parastegodon*) *akashiensis* ranges from the upper part of KU2 up to the lower lart of KU3.

2. *Mammuthus armeniacus taiwanicus* ranges from KU5 up to KU6.

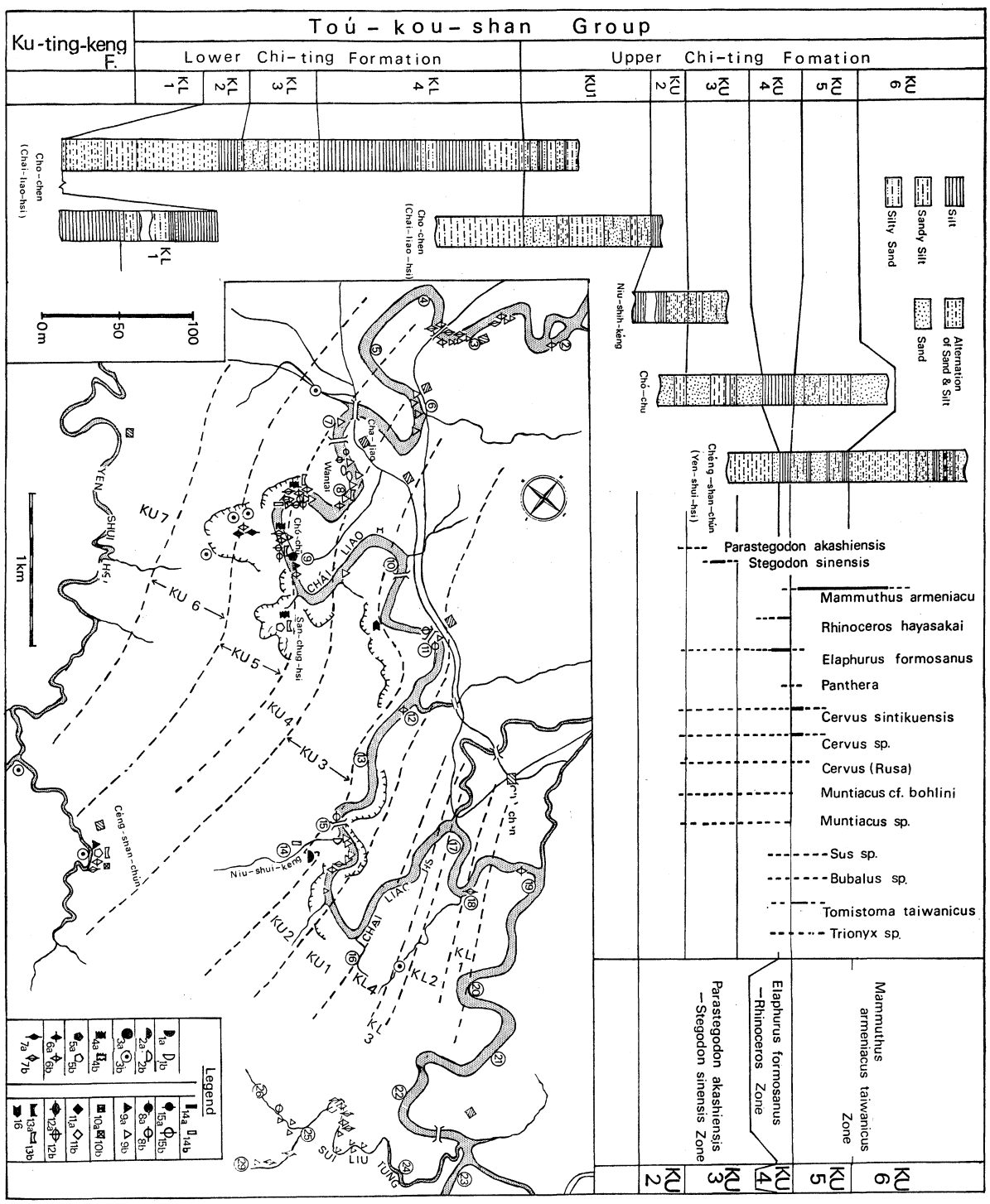
3. *Rhinoceros* (probably new species) ranges from the upper part of KU4 up to the lower part of KU5.

4. *Stegodon sinensis* occurs from the lower part of KU3.

5. *Elaphurus formosanus*, *Muntiacus* cf. *bohlini* and *Muntiacus* sp. ranges from KU2 up to KU4.

6. *Cervus* (*Sika*) *sintikuensis*, *Cervus* (*Sika*) sp. and *Cervus* (*Rusa*) sp. ranges from KU2 up to the lower part of KU5.

7. *Tomistoma*, *Sus*, *Trionyx*, *Macaca*, *Panthera* and *Bubalus* ranges from KU3 up to the lower part of KU5.



Text-fig. 2. Columnar sections and geologic map of Cho-chen area, Tainan Prefecture.
Legend: a: the specimens picked up from the degrated sediments or excavaged from the bed; b: the specimens collected from the river floor.
1. *Stegodon* (*Parastegodon*) *akashiensis*, 2. *Stegodon sinensis*, 3. *Mammuthus armeniacus taiwanicus*, 4. *Tomistoma taiwanicus*, 5. *Rhinoceros hayasakai*, 6. *Cervus* (*Sika*) sp., 7. *Cervus* (*Sika*) *taiouanus*, 8. *Muntiacus* cf. *bohlini* 9. *Elaphurus formosanus*, 10. *Panthera*, 11. *Cervus* (*Rusa*,) 12. *Sus*, 13. *Trionyx*, 14. *Bubalus*, 15. *Muntiacus* sp., 16. *Pisces*.

Consequently, the writers can propose the following tentative zones in the Chi-ting Formation based on the mammalian fossils:

KU2–KU3 ..... *Stegodon* (*Parastegodon*) *akashiensis-Stegodon sinensis* Zone
KU4 ..... *Elaphurus formosanus-Rhinoceros hayasakai* Zone
KU5–KU6 ..... *Mammuthus armeniacus taiwanicus* Zone

Cervid Assemblage from the Chi-ting Formation of the Toú-kóu-shan Group

The cervid assemblage of the present collection from the Chi-ting Formation is composed of the following six species.

	Frequency
Elaphurus (*Elaphurus*) *formosanus* SHIKAMA	23 %
Muntiacus cf. *bohlini* TEILHARD de CHARDIN	16 %
Muntiacus sp.	0.7%
Cervus (*Rusa*) sp.	0.7%
Cervus (*Sika*) *sintikuensis* SHIKAMA	32 %
Cervus (*Sika*) sp.	26 %

As seen in the table, *C.* (*S.*) *sintikuensis*, *C.* (*S.*) sp., *E.* (*E.*) *formosanus* and *M.* cf. *bohlini* are abundant in occurrence while the others are rather rare. In this point, the Cho-chen deer assemblage may be called as the *Sika-Elaphurus* assemblage and is judged to be very important as a representative deer community of low-land fauna in the northeast Asia.

Elaphurus formosanus is an important species for the consideration of the phylogeny of the Elaphurine because the antler of this species holds intermediate characters between the subgenus *Elaphuroides* and *Elaphurus* (s.s.). That is, the fore tine of *E. formosanus* close to those of *E.* (*Elaphuroides*) *bifurcatus* from the Early Pleistocene Nihowan Formation in North China or *E.* (*Elaphuroides*) *shikamai* from the Akashi Formation of the Osaka Group in Japan while its posterior tine resembles those of *E.* (*Elaphurus*) *menziesianus* from the Archeological Site of Anyang, North China.

Cervus (*Sika*) *sintikuensis* Shikama is small deer having more primitive characters in the antler and the teeth than ever known fossil and living species of *Cervus* (*Sika*). *Muntiacus* cf. *bohlini* TEILHARD de CHARDN closely resembles *M. bohlini* (=*Cervulus bohlini*, TEILHARD de CHARDIN, 1940) from Loc. 18 in Huaiyu (Villafranchian), North China.

The Cho-chen deer assemblage seems to be allied to those of the Middle Pleistocene *Stegodon-Ailuropoda* Fauna in South China (KAHLKE, 1961) in existence of *Muntiacus* and *Cervus* (*Rusa*) but differs from them by dominance of *E. formosanus* and *C. sintikuensis*.

In existence of *Elaphurus*, *Muntiacus* and *Rusa*, the Cho-chen deer assemblage much resembles the Early Pleistocene Nihowan fauna (N. China) but differs from this assemblage by the absence of *Cervus* (*Eucladoceros*). The Cho-chen deer assemblage is

also discriminated from the Kuchinotsu-Akashi vertebrate Fauna (OTSUKA, 1969) by the existence of *Muntiacus* and *C.* (*S.*) *sintikuensis*.

In existence of the archetypal *Muntiacus*, the Cho-chen deer assemblage also resembles the Yushé fauna of the Yushe Basin in North China but is different from this fauna in absence of *Eostyloceros*, *Metacervulus* and *Cervus boulei*.

The Cho-chen deer assemblage is also realted to those of Lco. 18 in Huaiyu, Northwest Peking by the existence of *Muntiacus* cf. *bohlini* but is distant from this assemblage by abundant *Elaphurus* and *Sika*.

The Choukoutien deer fauna which is characterized by predominance of *Cervus* (*Sika*) *greyi*, *Cervus* (*Euryceros*) *pachyosteus* and *Moschus moschiferus pekinensis* is discriminated from the Cho-chen deer assemblage by the absence of *Elaphurus*. Trinil and Djetis Fauna in Java are also discriminated from the Cho-chen deer assemblage in the same respects.

Such being the case, the Cho-chen deer assemblage seems to be different from any other deer assemblages known in China, Japan and Java. If we pay attention to the existence of archetypal cervids of *Elaphurus*, *Sika*, and *Muntiacus*, however, the Cho-chen deer assemblage seems to be closely related to the Early Pleistocene Nihowan (N. China) and the Akashi (Japan) faunae than the Middle Pleistocene Chukoutien and Wanshien faunae in China (probably Middle- to Upper Pleistocene).

In 1937, SHIKAMA described such cervids fossils as *Cervus* (*Sika*) *taevanus*, *C.* (*Rusa*) *timoriensis* BLAINVILLE, *C.* (*Depéretia*) *kokubuni*, *C.* (? *D.*) *syatinensis* and *Capreolus* (?) *formosanus* from the Cho-chen area and he regarded the Cho-chen fauna coeval with the Toú-kóu-shan — Chú-kŏu-shan faunae to Pliocene (mid. up. Villafranchian of nowadays) allowing the predominate appearence of Akashi (Japan)-Nihowan (N. China) elements which were then regarded as useful indicators of Villafranchian. As will be discussed in the next chapter, however, two species of SHIKAMA's "*Depéretia*" such as *kokubuni*, *syatinensis* and *Capreolus formosanus* are regarded as a single species belonging to *Elaphurus*. Therefore, species name "*formosanus*" was elected as a newly identified *Elaphurus*. Furthermore, his *taevanus* was regarded as a variation of *sintikuensis*. Consequently, deer species described by SHIKAMA (1937) are revised as follows:

Cervus (*Sika*) *sintikuensis* SHIKAMA

Elaphurus (*Elaphurus*) *formosanus* (SHIKAMA)

Cervus (*Rusa*) *timoriensis* ?

As the result of the present study, the writers came to the same conclusion as SHIKAMA's opinion in regard to the age of the Cho-chen deer assemblage.

Systematic Description

Order Artiodactyla

Family Cervidae GRAY, 1821

Genus *Elaphurus* MILNE-EDWARDS, 1866

1866. MILNE-EDWARDS, A.: *Ann. Sci. Nat. (Zool)*, 5, 380–382.
1915. LYDEKKER, R.: *Cat. Ung. Mamm. Brit. Mus.*, 4, 151–153.
1930. TEILHARD de CHARDIN, P. &. J. PIVETEAU: *Ann. Pal.* 19, 46–48.
1936. ———— & C. YOUNG: *Pal. Sinica*, ser. C, 12, fasc. 1, 30–38.
1936. SHIKAMA, T.: *Jub. Comm. Prof. Yabe's 60th Birthday*, 2: 1161–1162.
1972. OTSUKA, H.: *Bull. Nat. Sci. Mus.*, 15, (1), 197–210.
1976. ———— & Y. HASEGAWA: *Bull. Nat. Sci. Mus.*, ser. C, (Geol. & Paleont.), 2, (3), 139–143.

Subgenus *Elaphuroides* OTSUKA, 1972

Type-species. – *Elaphurus* (*Elaphuroides*) *shikamai* OTSUKA

Geologic range. – Early Pleistocene (Middle- to Upper Villafranchian)

The following two species are refererable to the subgenus *Elaphuroides*:

Elaphurus (*Elaphuroides*) *shikamai* OTSUKA, 1968 and *E.* (*Elaphuroides*) *bifurcatus* TEILHARD and YOUNG, 1936.

Subgenus *Elaphurus* (MILNE-EDWARDS, 1866) OTSUKA, 1972

Type-species. – *Elaphurus* (*Elaphurus*) *davidianus* MILNE-EDWARDS, 1866

Geologic range. – Late Pliocene to recent.

The following four species are referable to the subgenus *Elaphurus*.

E. (*Elaphurus*) *davidianus* MILNE-EDWARDS, 1966
E. (*Elaphurus*) *menziesianus* TEILHARD and YOUNG, 1930
E. (*Elaphurus*) *akashiensis* SHIKAMA, 1964
E. (*Elaphurus*) *tamaensis* OTSUKA & HASEGAWA, 1976

Elaphurus (*Elaphurus*) *formosanus* (SHIKAMA), 1937
Pl. 3, figs. A and B; Pl. 4, figs. 1–12; Pl. 5, figs. 1–6.

Cervus (*Depéretia*) *kokubuni* SHIKAMA, 1937, *Sci. Rep. Tohoku Imp. Univ.*, 2nd. ser. (Geol.), vol. XIX, no. 1, p. 83, Pl. XIV, fig. 17.

Cervus (*Depéretia* ?) *syatinensis* SHIKAMA, *Ibid.*, 2nd, ser. (Geol.), vol. XIX, No. 1, p. 83, Pl. XVI, figs. 19–20.

Capreolus (?) *formosanus* SHIKAMA, *Ibid.*, 2nd. ser. (Geol.), vol. XIX, figs. 21 and 22.

Referred specimens. – Thirty five antler specimens, five isolated upper molars and eight isolated lower molars are treated. Among the antler specimens, nineteen specimens are right antlers, sixteen left antlers. Most specimens are incomplete preservation and preserved no main part of the antler above the first fork, excepting a

single specimen. They occupy about 23% of total number of cervid specimens in the collection.

Specific diagnosis. – Elaphurine with small- to medium sized, slender antler. Antler rugose, tuberculated, forked at rather high position above burr. Burr nearly circular in section, moderately rugose. Fore tine projects upward, somewhat forward, making gnetle curvature and finally forked into two lateral prongs. The posterior tine projecting straightly backward, somewhat upward, without any more forking. Surface very rugose with many small snags and tubercles which are developed on the inner surface.

Upper third molar (M3) is large and strongly constructed but it is narrower than the living Pére DAVID's deer; the protocone is much distended inward and its postero-inner wall is clearly constricted like a protocone of *Merychippus*. Lower molars (M1–M3) are also large with much distended lobes but each molars are shorter than those of the living Pére DAVID's deer.

Description -.

Antler.

A left antler (Reg. no. ESK 6041; Pl. 3, figs. 1a-1c; Locality: Mudstone bed exposed along the river side of Chái-liao-shi, Chó-chü of Chái-liao, Tainan Prefecture; Horizon: Light blue mudstone bed belonging to KU 4 of the Upper Chi-ting Formation). An incomplete left antler preserved most part of the antler but lacking a basal part of the beam below the first forking and a tip portion of the fore tine. Fore tine projects upward, somewhat foward making gentle curvature and finally forked into two lateral prongs at a point 100 mm above the first forking. However, these two prongs are completely broken off from its base. Distance between the first and the second forks is short measuring 130 mm along the anterior border. A small snag presents on the outer surface of the fore tine just beneath the second forking.

The posterior tine is long, slender, measuring 500 mm in preserved length. It projects almost straightly backward, somewhat upward, making 100 degrees with the fore tine. It is much rugose and tuberculated with many accessory prongs and remarkable longitudinal furrows. Tubercles are rather small and are mostly developed on the inner surface. They are directed backward.

A basal part of right shed antler (Reg. no. 54; Pl. 4, fig. 12; C.W. PAN's Collection; Locality: A river floor of the Chái-liao-hsi). This is a largest antler specimen of this species in the collection. Fore- and the posterior tines are completely borken off from its base. Burr much worn and subcircular in section, measuring 45 mm×40 mm in diameter. In anterior view, an axis of the beam below the forking declines somewhat outward, and a fore tine directs more outwardly than the posterior one. Beam below the first forking is stout, nearly oval in section and is covered with faint, longitudinal grooves and shallow furrows. Fore tine is forked at very high position (about 85 mm along the inner border) above the burr. A cutting plane of the fore tine is wider than

* Abbreviation for the Institute of Earth Sciences, Faculty of Science, Kagoshima University.

those of the posterior one where it shows subrectangular outline.

A right antler with a pedicle attached (Reg. no. 57; Pl. 4, fig. 8; C.W. PAN's Collection; Locality: A river floor of the Chái-liao-hsi). Pedicle is rather short, being 20 mm in minimum length, 27.3 mm in fore-and-aft diameter. Burr is much borken but shows subcircular outline. Beam below the forking shows suboval outline in section with nearly flat inner, somewhat distended outer surface. Fore tine projects directly upward, somewhat forward. The posterior tine, forking at 60 mm above the burr, projects backward, somewhat upward, making an angle more than 80 degrees with a fore tine. Transverse section of the posterior tine near the forking point is nearly circular, measuring 21.8 mm×25.2 mm in diameters at its base. Surface of the antler is rather rugose with shallow but wide furrows and grooves.

An incomplete left shed antler (Reg. no. 47; Pl. 4, fig. 7; C. W. PAN's Collection; Locality: Loc. P3 of the Chái-liao-hsi; Horizon: Precise horizon is unknown, however it may be possible to suppose that this specimen might have derived from the Upper Chi-ting Formation, probably KU3 or KU4). Fore tine is completely borken off and the posterior tine is barely preserved. Antler is very slender and relatively rough with numerous shallow longitudinal grooves and ridges.

Burr much worn and shows nearly circular outline, measuring 28 mm×29.5 mm in diameters. The posterior tine is forked at very high position (about 72 mm) above the burr. It projects backward, somewhat upward, making about 30 degrees with an axis of the beam below the first forking.

A fragment of the posterior tine of a right antler (Reg. no. 89; Pl. 5, fig. 5; C.M. CHEN's Collection; Locality: A river floor of the Chai-liao-hsi). A fragment of the posterior tine is 94 mm in preserved length. Surface is very rugose with rather deep, narrow furrows with many small tubercles. An interval of each tubercles are 15 mm in average.

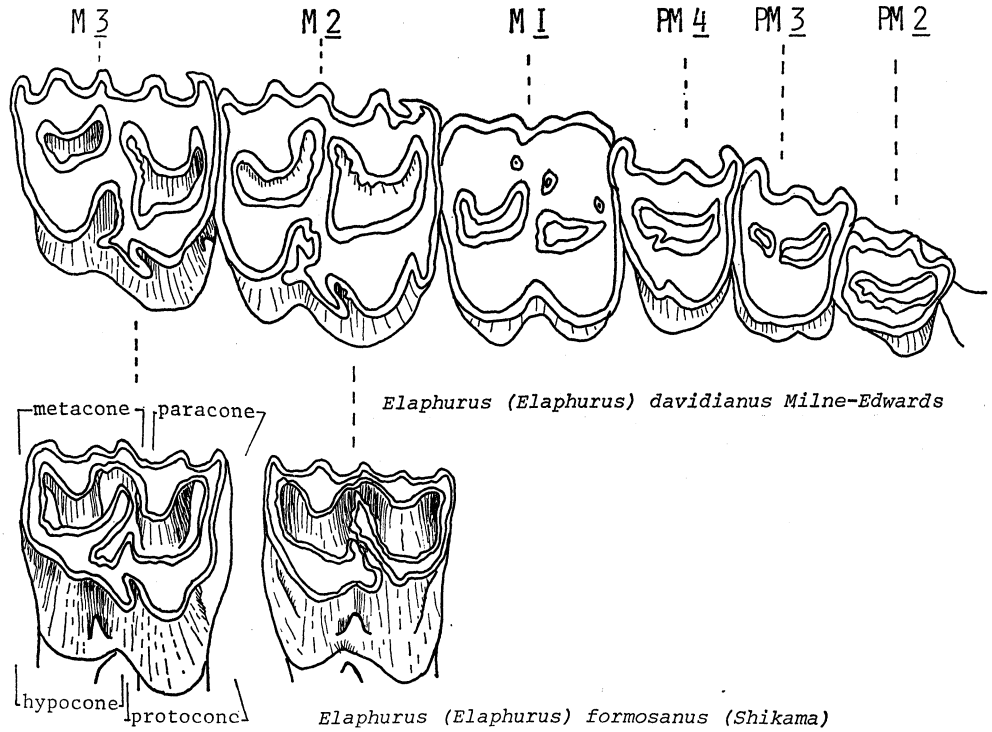
A fragment of the posterior tine of the right antler (Reg, no. 93; Pl. 5, fig. 7; C.W. PAN's Collection; Locality: Loc. P8 or P9 of the Chái-liao-hsi; Horizon: Exact horizon is uncertain (probably from KU4 or KU5 of the Upper Chi-ting Formation). A fragment of the posterior tine of a right antler is 86 mm in preserved length. It is slender with suboval outline and bent upward. Noticeable two tinelets exist on the upper surface of a tine. They declines backward, measuring 27 mm in maximum width at its base.

Upper molar

Upper third molar (M3): Six left thrid molars (Reg. no. E4; Pl. 5, fig. 13) are in the collection. A left third molar (Reg. no. E4; Pl. 5, fig. 13) is large and strongly constructed. The first lobe remarkably distends inward; especially the posterio-inner surface is clearly constricted and distends inward like a protocone of *Merychippus* (Text-fig. 3). A basal cinglum is seen on the antero-inner surface of the protocone and on the inner wall of the hypocone. Paracone has nearly rectangular outline on the occusal surface and remarkably distends inwardly. Para-, meta- and mesostyles

are not developed compared with the those of the living Pére DAVID'd deer (*E. davidianus*). Small accessory column (entostyle) lies on the outer wall between the first and second lobes.

Upper second molar ($M\bar{2}$): Seven isolated upper $M\bar{2}$ are treated. It is also strongly constructed. The postero-inner wall of the protocone is constricted and projects inward. In occusal view, para- and metastyles are broad and show nearly rectangular outline. The mesostyle is moderately developed. Large accessory column distirct, cylindrical or tabular form.



Text-fig. 3. Upper molars of *Elaphurus davidianus* MILNE-EDWARDS and *Elaphurus formosanus* (SHIKAMA)

Lower molar: Five third ($M\bar{3}$), single second ($M\bar{2}$) molars, first ($M\bar{1}$) and third premolar ($PM\bar{3}$) are in the collection.

Lower thrid molar ($M\bar{3}$): Five isolated lower third molars (Plate 3, figs. 9, 11,12) are in the collection. The third molar is large and lobes are well distend outward. Para- and metastyles are remarkably developed. Prominent accessory columns are exist on the outer wall between each lobes.

In occusal view, para- and entoconids are broad and show nearly circular outline. Rather remarkable cinglum is recognized on the antero-inner wall of the first lobe.

Lower first and the second molars ($M\bar{1}$ and $M\bar{2}$) (Plate 5, figs. 10, 14 and 16) are large; the anterior and the posterior lobes are remarkably distended. Para-and metastyles are well developed. A cingulum is recognized on the antero-outer margin of the anterior lobe.

Table 1. Measurements (in *mm*) of lower molars of *E. formosanus* and *E. davidianus*.

Position	Species Name	Reg. No.	Length	Width (anterior lobe)	Remarks
$M\bar{3}$	*E. formosanus*	162	27.0	12.1	C.W. PAN's Collection
		175	30.0	14.6	〃
		E3	—	14.0	〃
		E1	30.3	14.3	〃
		E2	30.0	14.3	〃
		133	30.8	14.6	〃
	E. davidianus	No. 1870–65 male	30.25	14.5	Institute de Zoologie, Museum Nationale dHistoire Naturelle, Paris
		No. 1870–66 female	29.8	14.7	〃
		No. 1966–02 male	33.8	16.4	〃
$M\bar{2}$	*E. formosanus*	112	20.1	14.5	C.W. PAN's Collection
		119	22.7	15.0	〃
	E. davidianus	No. 1870–65 male	23.3	14.0	Institute de Zoologie, Museum Nationale d'Historie Naturelle, Paris
		No. 1870–66 female	24.8	14.8	〃
		No. 1966–02 male	26.0	15.1	〃

Table 2. Measurements (in *mm*) of upper molars of *E. formosanus* and *E. davidianus*.

Position	Species Name	Reg. No.	Length	Width (anterior lobe)	Remarks
$M\underline{3}$	*E. formosanus*	E4	24.2	24.2	C.W. PAN's Collection
	E. davidianus	No. 1870–65 male	22.4	22.5	Institute de Zoologie, Museum Nationale d'Histoire Naturelle Paris
		No. 1870–66 female	23.9	25.0	〃
		No. 1966.02 male	26.2	27.2	〃
$M\underline{2}$	*E. formosanus*	E5	19.8	19.6	C.W. PAN's Collection
		E6	17.4	22.6	〃
		150	19.2	18.0	〃
		96	19.8	20.6	〃
		164	20.2	18.3	〃
		105	21.6	+16	〃
	E. davidianus	No. 1870–65 male	21.6	24.0	Institute de Zoologie, Museum Nationale d'Histoire, Naturelle, Paris
		No. 1870–66 female	23.7	25.8	〃
		No. 1966–02 male	26.2	26.0	〃

Table 3. Measurements of antler of fossil and living species of *Munticaus* (in *mm*).
( ): average dimention n: number of specimen F-A: fore-aft S-S: side to side

Species Names	Locality & Horizon	Length of Pedicle	Diameter of pedicle F-A	Diameter of pedicle S-S	Diameter of burr F-A	Diameter of burr S-S	Length of Antler	Height of Fork	Length of brow tine	Reamkrs
M. cf. *bohlini*	Cho-chen,									
3	Chi-ting F.	—	—	—	25.8	25.5	47.4	—	—	Kuo's Collection
4		33	15.4	—	22.6	22.5	+53	—	—	Pan's Collection
5		—	—		19.9	16.8	+38.6	—	—	
6		—	—		18.8	17.7	+47	—	—	
7		—	—		13.8	14.2	+28	—	—	
8		+24	20		35.8	28.8	+28	11.8	+11	Kuo's Collection
9		+22	17		24.6	20.0	+36	13.0	—	Pan's Collection
10		—	—		26.2	21.8	+49	14.8	11-12	〃
11		—	—		21.3	17	+16	15.2	—	〃
12		—	—		22	21.5	+48	14.1	—	〃
13		—	—		19.3	18.1	+14.5	11.9	7-8	〃
14		—	—		22.8	17.4	+37	—	—	〃
15		+ 2	—		+26	26.5	+37	—	—	〃
16		—	—		15	10	+35	—	—	〃
M. sp.	Sui-liu-tung									
1	of Cho-chen,	—	—		25.8	25.5	81.4	20.4	ca. 6	Chen's Collection
2	Chi-ting F.	—	—		19.2	16.5	50.0	15.5	ca. 5	Pan's Collection
M. bohlini	Loc. 18 in Huaiyu, N.E. Peking	20-35 (29) n=6	12-18.5 (16.6) n=6				72-97 n=7	18-31 (20.3) n=6		Teilhard de Chardin (1940)
M. bohlini (=*Cervulus* cf. *sinensis*)	Nihown	49 n=1	18.5				108			Teilhard de Chardin & Piveteau (1930)
Cervulus lacustris	Yushe Series (Zone III)	27 n=1	16-31 (21.8)		16.5	27.3 n=6	96-122 (109) n=5	16-(31) (21.8)	9-22	Teilhard de Chardin & Trassaert (193)
Cervulus nanus	Yushe Series (Zone III)	31	11		9.5	13	43	17.5		Teilhard de Chardin Trassaert (1937)
Paracervulus simplex	Yushe Series (Zone III)	15-17	12-18		21-30 (16.6)		57-96 (25.8)			Teilhard de Chardin & Trassaert (1937)
Paracervulus attenuatus	Yushe Series (Zone III)		15-19 (16.7) n=3				84-108 (96.7) n=3	39-52 (47.7) n=3		Teilhard de Chardin & Trassaert (1937)
M. reevesi	Recent, China	30-71 n=18	13-18 n=18				50-93 n=18	8-20 n=18	9-25 n=18	Colbert & Hooijer (1952)
M. r. micrusus	Recent, Taiwan	25-43 n=3	14-15 n=3		18-23.6 n=3		66-77 n=3	11-13 n=3	16-19 n=3	Coll. of Inst. Earth Sci., Kagoshima Univ.
M. m. muntjak	Recent, Java	43-110 (65.8)	51-110 n=14				51-210 (125) n=9			Erdbrink (1973) RMNH, Leiden
N. n. pleiharicus	Recent, S. Borneo	43-75 (56.3) n=6					28-120 (75.5) n=4			Erdbrink (1973) RMNH, Leiden
M. m. rubidus	Recent, N. Borneo	41-61 n=3	19-21				95-103	14-19	11-42	Inst. Earth Sci. Kagoshima Univ.
M. m. vaginalis	Recent, India	67-87	15-21				87-102	19	32	Colbert & Hooijer (1952)
M. m. grandiornis	Recent, Burma	25-54					200-230			Eddbrink (1973)
M. crinifrons	Recent, S. China	44	14				64	21	21	Colbert & Hooijer (1954)
M. kendengensis	Java, Mid. Pleistocene	34-84	24-28 (19) n=3				115-183 (152) n=3	24-39 (33) n=3	92-109 (100) n=3	Stremme (1911), Koenigswald (1933)
M. m. muntjac	Java, Mid. Pleistocene	66					97		51	Koenigswald (1933)
M. m. margae	Yenochingkou, Sczechuan	73-78 (75.5)	17-30 25.8 n=6				48-93(+) (68.6) n=5	15-26 (18.6) n=8	19(+)-34(+)	Colbert & Hooijer (1952)

Comparisons and observations. – When one of us (SHIKAMA, 1937) reported the fossil deer fauna from Cho-chen of Taiwan, he described two new species referable to the subgenus *Depéretia* SHIKAMA (=*Nipponicervus* KREZOI) under the name of *Cervus* (*Depéretia*) *kokubuni* and *Cervus* (*Depéretia*) *syatinensis*. The former species is established based on the "proximal portion of a right antler" and the latter species based on "the proxomal porition of a young left antler". He compared *C. kokubuni* with *C.* (*D.*) *kazusensis* from the Pleistocene of the Japanese Islands and discriminated it from the latter having low point of the first forking and rugose surface. He, furthermore, distinguished it from the majority of the species of *Depéretia* by "the extraordinary bending of the antler outward". He regarded *C.* (? *D.*) *syatinensis* as an independent species from *kokubuni* by small slender antler.

He, furthermore, described a fragmental antler specimens of the left (?) antler under the name of *Capreolus* (?) *formosanus* and regarded this species as one of a descendant of *Procapreolus rütimeyeri* SCHLOSSER recorded from the lower Pliocene deposits of Mongolia.

As a result of the present study on the fossil deer from the Chái-liao-hsi, the writers came to the following conclusions. The characters of such three species as *C.* (*D.*) *kokubuni*, *C.* (? *D.*) *syatinensis* and *Capreolus* (?) *formosanus* are regarded as a variation of a single species referable to the genus *Elaphurus*. Slight differences of the ornamentation and size of the antler among these species seem to suggesting the characters of different growth stage of the antler.

Nearly complete specimen of antler excavaged at Chái-liao-hsi (Pl. 3, figs. a and b) and a fragment of an antler with pedicle attached (Pl. 4, fig. 8) clearly show the character of *Elaphurus* from the Toú-kóu-shan Group. So long as these two specimens are concerned, the first forking is at very high position above the burr as seen in the case of "*Depéretia*" and thick fore tine streches straightly upward making large angles with posterior tine. Judging from these characters, "the first tine" of the type specimens of *C. kokubuni* and *C. syatinensis* are regarded as the posterior tine of *Elaphurus*, while the type specimen of *Capreolus* (?) *formosanus* is safely referable to the beam of *Elaphurus*. And such three species as *kokubuni*, *syatinensis* and *formosanus* are included in a single species of the genus *Elaphurus*. In the present paper, the writer selected the specific name *formosanus* for newly identifed *Elaphurus*.

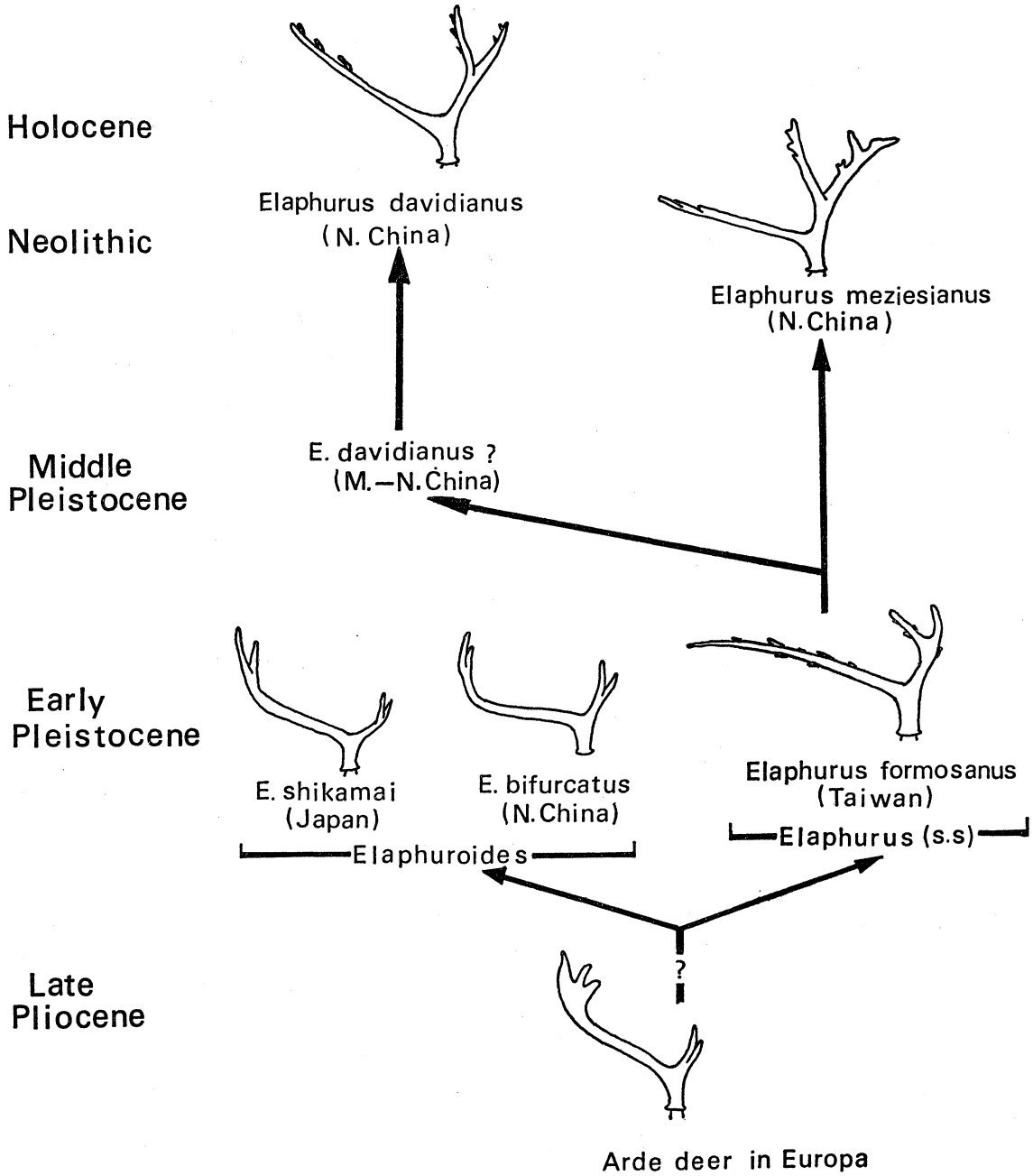
The antler of *Elaphurus formosanus* has an intermediate characters between the subgenera *Elaphurus* (s.s.) and *Elaphurodies*. For instance, the fore tine of this species projects upward, somewhat forward making gentle curvature and finally forked into two lateral prongs as seen in the subgenus *Elaphuroides*, while the posterior tine streches straightly backward with many accessory tinelets as seen in the subgenus *Elaphurus* (s.s.).

Upper molar of *E. formosanus* closely resembles those of *E. davidianus* by much distended protocone with clearly constricted posterio-inner wall, but the former is different from the latter by narrow molar with less developed para- and metastyles

(Text-fig. 3).

As a whole, however, the present species is more close to the subgenus *Elaphurus* especially to *Elaphurus menziesianus* (SOWERBY) from the Archeological Site of Anyang of North China, but it has more primitive characters than the latter.

At present, the writer have an opinion that the subgenus *Elaphurus* has differentiated into two subgenera as *Elaphurus* (s.s.) and *Elaphuroides* at the age of the Early Pleistocene of northeastern Asia.



Text-fig. 4: Phylogeny of the genus *Elaphurus* (after OTSUKA, 1972; partly revised)

Family Munticinae

Genus *Muntiacus* RAFINESQUE, 1815

Muntiacus cf. *bohlini* TEILHARD de CHARDIN

Pl. 6, figs. 1–12, 15–21.

cf. *Muntiacus bohlini* TEILHARD de CHARDIN, 1940, *Pal. Sinica*, Whole ser. no. 124, p. 79–88.

Referred specimens. – Fourty five specimens including sixteen antlers, eleven isolated upper teeth, ten isolated lower teeth, five lower jaws and three other bones are treated. Among six antler specimens, eight specimens are right antler. Most of the antler specimens are incomplete in preservation and preserve no main part of the beam above the forking.

Diagnosis. – Small *Muntiacus* with small- to medium-sized antler. Burr, less rugose, oval in outline. Fore tine small or very tiny. Beam flattened in fore-and-aft direction, somewhat declines backward. Surface of the antler rather rugose with remarkable grooves and furrows. Molars and jaws are small as *Muntiacus*, corresponding to those of *C. bohlini* in size.

Description. -

Antler. Antler shows considerable variation in form and size, suggesting different growth stages.

A left shed antler of young male (Reg. no. 7, Pl. 6, fig. 6; C.W. PAN's Collection), is small, measuring 32 mm in preserved length. It is much worn and black coloured. Burr thin, nearly circular in outline, measuring 13.8×14.2 mm in diameters. Beam nearly straight, declines slightly backward. Fore tine is very tiny.

A right shed antler of young male (Reg. no. 16, Pl. 6, fig. 1; C.W. PAN's Collection; Loc. P7 of the Chái-liao-hsi) is small, measuring 35 mm in length. It streches upward from the base with declined tip portion. Burr thin, oval in outline, measuring 15 mm (fore-and-aft) × 10 mm(side-to-side) diameters.

A right shed antler of the young male (Reg. no. 3, Pl. 6, fig. 2, T.L. KUO's Collection) is small, slender and much declines backward. It is measured 53.4 mm in maximum length. Burr broad, compressed in fore-and-aft direction. Surface of antler is covered with rather prominent wide, deep furrows.

A right antler with pedicle (Reg. No. 8, Pl. 6, fig. 5; T.L. KUO's Collection) is 55 mm in preserved length. Pedicle and basal part of the antler are preserved. Pedicle is 24 mm in preserved length, being compressed laterally. Burr thin, oval in transverse section, measuring 28.8 mm×35.8 mm in diameter. Tiny fore tine, which lacks a tip porition, projects somewhat outward. The posterior tine, is also slender with subcircular outline and is lyrated backward making, an angle of 80 degrees with the fore tine.

Limb bones. Metacaprus, tibia and tarsus are in the collection. Measurements of these bones are follows (in *mm*):

Metacarpus (Reg. no. 902, Pl. 6, fig. 21;T.L. KUO's Collection):

Preserved length: +44; Diameter at distal portion: 152 (side-to-side) × 9.5 (fore-and-aft)

Tibia (Reg. no. 903; C.W. PAN's Collection):

Preserved length: +69; Diameter at distal end: 16.3 (side-to-side) × 12.6 (fore-and-aft)

Tarsus: (C.W. PAN's Collection): Maximum length: 18.7; Diameter at proximal end: 10.3 (side-to-side); Diameter at distal end: 11.0 (side-to-side)

Lower jaws and molars:

Four fragmental lower jaws with molars and two isolated third molars are in the collection. Lower jaw is small in size. It is slender as *Muntiacus*, larger than *M. reevesi*, smaller than in *M. muntjak*. Lower molars are rather small sized and para-, meso- and entostyles are less developed; prominent accessory column is exists between each lobes. Mandibular index ranges from 55.6 to 74.7. Length of the lower teeth row ($M\bar{1}$-$M\bar{3}$) is almost equal to those of *M. bohlini* and much shorter than those of *M. muntiacus vaginalis* and *M. m. margae*.

Upper teeth.

Eleven isolated molars are in the collection. Each molars are moderate sized as *Muntiacus*, larger than in *M. reevesi*, much shorter than in *M. muntjak*. An accessory column exists on the inner wall of each lobes; especially those of $M\bar{3}$ is larger than the others. Para-, meso- and metastyles are moderately developed. Each molars are wider than those of the living species of *Muntiacus*.

Comparisons. – Although the antler of *Muntiacus* cf. *bohlini* from the Chi-ting Formation shows considerable extent of variation in form and size, those of full-grown stage are chatecterized by small brow tine, subrectangular outline of burr and somewhat declined posterior beam with rough surface. As far as these characters are concerned, the present species is allied to *Muntiacus muntjak margae* HOOIJER (HOOIJER, 1951; COLBERT & HOOIJER, 1953) of the Middle Pleistocene *Stegodon-Ailuropoda* Fauna in Yenchigkou of Szechuan, south China and *Muntiacus bohlini* TEILHARD de CHARDIN from loc. 18 of the Early Pleistocene fissure deposits in Nothn China (TEILHARD de CHARDIN, 1940). The present species, however, clearly distinguished from *C. m. margae* by small molars and jaws. The present species is close to *M. bohlini* (*Cervulus bohlini*) in size, mode of the forking of the antler and in the dimentions of the upper teeth row ($M\underline{1}$–$M\underline{3}$). Strictly speaking, however, the present species is somewhat differs from *M. bohlini* having somewhat small lower molar and low horizontal ramus (Tables 4 and 5).

The present species somewhat resembles *Paracervulus simplex*, *Muntiacus lacustris* (=*Cervulus lacustris*), *M. nanus* (=*Cervulus nanus*) and *M. attenuatus*, recorded from the Plio-Pleistocene deposits in Southeast Shansi (TEILHARD de CHARDIN & TRASSAERT, 1937), by the antler which is covered with rather prominent furrows and grooves, but the present species are safely discriminated from the latter four species by low-forked antler with nearly subtriangular burr.

The present species has more triangular outline of burr and large molars than those of the living species of *Muntiacus* now living in the China (*M. reevesi* in Noth China, *M. reevesi micrusus* in Taiwan), and has smaller molar than the living species of *M. muntjak* in the southeastern Asia and *M. crinifrons* in the southeastern China.

The present species is also discriminated from the fossil species of *Muntiacus* from the *Pithecanthropus* Fauna in Java such as *Muntiacus kendengensis* and *M. bumiajuensis*, by shorter brow tine and larger upper molars, respectively.

Muntiacus sp.

Pl. 6, figs. 13, 14 and 22.

Referred specimens. – Two shed antlers and a metacarpal bone are in the collection. These are collected from the liver floor of the Chái-liao-hsi and the Sui-liu-tung. Exact horizon of these specimens are uncertain, however, it may be possible to suppose that these are derived from the Upper Chi-ting Formation of the Toú-kóu-shan Group.

Description. – A right shed antler (Reg. No. 1; Pl. 6, fig. 13, C.M. CHEN's Collection; Locality: river floor below the Huhshie bridge of Cho-chen). Nearly complete shed antler is 82 mm in length. Burr is almost circular, thin, measuring 25.5 mm (side-to-side) × 27.6 mm (fore-and-aft) in diameters. It projects straightly upward and its tip portion is slightly bent backward. The outer surface somewhat distends outward while the inner surface much concaved, hence, the antler shows lunar-shaped outline in transverse section. Tiny fore tine, which arising from the anterio-outer coner of the beam, projects anterio-inward. Surface of the antler is smooth except the basal portion.

A right shed antler of young male (Reg. no. 2, Pl. 6, fig. 14; C.W. PAN's Collection; Locality: river floor of the Chái-lioa-hsi of Cho-chen) is 53 mm in length. Burr is thin with nearly circular outline, measuring 16,5 × 19.2 mm in diameter. The beam streches upward, somewhat outward with nearly flat inner, somewhat distended outer surface. A tiny fore tine arises from the anterio-outer surface of the beam. Surface of the antler is almost smooth.

Comparisons. – *Muntiacus* sp. from the Chi-ting Formation has typical antler as seen in the living species of *Muntiacus* and is safely discriminated from *M.* cf. *bohlini* by having nearly circular outline of burr and flattened beam with smooth surface. However, it is difficult to dicide the precise systematic position of this species based on only the antler. Because there are five living species and 17 subspecies of *Muntiacus* in the southeastern Asia and these showing considerable extent of variation of the antler in form and size. More number of specimen is needed to clarify the systematic position of the species here retained.

Table 4. Measurements of cheek teeth and jaws of recent and fossil *Muntiacus* (in *mm*). ( ): average dimion, n: number of specimen.

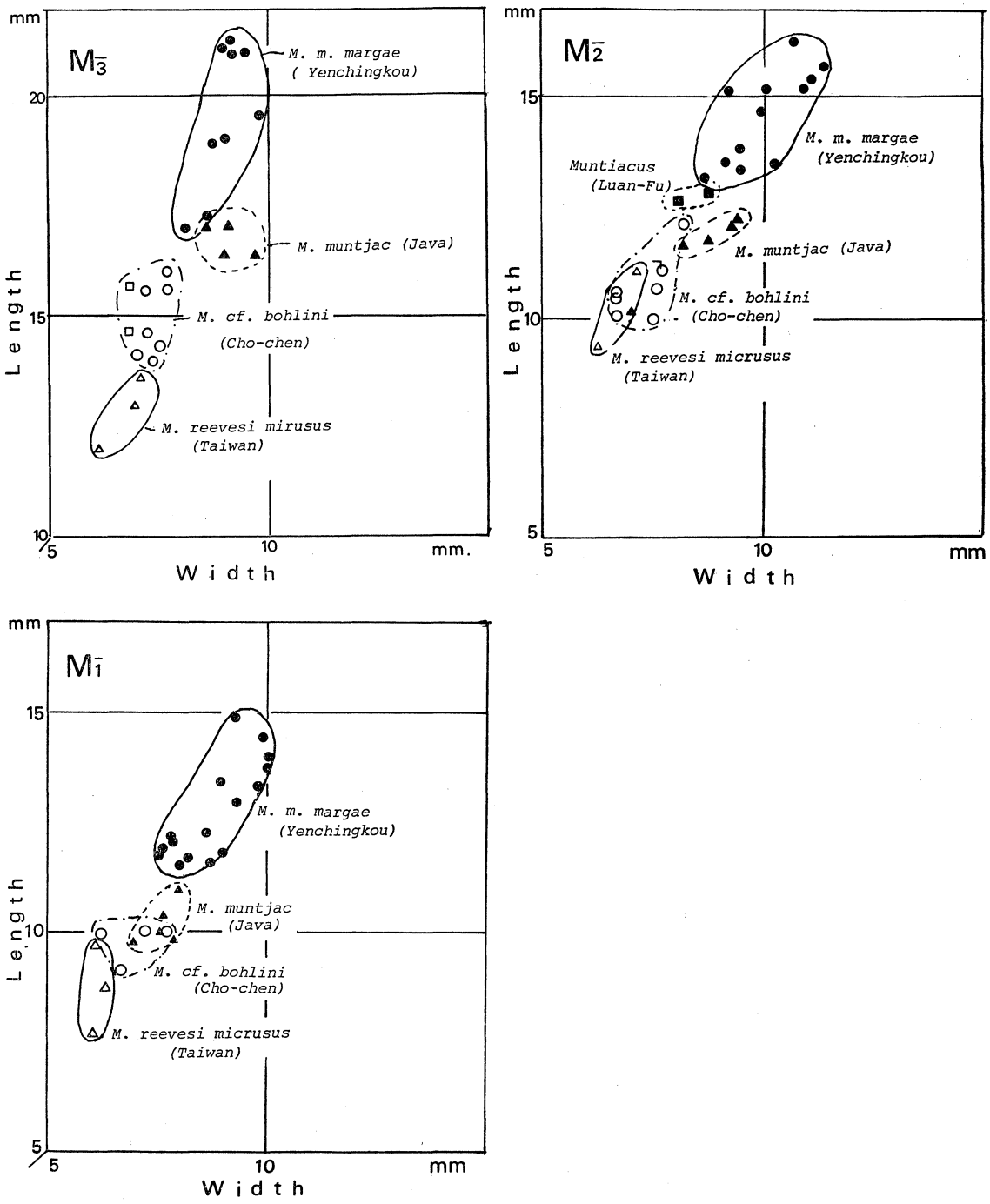
Species Name	Locality	$M\bar{1}$-$M\bar{3}$	$M\underline{1}$-$M\underline{3}$	Height of ramus below $M\bar{3}$	Remarks
M. cf. *bohlini*	Cho-chen, Taiwan	33.5-38.1 (35.8) n=3	36 n=1	15.2-16.9 (15.6) n=4	
M. bohlini (=*Cervulus bohlini*)	Loc. 18, ME Peking	38-40 (38.8) n=3	36 n=1	ca. 21 n=1	TEILHARD de CHARDIN (1940)
M. bohlini (=*Cervulus* cf. *sinensis*)	Nihowan	ca. 39.5 n=1	—	19.0 n=1	TEILHARD de CHARDIN & PIVETEAU (1930)
"Muntiacus"	Luan-Fu, S.E. Shansi	35 n=1	—	19.3 n=1	ERBRINK (1973)
M. m. margae	Yenchingokou, Wanshien, Szechuan	40-50 (45.5) n=9	—	23.2-27.4 (25) n=7	HOOIJER (1951), COLBERT & HOOIJER (1953)
M. reevesi	Central China Recent	31-38 n=31	24-31 n=31	—	COLBERT & HOOIJER (1953), A.M.N.H. (M.)
M. m. vaginalis	India, Recent	37-44 n=7	32-39 n=7		COLBERT & HOOIJER (1953), A.M.N.H. (M.)
M. m. crihifrons	South China	40 n=1	34 n=1		COLBERT & HOOIJER (1953), A.M.N.H. (M.)
M. reevesi micrusus ♀	Taiwan, Recent	30-33.8 n=3	—	11.9-12.9 (12.6) n=3	R.M.N.H., Leiden
〃 ♂	〃	—	—	14.6 n=1	R.M.N.H., Leiden
M. m. muntjak ♀	Java, Recent	40.5 n=1	—	18.0 (12.6) n=3	R.M.N.J.H., Leiden
〃 ♂	〃	37.4-38.5 (38.1) n=3	—	16.7-18.5 (12.7) n=3	R.M.N.H., Leiden

Genus *Cervus* LINNAEUS, 1785
Subgenus *Rusa* SMITH, 1827

Type-species.-Cervus unicolar BECHSTEIN, 1799

Cervus (*Rusa*) sp.
Pl. 8, figs. 1 and 2

Referred specimens. – Three incomplete antler specimens are in treated. These are larger than the other antler specimens referable to *Cervus* (*Sika*) in the present collection now on hand.



Text-fig. 5. Graph showing the relationship between the length and and the width of the lower molars ($M\bar{1}$, $M\bar{2}$, $M\bar{3}$) of *Munticaus*.

Description. –

Antler.

An incomplete right shed antler (Reg. no. 45; pl. 8, fig. 1; C.W. PAN's Collection; Locality: A river floor of the Chái-liao-hsi). Antler large and thick. Burr, fore tine and the beam above the first forking are competely broken off. Broken end of the beam

below the first fork is measured 40 mm (side-to-side) × 55 mm (fore-and-aft) in diameters. The beam is much compressed and flattened.

In lateral view, the beam expands upward. Fore tine is forked at just above the burr and projects anterio-upward. It is also compressed laterally and show the tabular outline in transverse section. Surface of the antler is much smooth.

An incomplete right antler with pedicle attached (Reg, no. 45; Pl. 6, fig. 2; C.W. PAN's Collection; Locality: river floor of the Chái-liao-hsi (between loc. P7 and P8). Antler thick but much worn. Burr and the beam below the first forking are much compressed and shows suboval outline in transverse section. Burr much worn, measuring 57×39 mm in diameters. Fore tine, which is completely broken off from its base, is forked at a point just above the burr, making about 45 degrees with beam. The beam above the first fork shows compressed outline.

Comparisons. – The antler specimens described above are thick and a fore tine is forked at a point just above the burr without clear constriction of the beam. By these characters, the present specimens more closely resembles the living Samber deer than the other living *Sika* deer,

One of us (SHIKAMA, 1937) recorded an incomplete, much worn left antler under the name of *Cervus* (*Rusa*) *timoriensis* (?) BLAINVILLE from the Chái-liao-hsi of Cho-chen. Although the present two antler specimens resemble the antler of SHIKAMA's *timoriensis* (?), they are discriminated from the latter by much compressed beam. More complete specimens may be needed to clarify the systematic position.

Subgenus *Sika* SCLATER, 1870

Type-species. - *Cervus nippon* TEMMINCK, 1873

Cervus (*Sika*) *sintikuensis* SHIKAMA

Pl. 7, figs. 1–10.

Cervus (*Sika*) *sintikuensis* (NAGASAWA MS) SHIKAMA, 1937, *Sci. Rep. Tohoku Imp. Univ.*, Second Ser. (Geol.), vol. XIX, no. 1, p. 78–79.

Cervus (*Sika*) *sintikuensis* SHIKAMA, 1941, *Jub. Pub. Comm. Prof. H. Yabe's 60th Birthday*, p. 1126–1170.

Referred specimens. – More than seventy eight specimens including antler, upper- and lower jaws, and skeletal parts of limb bones are in the collection. Among these a few specimens are excavaged from the bed belonging to the Upper Chi-ting Formation and the others are collected from the river floor of the Chái-liao-hsi.

Diagnosis. – *Cervus* (*Sika*) *sintikuensis* SHIKAMA was proposed by one of us (SHIKAMA, 1937) based on an incomplete left ramus with three molars from the Pleistocene deposits distributed on Chutung of Hsinchu Prefecture, northeast Taiwan. In the paper, he gave the following specific diagnosis: "Rather small deer allied to *C. nippon nippon* or *C. taevanus*; teeth distinctly compressed and flattened, third lower molar not exceeding 10 mm in width; accessory column not well developed". He,

furthermore, added the following remarks: "Since most deer do not have flattened molars as *sintikuensis* there is no dobut of its being a valid species though much allied to *C. nippon nippon* TEMMINCK or *C. taevanus* BLYTH".

By Examination of abundant antler and molar specimens of *C. sintikuensis* in the present collection from the Chi-ting Formation, we obtained the following diagnosis; Antler small, much compressed and flattened; fore tine small and forked at low position ranging from 18 mm to 32 mm and its angle from 75 to 90 degrees. Upper and lower molars smaller than in the living *Sika* deer. Lower teeth are sometimes distinctly compressed and flattened; accessory columns not developed. Lower third molar ($M\bar{3}$) shorter and narrower than those of *C. nippon* and *C. taiouanus* and *C. greyi.* Lower second ($M\bar{2}$) and first molar ($M\bar{1}$) nearly same in length as those of *C. nippon* but smaller than *C. taiouanus and C. greyi.*

Description. – Antler. The antler specimens referable to *C.* (*S.*) *sintikuensis* show a low first forking ranging from 13 mm to 32 mm in height and angle of the first forking ranging from 65 to 90 degrees.

An incomplate right shed antler of young male (Reg. no. 8, Pl. 7, fig. 16, C.W. PAN's Collection; Loc. P3 or P4 of a river floor of the Chái-liao-hsi). It is 50 mm in preserved length from the burr to the broken end of the beam just above the burr.. Burr thin and broad in fore-and-aft direction, measuring 24.8×19.5 mm in diameters. Small fore tine forked at low position (about 19 mm) above the burr. Surface of the beam is almost smooth.

An right shed antler (Reg. no. 31, Pl. 7, fig. 13; C.W. PAN's Collection; Loc. P24–P25 of the Chái-liao-hsi). Apical part of the fore tine and the upper part of the main beam above the first forking are broken off. Burr is rather thin, broad in the fore-and-aft direction and compressed laterally. The fore tine is forked at low position above the burr and projects forward. The beam above the first forking much declines backward making 90 degrees with the first tine, and formed prominent "web" porition.

A left shed antler (Reg. no. 42; Pl. 7, fig. 12; C.W. PAN's Collection; Loc. P15–P16). Antler shows dark brown colour and much worn. Apcial part of the fore tine and the beam above the first forking are borken off. Burr is thin, and oval in outline. Beam is much compressed and flattened laterally. The fore tine is small, compressed laterally and forked at 31 mm above the burr, making 85 degrees with the beam. The web portion between the first tine and the beam is prominent.

Lower teeth.

Third molar ($M\bar{3}$) (Pl. 7, figs. 1–3, 6, 7, 8) is rather small, measuring 22.5 mm in length, 10.2 mm in width in average. Each lobes are less distended laterally and sometimes very compressed and flattened. Para- and metastyles are less developed. As general, the third lobe is small and sometimes degenerated. A small accessory column exists between the first and the second lobes but sometimes lacks it.

Lower second molar ($M\bar{2}$) (Pl. 7, figs. 6–8) is small size as *Sika,* measuring 22.5 mm in length, 10.2 mm in width. Para- and metastyles are less developed. A faint

cinglum exists on the basal part of the anterio-outer wall of the anterior lobe. A small accessory column is exist between the anterior- and the posterior lobes.

Lower first molar ($M\bar{1}$) (Pl. 7, fig. 7) is nearly same length as in the living Japanese deer but sometimes thinner (9.8 mm in average) than *C. nippon*. Mandibular teeth row ($M\bar{1}$–$M\bar{3}$) is 57 mm long in average length.

Upper molar teeth.

Upper molars are large as *Sika*; $M\underline{1}$ is 15.8 mm, $M\underline{2}$ about 17.9 mm, and $M\underline{3}$ about 18.2 mm in average length. A cylindrical accessory column is developed in $M\underline{1}$, $M\underline{2}$ and $M\underline{3}$; the cinglum is also seen on the anterio-inner wall of the first lobe and the postero-inner corner of the second lobe of each molars; the "eperon hypoconal" is sometimes recognzied on the inner wall of the posterior lobe of the hypocone. Length of teeth row ($M\bar{1}$–$M\bar{3}$) is 44.5 mm long in average.

Comparisons. – The forking mode of the antler of *Cervus* (*Sika*) *sintikuensis* SHIKAMA quite resembles those of *C.* (*S.*) *greyi* ZDANSKY from the Middle Pleistocene deposits of North China (ZDANSKY, 1925) or *C.* (*S.*) cf. *greyi* from the Late Pleistocene deposits from Seto Inland Sea, West Japan (OTSUKA & SHIKAMA, 1977). However, *C.* (*S.*) *sintikuensis* is discriminated from *C.* (*S.*) *greyi* by smaller antler with low forking and size of the molars as will be mentioned later. The present species is also allied to the living species of *Sika*-deer such as *C.* (*S.*) *nippon*, *C.* (*S.*) *yezoensis* and *C.* (*S.*) *taiouanus* but differs from the latter three species by small and more flattened antler with wide and low first forking. The present species is also discriminated from *C.* (*S.*) sp. from the Chiting Formation in the present paper by same respects.

Text-figs. 7–11 are graphs showing the relationships between the length and the width of cervid the molars in the present collection now on hand. The molars of *Elaphurus* and *Muntiacus* are safely discriminated from those of *Sika* by its size. The molars of the subgenus *Sika* are small- or mederate size and they are roughly grouped into two types based on size. Among these, the specimens group of small-sized molar is regarded as represent those of *C.* (*Sika*) *sintikuensis*.

As was pointed out by SHIKAMA (1937), the molar of the holo- and the homoetypes of *C. sintikuensis* distinctly compressed and flattened and the third molar smaller than 10 mm in width.

There are more than nine lower third molars in the collection, among which two specimens not exceed 10 mm in width, however, these dental features and size change gradually to the group of the molar specimens which exceeding 10 mm in width. Therefore, the writer here regard that the molars of holo- and the homoetypes represent the extreme variation from mean of *sintikuensis*. So long as the present collection is concerned, the third lower molar ($M\bar{3}$) of *C. sintikuensis* has a width ranges from 8.0 mm to 10.8 mm (10.2 mm in average) and a length from 20.0 mm to 23.5 mm (22.5 mm in average).

The third lower molar of *C. sintikuensis* is somewhat shorter and narrower than the in living *C. nippon* and *C. taiouanus*, much shorter and narrower than the fossil

Table 5. Measurements of the molar of *Cervus* (*Sika*) *sintikuensis*, *Cervus* (*Sika*) sp., *Cervus* (*Sika*) *greyi* and *Cervus* (*Sika*) *nippon*.
*) from Chi-ting Formation; ( ): average dimention

Species Name / Position		*sintikeusnsis**		*Cervus* (*Sika*) sp.*		*greyi*		*nippon*	
		width	length	width	length	width	length	width	length
Lower molar	$M\bar{3}$	9.5-10.8 (10.2) n=9	20.5-23.5 (22.5) n=9			12.3-14.5 (13.6) n=6	25.0-28.6 (26.7) n=6	11.0-12.5 (11.4) n=18	20.9-26.4 (24.1) n=18
	$M\bar{2}$	10.0-11.3 ( ) n=17	16.0-18.2 (17.3) n=17	9.7-11.5 (10.7) n=10	17.4-20.8 (19.0) n=10	12.2-13.5 (13.2) n=9	17.4-22.5 (19.9) n=9	11.0-12.5 (11.5) n=18	15.2-18.5 (16.1) n=18
	$M\bar{1}$	9.0-10.4 (9.8) n=10	14.6-16.0 (15.4) n=9	9.5-10.2 (9.7) n=4	16.3-16.7 (16.5) n=4	11.2-13.1 (11.9) n=7	15.5-20.0 (17.3) n=7	8.7-11.4 (10.4) n=18	12.0-16.5 (14.6) n=18
	$PM\bar{4}$	7.6-8.0 (7.9) n=3	12.0-13.0 (12.5) n=3	8.0-9.1 (8.8) n=3	14.5-16.2 (15.2) n=3	9.5-10.8 (10.1) n=5	13.8-16.7 (15.2) n=5	—	—
	$PM\bar{3}$	6.3-7.2 (6.8) n=5	11.8-13.2 (12.4) n=5	7.7-8.3 (8.0) n=5	13.5-16.1 (14.7) n=5	7.9-9.4 (8.6) n=5	14.5-16.1 (15.3) n=5	—	—
Upper molar	$M\underline{3}$	16.0-17.1 (16.5) n=8	16.0-19.0 (17.1) n=8	17.7-18.9 (19.1) n=6	17.3-19.3 (18.2) n=6	19.7-21.7 (20.8) n=8	20.0-22.1 (20.9) n=8	14.3-18.0 (16.5) n=5	15.0-18.0 (16.8) n=5
	$M\underline{2}$	15.0-17.3 (16.4) n=9	15.5-17.2 (16.3) n=9	17.2-18.8 (17.8) n=4	17.0-20.1 (17.9) n=12	19.5-21.7 (20.4) n=12	17.9-21.5 (19.7) n=12	14.9-17.9 (16.6) n=5	15.2-16.2 (15.9) n=5
	$M\underline{1}$	14.2-15.9 (15.2) n=6	13.0-15.3 (14.0) n=6	15.0-16.3 (15.8) n=4	15.0-16.6 (15.8) n=4	15.9-19.9 (18.9) n=12	14.6-19.9 (17.3) n=12	13.6-16.6 (15.4) n=5	13.2-14.2 (13.6) n=5
	$PM\underline{4}$	+11.2 n=1	11.9 n=1	15.6 n=1	12.7 n=1	15.4-17.4 (16.5) n=11	12.0-15.2 (13.1) n=11	12.4-14.2 (13.2) n=5	9.9-10.8 (10.4) n=5
	$PM\underline{3}$	11.5 n=1	1.2 n=1	13.2-14.1 (13.7) n=2	12.2-12.3 (12.3) n=2	14.2-15.7 (15.1) n=9	13.3-16.0 (14.2) n=9	10.5-12.5 (11.4) n=5	11.3-12.8 (12.3) n=5
	$PM\underline{2}$	9.2 n=1	8.5 n=1	10.1 n=1	11.3 n=1	12.8-14.0 (13.4) n=8	13.8-18.1 (15.3) n=8	—	—

species of *C. greyi*. According to NAGASAWA (1932) and MATSUMOTO (1926), the average length of the lower third molar ($M\bar{3}$) of *C. nippon* and *C. taiouanus* is 24.9–23.5 mm, 24.5 mm, respectively.

The length of lower first ($M\bar{1}$) and second ($M\bar{2}$) molars of *C. sintikuensis* is nearly same as those of *C. nippon*, somewhat smaller than in *C. taiouanus*, much smaller than in *C. greyi* and more flattened than those of other living and fossil species of *Cervus* (*Sika*) (See Table 6 and Text-figs. 8 and 9).

The length of mandibular teeth row ($M\bar{1}$–$M\bar{3}$) of *C. sintikuensis* is 57.0mm (Specimen No. a) while those of *C. nippon* and *C. greyi* are 53.3 mm, 65.3 mm in average, respectively.

Table 6. Length of lower teeth row ($M\bar{1}$–$M\bar{3}$) of *Cervus* (*Sika*) (in *mm*):

Species Name	Sex	Length $M\bar{1}$–$M\bar{3}$	Locality
Cervus (*Sika*) *sintikuensis* (No. A1)		57.0	Chai-liao-his (C.W. PAN's Collection)
Cervus (*Sika*) *nippon*	Male	52.8	Akiyoshi-dai, Japan
Cervus (*Sika*) *nippon*	Male	54.6	Inuyama, Japan
Cervus (*Sika*) *nippon*	Male	52.5	Saijo, Japan
"*Pseudaxis*" *greyi* (M2378)		60.0	Loc. 105, N. China (Uppsala)
〃 (M2327)		71	Loc. 53, N. China (Uppsala)
〃 (AMNH26314)		66.9	
〃 (AMNH26314)		63.0	
"*Pseudaxis*" *magnus* (M2097)		74.5-77 (75.75)	Loc. 24-S, N. China (Uppsala)

Table 7. Length of upper teeth row ($M\underline{1}$–$M\underline{3}$) of *Cervus* (*Sika*) (in *mm*).
( ): average dimention, n: number of specimen

Species Name	Sex	Length $M\underline{1}$–$M\underline{3}$	Locality
Cervus (*Sika*) *sitikuensis*			
No. 111		45.7	Chai-liao-hsi, Cho-chen
No. 108		42.6	C.W. PAN's Collection
Cervus (*Sika*) *nippon*	male	53.8-55 n=2	M13730, Yatsugadake, Japan (Recent)
Cervus (*Sika*) *nippon*	male	45.7 n=2	Akiyoshi-dai, Japan (Recent)
Cervus (*Sika*) *nippon*	male	46.5-46.6 n=2	Inuyama, Japan (Recent)
"*Pseudaxis*" *greyi*		50.9-56.6 (55.0) n=6	Loc. 105, N. China
"*Pseudaxis*" *magnus*		65.8-71.7 (68.1)	Loc. 24-S, N. China

Cervus (*Sika*) sp.
Pl. 8, figs. 3–21.

Referred specimens. – More than seventy six specimens including antlers, lower jaws, isolated lower teeth, upper teeth and some skeletal parts are in the collection. Among

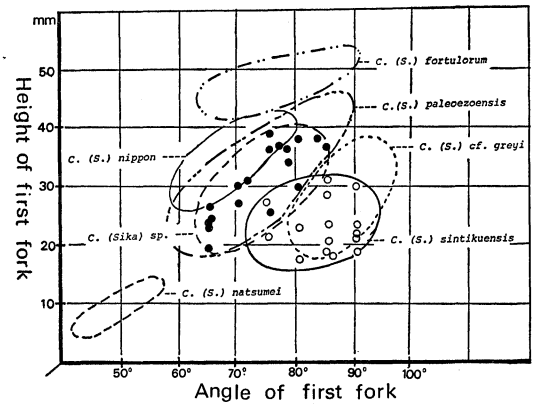
these, the antlers and molar specimens are most abundant. The antler specimens, however, are very incomplete and mostly represented by a basal part of the antler below the first forking.

Diagnosis. – Antler small- to medium size for the subgenus *Sika*. Fore tine forked at relatively low position above burr, making more than 65 degrees with the beam. Beam below the first fork and the burr are nearly circular in section. Lower and upper teeth longer than in the living *Sika* and inner and outer crescents being more or less flattened.

Description. –

A left shed antler of young male (Reg. no. 6; Pl. 8, fig. 16; C.W. PAN's Collection; Locality: Loc. P15–P16 of the Chái-liao-hsi; Horizon: Upper Chi-ting Formation).

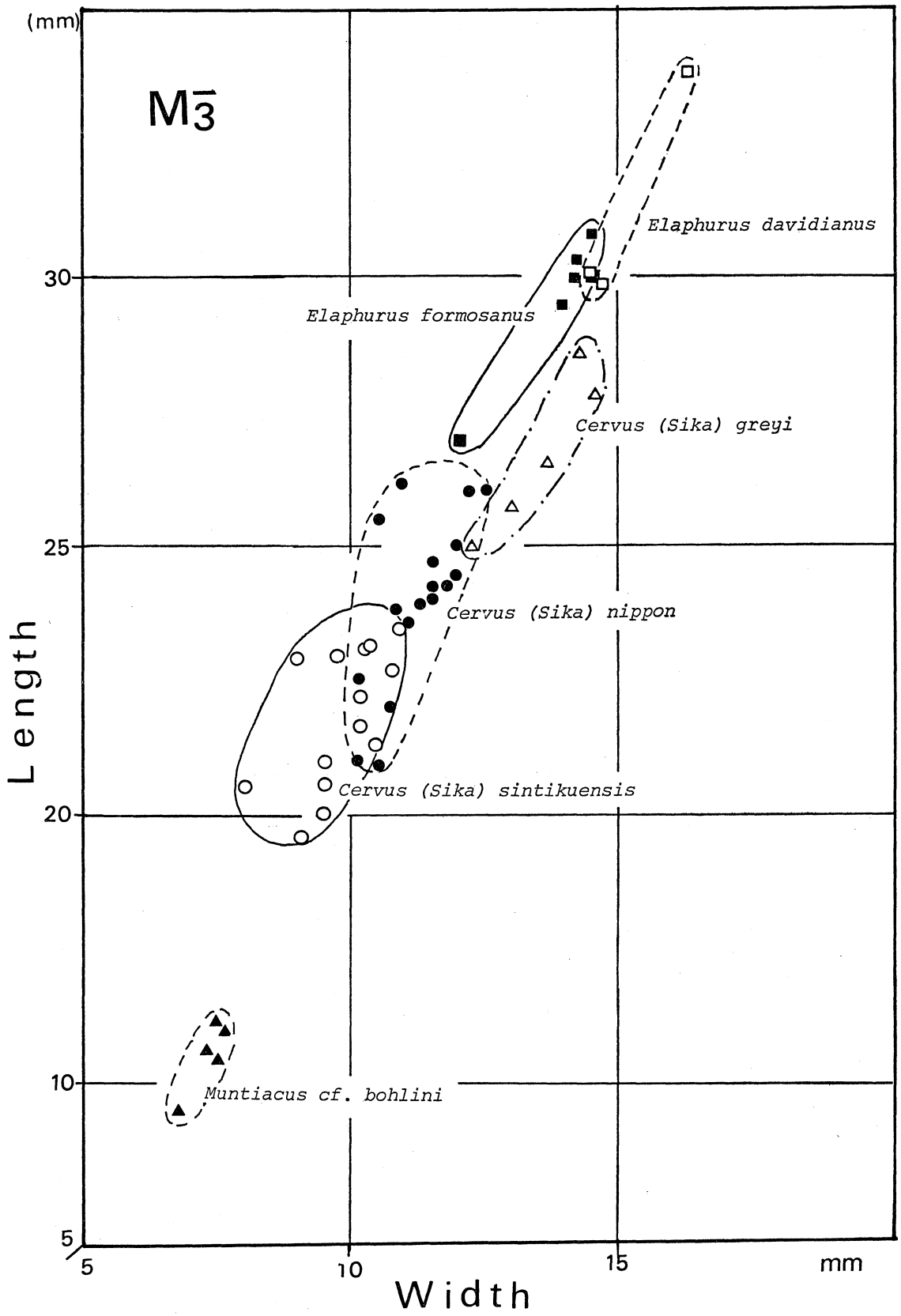
Antler is slender, being 50 mm in preserved length. Fore tine and the beam above the first forking are completely borken off. Burr is rather thin, almost circular, measuring 20 mm×22 mm in diameters. The beam below the first fork streches straightly upward. Small fore tine is forked at about 27 mm above the burr. Surface of the antler is rather smooth.



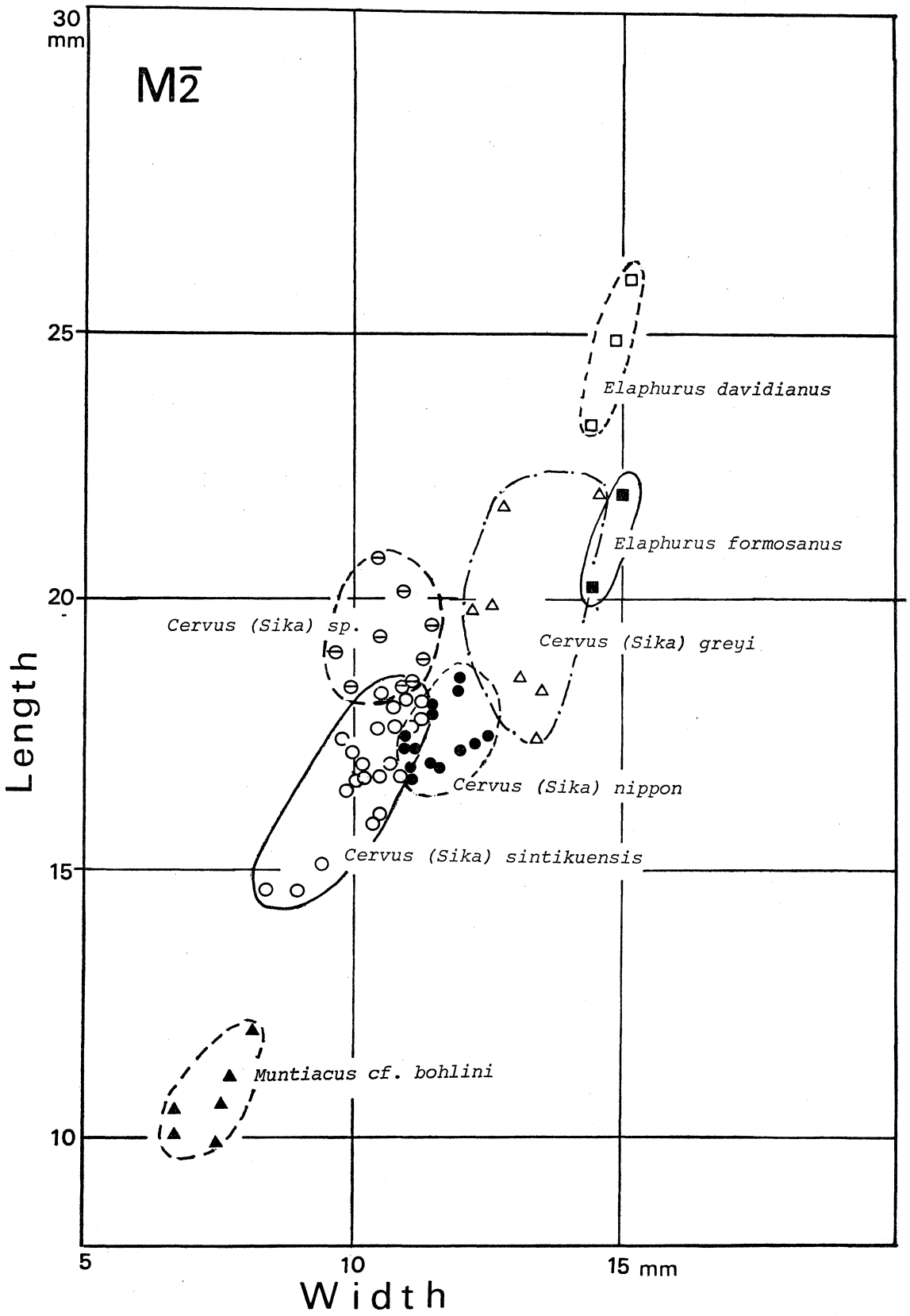
Text-fig. 6: Graph showing the relationship between the height and angle of the first fork of the antler of *Cervus* (*Sika*).

A left shed antler (Reg. no. 1; Pl. 8, fig. 19; C.W. PAN's Collection; Locality and horizon: *Ibid.*). Fore tine and the beam above the first fork are borken off. The antler is rather slender and the surface is covered with shallow, rather broad furrows. Burr is moderately thick and nearly circular in transverse section. Fore tine forked at 37 mm above the burr, making 75 degrees with beam.

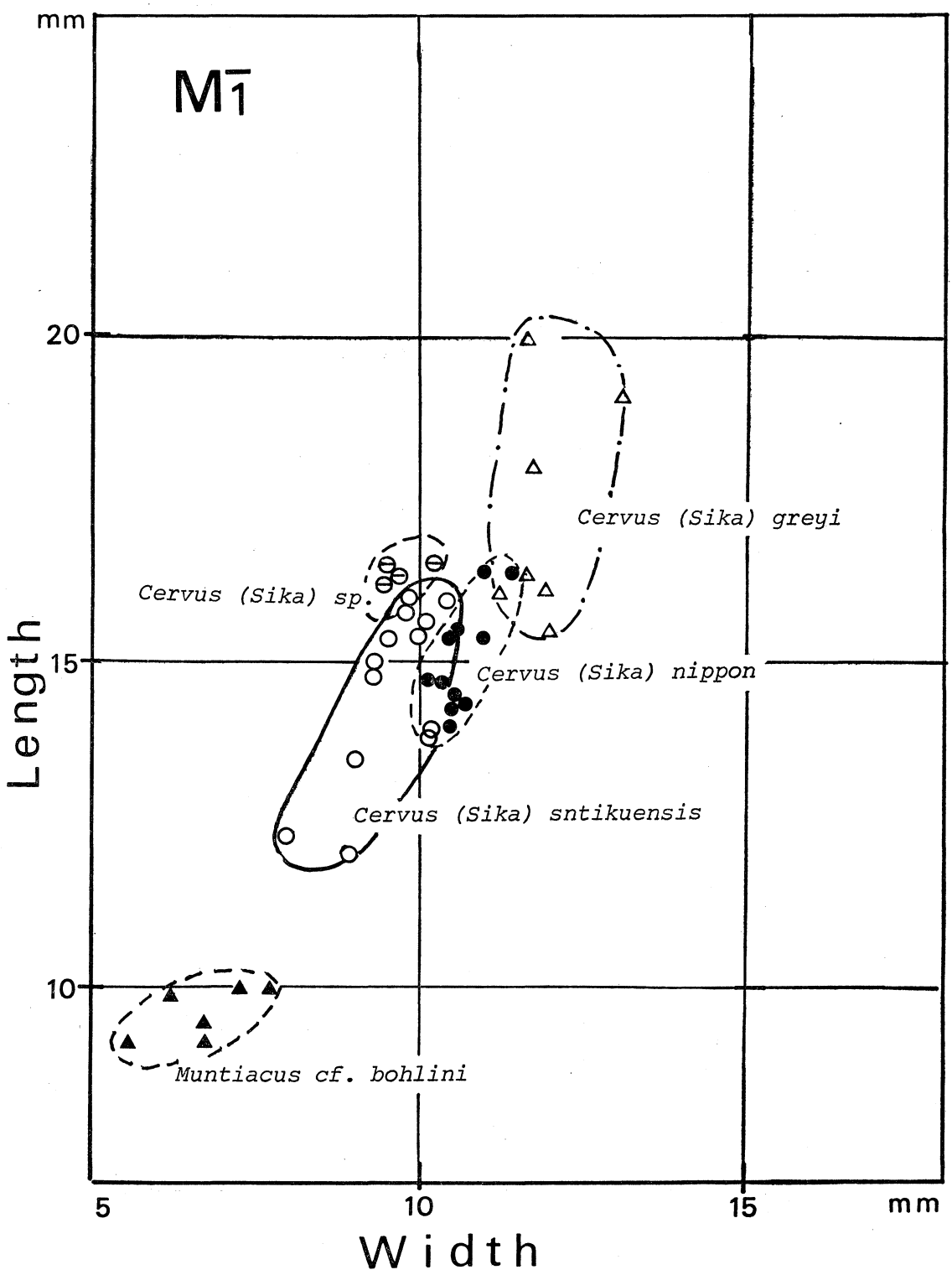
A right shed antler (Reg. no. 43; Pl. 8, fig. 20; C.W. PAN's Collection; Localty: Loc. P8–P9 of the Chai-liao-hsi; Horizon: Upper Member of the Chi-ting Formation). The first tine is completely broken off from its base. The beam above the first fork preserved 50 mm above the forking. Burr is moderately thick and nearly circular in outline, measuring 38×40 mm in diameter. The first tine is forked at 29 mm above the burr, making 90 degrees with the beam.



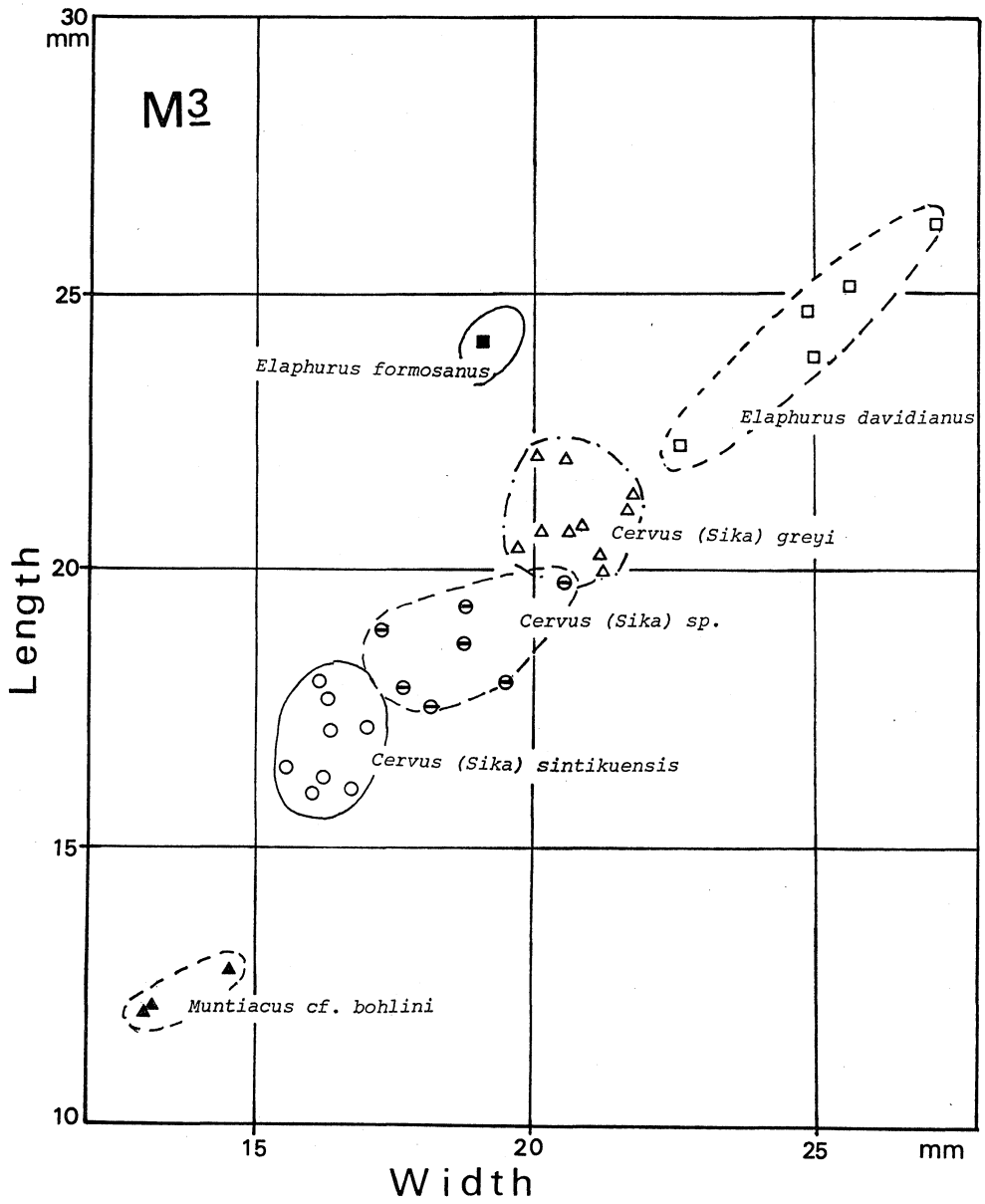
Text-fig. 7. Graph showing the relationship between the length and the width of the lower third molar (M3) of *Cervus* (*Sika*), *Elaphurus*, and *Muntiacus*.



Text-fig. 8. Graph showing the relationship between the length and the width of of the lower second molar (M2) of *Cervus* (*Sika*), *Elaphurus* and *Muntiacus*.



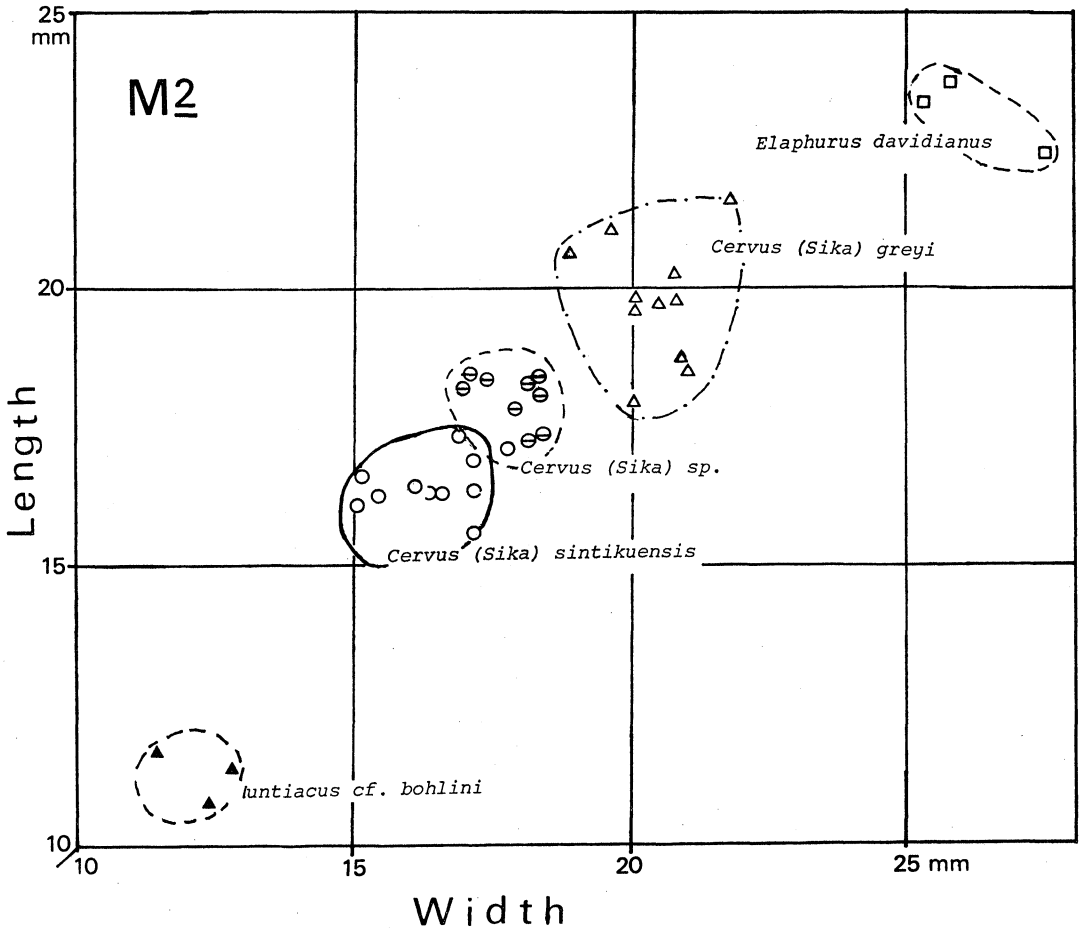
Text-fig. 9. Graph showing the relationship between the length and the width of the lower first molar ($M\bar{1}$) of *Cervus* (*Sika*), *Elaphurus* and *Muntiacus*.



Text-fig. 10. Graph showing the relationship between the length and the width of upper third molar (M3) of *Cervus* (*Sika*) and *Elaphurus* and *Muntiacus*.

A right antler with a pedicle attached (Reg. no. 84; Pl. 7, figs. 14A and 14B; T.L. Kuo's Collection; Locality: Chó-chü of Chái-liao of Tainan Prefecture; Horizon: the coarse sand bed (KU5) of the Upper Chi-ting Formation of the Toú-kóu-shan Group). The antler is moderate in size. It unpreserves the fore tine and the upper half of the beam above the first fork. Pedicle is almost circular in section, measuring 20 mm in minimum length. Burr is moderately rugose moderately thick and nearly circular outline, measuring 42 mm×43 mm in diameters. The fore tine which is forked at 39 mm above the burr, and projects forward, somewhat outward.

In lateral view., the beam streches upward making 75 degrees with the first tine.



Text-fig. 11. Graph showing the relationship between the length and the width of upper second molar (M2) of *Cervus* (*Sika*), *Elaphurus* and *Muntiacus*.

The beam is nearly circular in outline, measuring 60 mm×64 mm in diameters. In frontal view, the beam above the first fork distinctly declines outward.

Lower molar:

Lowr second and the first molars (M1 and M2) are longer but more flattened than the living *Sika* (*C. nippon* and *C. taiouanus*). The average length of M1 and M2 are about 16.5 mm and 19.0 mm respectively. Para- and metastyles are rather developed; folding of the inner crescent is remarkable. As general, the lower teeth more declines forward than in the other living *Sika*; small accessory column exists.

Upper molar:

Upper molars are also longer than the living Japanese deer. The third lower molar (M3) is 18.2 mm long, 19.0 mm wide in average and shows subrectangular outline in occusal view; remarkable accessory column is exist on the inner wall; meso-, para-, and metastyles are less developed; basal cinglum is recognized on the anterior wall of the inner crescent.

The first and second upper molars (M1, M2) are larger than in the living Japanese

deer. The average length of M1 and M2 are 15.8 mm and 17.9 mm, respectively. Each lobes rather well developed; it carries remarkable accessory tubercles between fore-and-aft lobes; accessory basal cinglum is rarely seen on the anterio-inner wall.

The premolars (P2, P3 and P4) are also broad and wide for *Sika*. Dimentions are shown in Table 5.

Comparisons. – So long as the basal porition of the antler is concerned, *Cervus* (*Sika*) sp. from the Chi-ting Formation resembles *Cervus* (*Sika*) cf. *greyi* from the Late Pleistocene deposits in Seto Inland Sea, West Japan (Text-fig. 6) (OTSUKA & SHIKAMA, 1977) in height and the angle of the first forking. However, It is different from *C.* (*S.*) *greyi* by small antler with low first forking. It is clearly discriminated from the living *C.* (*S.*) *nippon* or *C.* (*S.*) *taiouanus* by wide and low first forking. It is also distinguishable from *C.* (*S.*) *sintikuensis* from the Chi-ting Formation by height and narrower angles of the first forking and nearly circular outline of the beam.

Lower molars (M2, M1) of it are longer than in the living *Sika* (*C. nippon*, *C. taiouanus*) but somewhat flattened than the latters. *C.* (*Sika*) *greyi* is clearly discriminated from the present deer by larger lower and upper molars.

Upper molars M3–M1) of the present species are also larger than the in living *Sika* deer.

Consequently, there remains a possibility that *Cervus* (*Sika*) sp. from the Chi-ting Formation may become a new species of *Cervus* (*Sika*). More complete specimens is needed to clarify the precise systematic position.

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Locality Name

Akashi	明石	Huaiyu	峽灰	Szechuan	四川
Anyang	安陽	Huhshie	虎啣	Tainan	台南
Chái-liao	菜寮	Kansei	関西	Takeng	大坑
Cho-chen	左鎮	Kaoshiung	高雄	Tahsi	大溪
Chutung	竹東	Kuchinotsu	口ノ津	Taichu	台中
Chusan	竹山	Nantou	南投	Touliu	斗六
Chisan	旗山	Nihowan	泥河湾	Taoyuan	桃園
Chiai	嘉義	Niu-shih-keng	牛糞坑	Wantan	湾潭
Chéng-shan-chún	澄山村	Osaka	大阪	Wanshien	万縣
Choukoutien	周口店	Puli	埔里	Yuchih	魚池
Chó-chu	臭屈	Shian-san	香山	Yen-shui-hsi	塩水溪
Hsinchu	新竹	Sui-liu-tung	水流東	Yushé	楡社

Formation Name

Chi-ting	崎頂	Ku-ting-keng	古亭坑	Toú-kóu-shan	頭嵙山
Chú-kŏu-shan	触口山	Miáo-li	苗栗	Tung-hsiao	通霄
Haoyánshan	火炎山				

Person's Name

C.M. CHEN	陳春木	S. KANEKO	金子寿衛男	M.S. SU	蘇木樹
M.M. CHENG	金良晨	C.C. LIN	林朝棨	T. SHIKAMA	鹿間時夫
I. HAYASAKA	早坂一郎	Y. LIU	劉衍	K. TORII	鳥居敬造
T.L. KUO	郭徳鈴	C.W. PÁN	潘常武	H. OTSUKA	大塚裕之

Explanation of Plate 3

Fig. 1. *Elaphurus* (*Elaphurus*) *formosanus* (SHIKAMA) .....Page 34–40.
A left antler. Inner (A), outer (B) and frontal (C) views. A and B, × 0.4; C, × 0.4.


C
A
B

Explanation of Plate 4

Figs. 1–22. *Elaphurus* (*Elaphurus*) *formosanus* (SHIKAMA) ..... Page 34–40.

Figs. 1 and 2. A fragments of posterior tine of right antler, × 0.5. Fig. 1 (No. 90), Fig. 2 (No. 91)

Figs. 3, 7, 12: A basal part of right antler. Inner view. Fig. 3 (No. 60), Fig. 7 (No. 47) and Fig. 12 (No. 54).

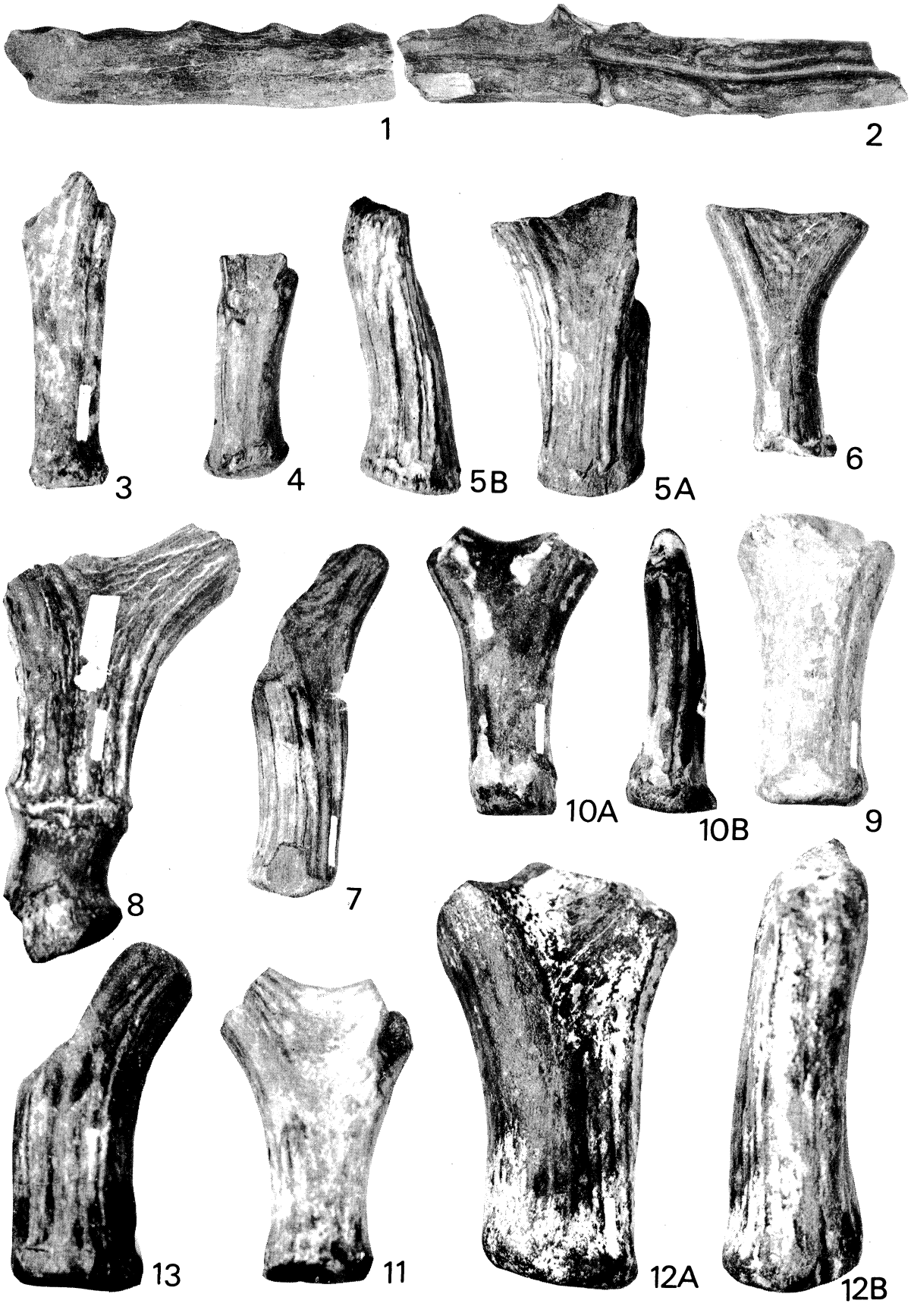
Figs. 8, 10, 11 and 13: A basal part of right antler. Outer view, × 0.5. Fig. 8 (No. 57), Fig. 10 (No. 57), Fig. 11 (No. 58).

Fig. 9. A basal part of left antler. No. 58. Outer view, × 0.5.

Fig. 4. A basal part of left antler. Outer view, × 0.5. (="*Capreolus* (?) *formosanus* SHIKAMA", SHIKAMA, 1937, *Sci. Rep. Tohoku Imp. Univ.*, vol. 19, no. 1, pl. 16, figs. 21 and 22).

Fig. 5. A basal part of left antler. Outer view, × 0.5. (="*Cervus* (*Depéretia*) *kokubuni* SHIKAMA", SHIKAMA, 1937, *Sci. Rep. Tohoku Imp. Univ.*, nvo. 19, no. 1, pl. 16, figs. 16 and 18).

Fig. 6. A basal part of right antler. Inner view, × 0.5. (="*Cervus* (*Depértia*) *syatinensis* SHIKAMA", SHIKAMA, 1937, *Sci. Rep. Tohoku Imp. Univ.*, vol. 19, no. 1, pl. 16, figs. 19 and 20).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12A
12B

Explanation of Plate 5

Figs. 1–16. *Elaphurus* (*Elaphurus*) *formosanus* (SHIKAMA) ..... Page 34–40.

Figs. 1 and 2: A fragment of posterior tine of right antler. Inner view, × 0.5. Fig. 1 (No. 92), Fig. 2 (No. 94)

Fig. 3: A fragment of fore tine of left antler, posterior view, × 0.5.

Fig. 4: A basal part of right antler, outer view, × 0.5.

Figs. 5 and 7: A fragment of posterior tine of right antler, Outer view, × 0.5. Fig. 5 (No. 89), Fig. 7 (No. 93)

Fig. 6: A basal part of left antler, Inner view, × 0.5.

Figs. 8–16: Upper and lower teeth, × 1. Occulsal (A) and outer (B) views.

Fig. 8: A right upper second molar ($M\underline{2}$), No. 150.

Fig. 9: A left lower third molar ($M\bar{3}$), No. El.

Fig. 10: A left lower thrid premolar ($PM\bar{3}$), No. P31.

Fig. 11: A left lower thrid molar ($M\bar{3}$), No. El.

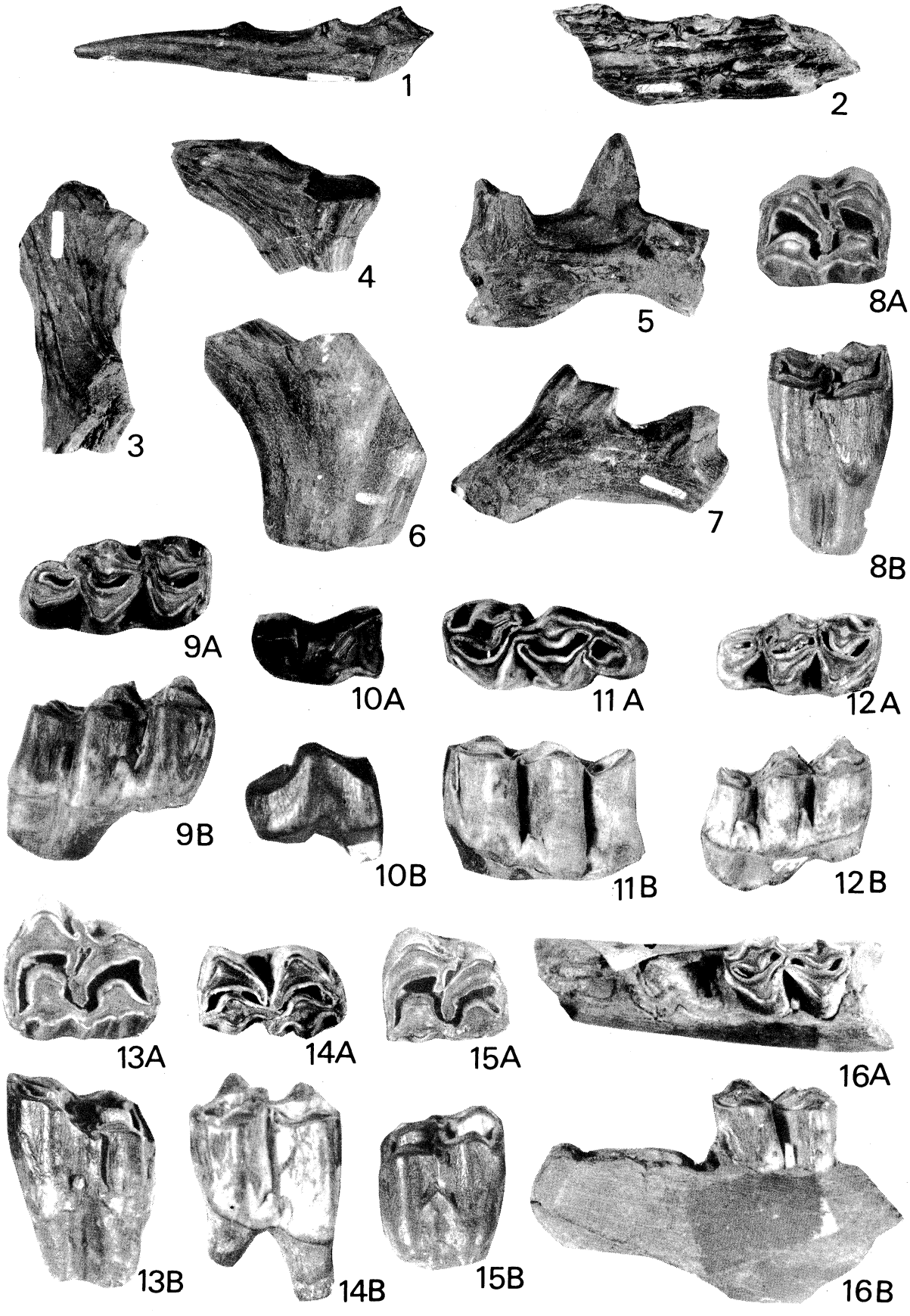
Fig. 12: A right lower third molar ($M\bar{3}$), No. 170.

Fig. 13: A right upper thrid molar ($M\underline{3}$), No. E4.

Fig. 14: A left lower second molar ($M\bar{2}$), No. 119.

Fig. 15: A right upper second molar ($M\underline{2}$), No. E5.

Fig. 16: A left lower jaw with second molar, No. 109.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16A
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Explanation of Plate 6

Figs. 1–12, 15–21: *Muntiacus* cf. *bohlini* TEILHARD de CHARDIN.....Page 41–43.

Figs. 1 and 5: A right antler. Inner (A), frontal (B) and upper (C) views, × 0.5. Fig. 1 (No. 16), Fig. 2 (No. 3), Fig. 3 (No. 12), Fig. 4 (No. 10) and Fig. 5 (No. 8).

Figs. 6–12: A left antler. Inner (A) and frontal (B) views, × 0.5.
Fig. 6 (No. 7), Fig. 7 (No. 13), Fig. 8 (No. 14), Fig. 9 (No. 11), Fig. 10 (No. 9), Fig. 11 (No. 4) and Fig. 12 (No. 12).

Figs. 15 and 20: A right lower jaw with molars, × 1. Fig. 15 (No. 114) and Fig. 20 (No. 115).

Fig. 17: A left lower jaw with third molar. Outer view, × 1. No. 174.

Fig. 18: A right lower jaw with first and second molars. Outer view, × 1. No. 72.

Fig. 19: A left lower jaw with second and thrid molars. Outer view, × 1. No. D1.

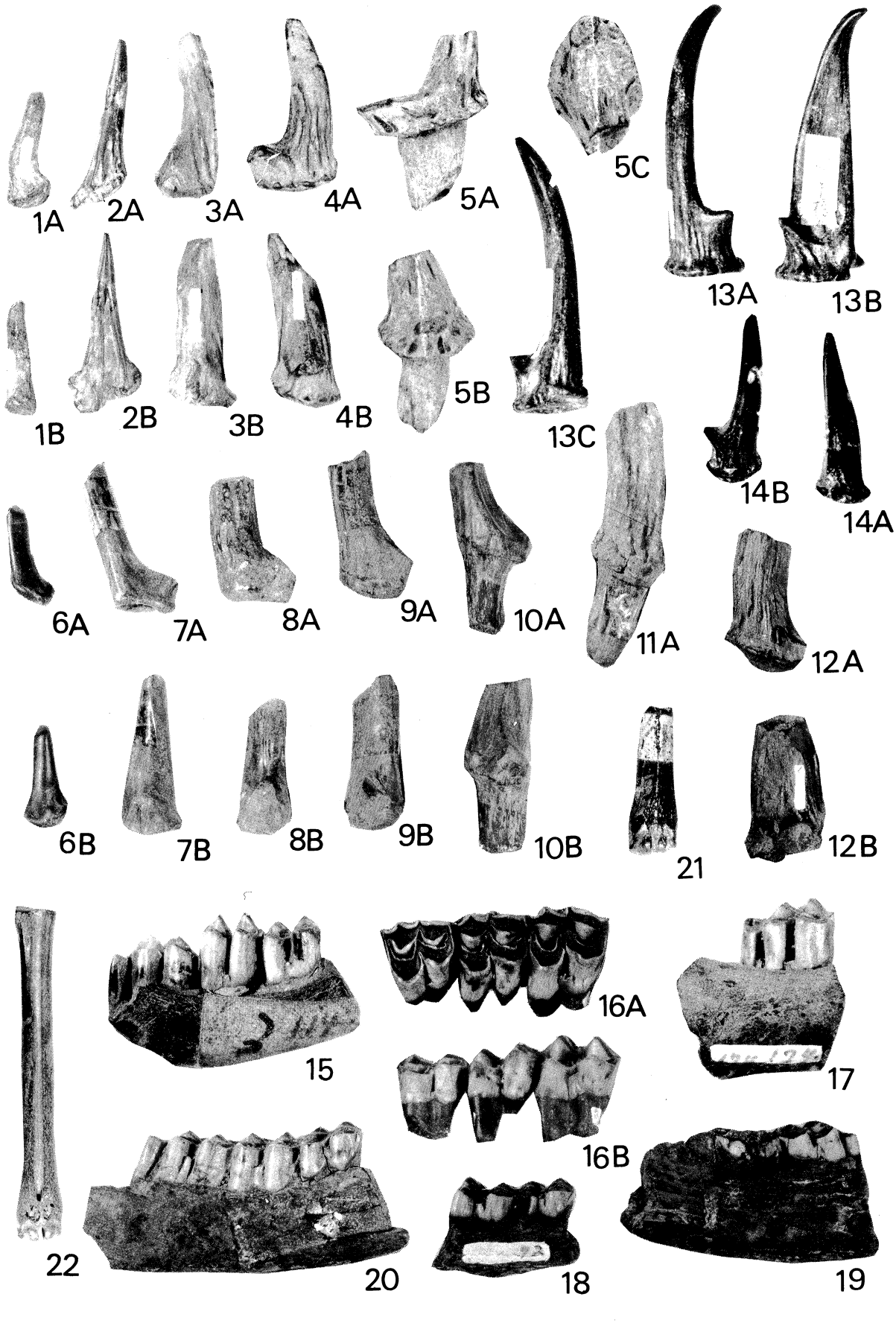
Fig. 16: Left upper molars (M1-M3). Occulsal (A) and inner (B) views, × 1. No. 79.

Fig. 21: A distal porition of right metacarpus. Frontal view, × 1. No.

Figs. 13, 14 and 22: *Muntiacus* sp. .....Page 43.

Figs. 13 and 14: A right shead antler. Frontal (A), inner (B) and posterior (C) views, × 0.5. Fig. 13 (No. 1) and Fig. 14 (No. 2).

Fig. 22: A right metatarsus. Frontal view, × 1 (No. 180).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Explanation of Plate 7

Figs. 1–10. *Cervus (Sika) sintikuensis* SHIKAMA ..... Page 46–50.

Fig. 1. A left lower third molar (M3). No. 2. Occulsal (A) and outer (B) views, × 1.

Fig. 2. A left lower third molar (M3). No. Cl. Occulsal (A) and outer (B) views, × 1.

Fig. 3. A right lower third molar (M3). No. 34. Occulsal (A) and outer (B) views, × 1.

Fig. 4. A right lower jaw with molars (M1-M3). No. al. Occulsal (A) and outer (B) views, × 0.5.

Fig. 5. A left upper first molar (M1). No. 57. Occulsal (A) and outer (B) views, × 1.

Fig. 6. A fragment of right lower jaw with molars (M2, M3). No. 111. Occlusal (A) and outer (B) views, × 1.

Fig. 7. A fragment of left lower jaw with molars (M1, M2). No. 103. Occulsal (A) and outer (B) views, × 1.

Fig. 8. A fragment of right lower jaw with molars (M1, M2), No. 123. Occulsal (A) and outer (B) views, × 1.

Fig. 9. A fragment of right lower jaw with thrid molar (M3). No. 106. Occulsal (A) and outer (B) views, × 1.

Fig. 10. A fragment of right lower jaw with molars (M1, M2), No. 118. Occulsal view, × 1.

Fig. 11. A fragment of right lower jaw with molars (M1, M2). No. 122. Occulsal view, × 1.

Fig. 12. A left shed antler (No. 42), Outer view, × 0.5.

Fig. 13. A left shed antler (No. 31). Inner view, × 0.5.

Fig. 14. A left shed antler (No. 29). Inner view, × 0.5.

Fig. 15. A left shed antler (No. 41). Inner view, × 0.5.

Fig. 16. A left shed antler (No. 8). Inner view, × 0.5.

Fig. 17. A left shed antler (No. 34). Inner view, × 0.5.

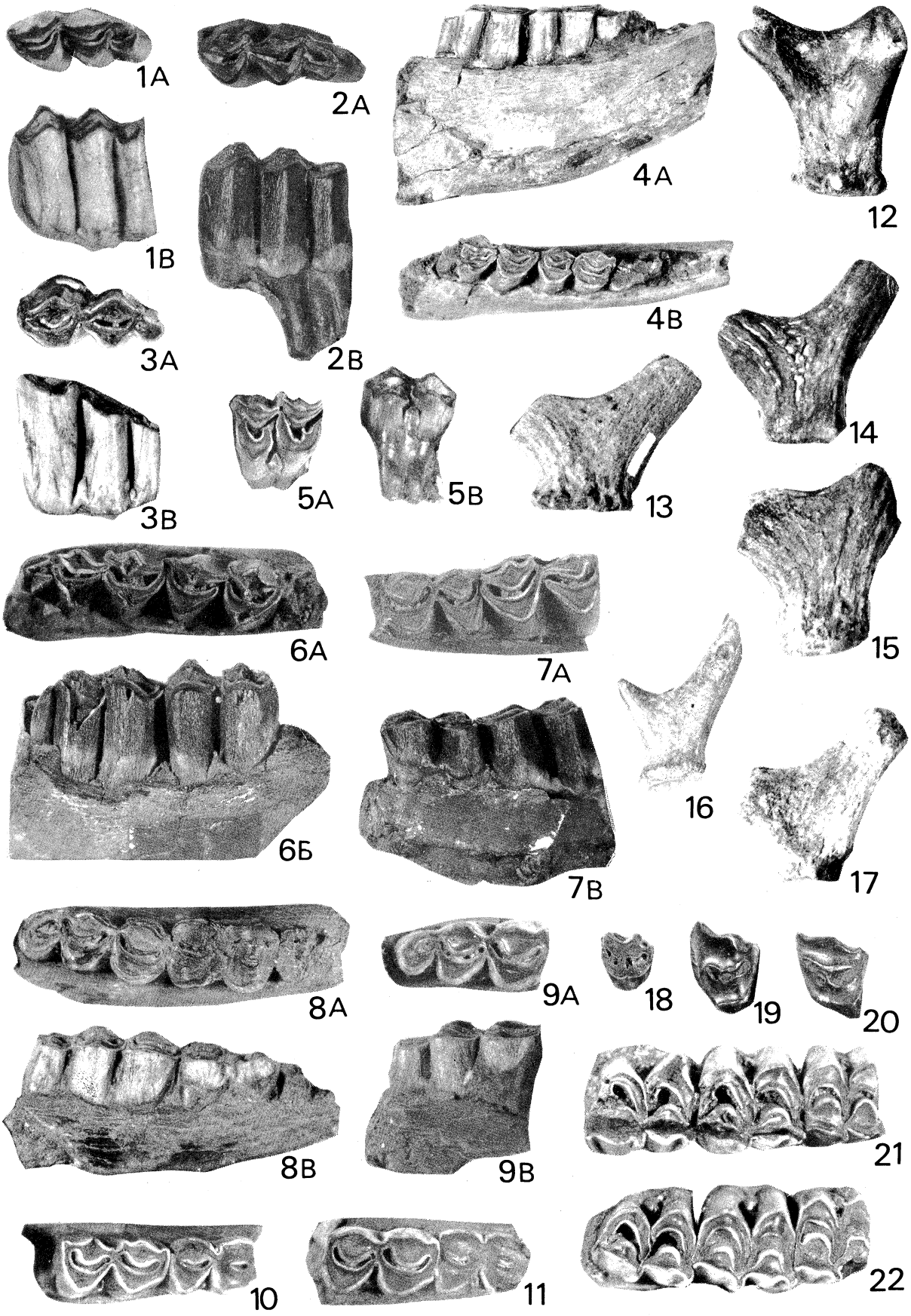
Fig. 18. A right upper second premolar (PM2). No. z, × 1.

Fig. 19. A right upper third premolar (PM3), No. y, × 1.

Fig. 20. A right upper foruth premolar (PM 4). No. x, × 1.

Fig. 21. Upper left teeth (M1–M3). No. 111. × 1.

Fig. 22. Upper left teeth (M1–M3). No. 108. × 1.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Explanation of Plate 8

Figs. 1–2. *Cervus* (*Rusa*) sp. ..... Page 44–45.

Fig. 1. A right shed antler (No. 45). Inner view, × 0.5.

Fig. 2. A left shed antler (No. 74). Outer view, × 0.5.

Figs. 3–21. *Cervus* (*Sika*) sp. ..... Page 50–57.

Fig. 3. A left upper third molar (M3), × 1. No. E7. Occulsal (A) and inner views, × 1.

Fig. 4. A left lower second molar (M2). No. A4. Occulsal (A) and inner (B) views, × 1.

Fig. 5. A left lower second molar (M2). No. 151. Occulsal (A) and inner (B) views, × 1.

Fig. 6. A left lower second molar (M2). No. A3. Occulsal (A) and inner (B) views, × 1.

Fig. 7. A right upper second molar (M2). No. 98. Inner (A) and occulsal (B) views, × 1.

Fig. 8. A left upper first molar (M1). No. 28. Inner (A) and Occulsal (B) views, × 1.

Fig. 9. A right upper second premolar (PM2). No. 40. Occulsal (A) and inner (B) views, × 1.

Fig. 10. A right upper third premolar (PM 3). No. 16. Occulsal (A) and inner (B) views, × 1.

Fig. 11. A left upper fourth premolar (PM4). No. 55. Occulsal (A) and inner (B) views, × 1.

Fig. 12. A right upper fourth premolar (PM4). No. 66. Occulsal (A) and inner (B) views, × 1.

Fig. 13. A left lower third premolar (PM3). No. P32. Occusal (A) and inner (B) views, × 1.

Fig. 14. Left antler (No. 84). Frontal (A) and outer (B) views, × 0.5.

Fig. 15. A left shed antler (No. 13). Inner view, × 0.5.

Fig. 16. A left shed antler (No. 6). Inner view, × 0.5.

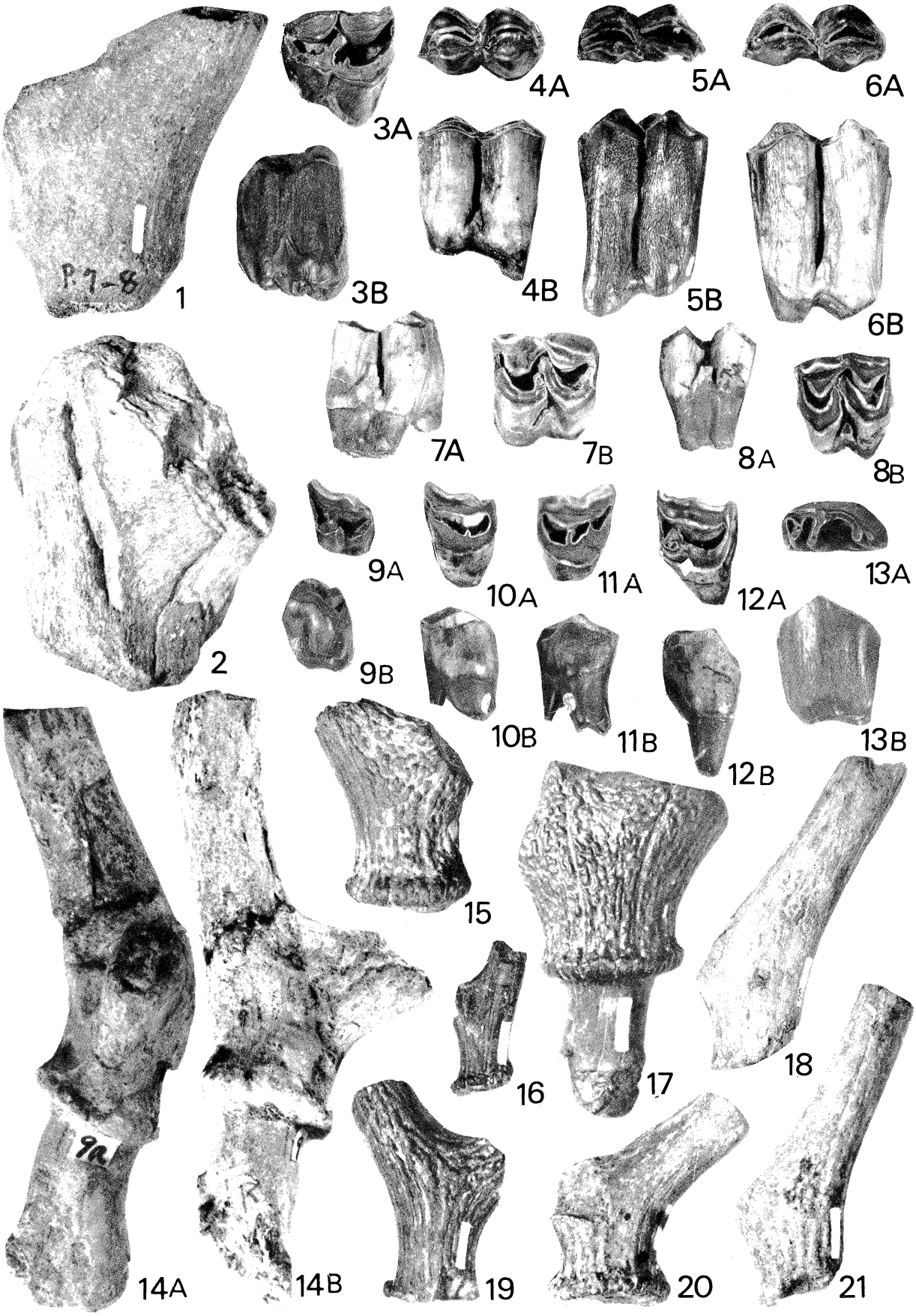
Fig. 17. A left antler with pedicle attached (No. 38). Inner view, × 0.5.

Fig. 18. A left shed antler (No. 36). Inner view, × 1.

Fig. 19. A left shed antler (No. 1). Inner view, × 1.

Fig. 20. A left shed antler (No. 43). Oucer view, × 1.

Fig. 21. A left shed antler (No. 28), Inner view, × 1.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