東北帝國大學

理科報告(地質學)

第參卷 第貳號

THE

SCIENCE REPORTS

OF THE

TOHÔKU IMPERIAL UNIVERSITY, SENDAI, JAPAN.

SECOND SERIES (GEOLOGY).

Vol. III., No. II.

For Sale by
Maruzen Company Ltd.

1918.

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On Some Fossil Mammals from Sze-chuan, China.

BY

HIKOSHICHIRÔ MATSUMOTO.

With Ten Plates and Four Text-Figures.

Introductory.

Fossil mammals from China are recorded by WATERHOUSE (1853), BUSK (1868), OWEN (1870), GAUDRY (1871), KOKEN (1885), LYDEKKER (1885, 1886 & 1891), V. LÓCZY (1898), SUESS (1899), SCHLOSSER (1903), &c. Among these authors' works, OWEN's, GAUDRY's, KOKEN's, LYDEKKER's and, especially, SCHLOSSER's are most important. For an accurate knowledge of the geological faunæ of Chinese fossil mammals, we are greatly indebted to the last named author, whose excellent monograph includes very many species.

SCHLOSSER distinguished four geological faunæ, namely Older Pliocene, Younger Pliocene, Older Pleistocene and Younger Pleistocene, in Chinese fossil mammals. The first, being the *Hipparion*-fauna, is again divided into two, a steppe and a forest, faunæ, both being very rich in species. The steppe fauna includes *Hipparion richthofeni, Mastodon pandionis, Rhinoceros habereri, Aceratherium blanfordi* var. *hipparionum, Anchitherium zitteri, Cameloparda lis* aff. *sivalensis, Alcicephalus sinensis, Urmiatherium* (?) sp., *Gazella dorcadoides, G. altidens, Palæoreas sinensis, Tragoceros grearius, Tr. spectabilis, Plesiaddax depereti, Strepticeros præcursor, St. annectens, Paraboselaphus ameghinoi, Pseudobos gracilidens, Ps. intermedius,* &c., and the forest fauna *Vulpes sinensis, Lutra brachygnathus, Meles taxipater, Machairodus horribilis, Dipoides majori, Mastodon lydekkeri, M. perimensis* var. *sinensis, Rhinoceros brancoi, Equus* cfr. *sivalensis, Gazella palæosinensis, Tragoceros sylvaticos,* &c.

The Younger Pliocene fauna provisionally includes *Stegodon cliftii* (=*St. sinensis* in the present paper; following PILGRIM, genuine *St. cliftii* is contemporaneous with *Hipparion*), *St. insignis* (=*St. orientalis* in the present paper), *Panthalops hundsiensis, Aceratherium* sp., *Equus sivalensis, Gazella subgutturosa, Hyæna macrostoma,* &c.

The Older Pleistocene fauna is characterized by *Ursus* aff. *japonicus, Hyænarctos* (?) sp., *Felis* sp., *Hyæna sinensis, Rhinoceros sinensis, Rh. plicidens, Tapirus sinensis, Chalicotherium sinensis, Equus* sp., *Sus* sp., *Cervus* (*Rusa*) *orientalis, C.* (*Axis*) *leptodus, Elephas namadicus,* &c.

The Younger Pleistocene fauna includes *Elephas primigenius, Rhinoceros* (*Cœlodonta*) *antiquitatis, Equus caballus, E. hemionus, Cervus* (*Cervus*) *mongoliæ, C.* (*Russa*) *aristotelis, C.* (*Axis*) *axis, Bos primigenius, Bison priscus* (the Chinese, as well as Japanese and Eastern Siberian, bisons may not be genuine *B. priscus*), &c.

Among these geological faunæ, the second, the *Stegodon*-fauna, is the least cultivated. We will here observe what SCHLOSSER states about it; he says: "Zwischen diesem anscheinend älteren Pleistocen und dem unzweifelhaften Tertiär—*Hipparion*-fauna—schaltet sich wahrscheinlich ein besonderer Horizont

ein, der allerdings nur Reste von wenigen Säugethierarten geliefert hat, nämlich die Zähne von *Stegodon cliftii*, *bombifrons* und *insignis* einerseits und etwas räthselhaften *Siplneus arvicolinus* von Quetae anderseits. Soviel über diese zähne von *Stegodon* auch schon geschrieben worden ist, so wenig Sicheres wissen wir über ihr Vorkommen." We see that, the *Stegodon*-fauna of China hitherto has been left rather as a blank page, no certain contemporaries of the Stegodonts being known.

Lately, the Zoöl. Inst., Imp. Univ., Tôkyô, has been presented by Mr. T. Sakawa a lot of fossil mammals, which were collected by him in a certain marly district of Sze-chuan, China. Owing to the kindness of my teacher, Prof. Watase, and under his direction, I was permitted to study this collection. After an examination, I have found that, this collection, though it is not very extensive, is no less interesting in containing certain Stegodonts and their contemporaries.

Judging from this collection, the *Stegodon*-fauna of Sze-chuan much resembles that of India and of Java, consisting chiefly of the bovine antilopes and Bovines, besides the Stegodonts. The *Stegodon*-fauna is certainly a forest, but not a steppe, fauna, as far as judged from the mammals belonging to it. The similarity of the *Stegodon*-faunæ of various lands may indicate the uniformity of the terrestorial conditions of those parts of the Oriental Region in those ages.

Hyænidæ.

Hyæna ultima, sp. nov.

(Pl. I., figs. 1–3)

A last right premolar attached to a small piece of an upper jaw in my material represents a species closely allied to *Hyæna spelæa* Goldfuss.

The premolar measures 42mm. in length, 22mm. in width and 22mm. in height. The dimensions of each lobe are as follows:

	Length.	Width.	Height.
Anterior lobe	7 mm.	13 mm.	15 mm.
Middle lobe	16 „	15 „	22 „
Posterior lobe	19 „	13 „	18 „
Inner accessory cone	9 „	9 „	10 „

The lower border of the crown of the premolar shows a graceful curve, with four concavities, one situating on the anterior side between the anterior lobe and inner accessory cone, one on either side of the middle part of the middle lobe and one at the posterior end of the posterior lobe. The anterior lobe is strongly reduced in size, and has a rudimentary, ill-defined cingulum on the anterior side. The tip of the same lobe is worn and blunt. The middle lobe is very stout, very acute at the tip, and has a distinct keel, which runs from the tip towards the inner accessory cone. The posterior half of the middle lobe forms an acute blade. The posterior lobe is well-developed, very long, wide, high, forming an acute blade; the posterior parts are moderately bent outwards. The middle and posterior lobes are slightly worn at the blade. The inner accessory cone is not much reduced in size, and is situated just inside the anterior lobe, being however more widely joined with the middle lobe than with the same. The anterior lobe and inner accessory cone end almost in a same frontal plane anteriorly.

The crown of the premolar is whitish yellow, while the piece of the upper jaw is light gray. This specimen is very slightly fossilised, bearing a small quantity of cave-loam. Therefore, it is very probable, that the present fossil belongs to Older Pleistocene.

The last upper premolar of the present species closely resembles that of *H. sinensis* Owen and

H. spelæa GOLDFUSS of Chinese and European Pleistocene respectively (the last species is, by some authors, referred to recent *H. crocuta*, notwithstanding of its being more specialised than it in certain characteristics). The present premolar differs from that of *H. sinensis* in the larger size, in the much more reduced anterior lobe, in the longer, wider and more acute middle lobe, in the much longer and stouter posterior lobe and in the very anteriorly situated inner accessory cone; and from that of *H. spelæa* in its larger size, in the slightly more reduced anterior lobe, in the much longer, wider, higher and much more acute middle lobe and in the much longer and higher posterior lobe. Further, the present premolar differs from that of *H. colvini* LYDEKKER, which appears to be most nearly allied to the present species among the Indian Pliocene forms, in the more reduced anterior lobe, in the wider, higher and more acute middle lobe and in the longer, wider and higher posterior lobe.

Following current theories, the Crocottine group are more specialised than the Euhyænine group. In the same direction of specialisation, there are two types of modification as to the form of the last upper premolar, the first being the decrease of the anterior lobe, hand in hand with the increase of the posterior lobe in size, and the second the diminution of the inner accessory cone. The first type is observable in the series of species of the Crocottine group, while the second in *H. eximia* ROTH & WAGNER and *H. gigantea* SCHLOSSER of the same group. The present premolar belongs to, and stands at the extreme of, the first type, having more reduced anterior and more increased posterior lobes than that of *H. spelæa*, which has hitherto been regarded as one of the most specialised form.

I have already stated above that, the present species is closely allied to *H. spelæa* merely in one point, namely in its strongly reduced anterior and much increased posterior lobe, but I am afraid that, the true, phylogenical relationships may probably be otherwise. In a lower view of the last upper premolar of *H. spelæa*, the posterior side of the inner accessory cone and the inner side of the middle and posterior lobes form together a very gentle curve, without any marked flexion at the middle of the middle lobe, so that the middle and posterior lobes are rather uniformly tapered hindwards; while in the same of that of the present species, as well as of *H. colvini*, *H. sinensis*, &c., the posterior side of the inner accessory cone and the inner side of the middle and posterior lobes form together a strong curve, with a more or less distinct flexion at the middle of the middle lobe, so that the posterior half of the middle lobe and the anterior part of the posterior lobe retain almost the same width, the posterior part of the posterior lobe being rapidly tapered hindwards to the very blunt posterior end. In the characteristics mentioned, the present species is nearer to *H. colvini* than to *H. spelæa*, and I am inclined to imagine that, the present species may possibly be a descendant of *H. colvini* of the Indian Pliocene.

Elephantidæ.

Stegodon orientalis OWEN.

(Pl. II., figs. 1–4; Pl. III., 1–3; Pl. IV., fig. 1)

Stegodon orientalis, OWEN, Quart. Journ. Geol. Soc. London, XXVI., 1870, p. 421. Pl. XXVIII., figs. 1—4.

Elephas insignis (pars; non FALCONER & CAUTLEY), LYDEKKER, Mem. Geol. Surv. India, Ser. 10, Vol. I., 1880, p. 268; LYDEKKER, loc. cit., Vol. II., 1884, p. 289; LYDEKKER, Brit. Mus. Cat. Foss. Mam., Pt. IV., 1886, p. 89.

Stegodon insignis, NAUMANN, Palæontogr., XXVIII., 1881, p. 12, Pls. III—V.; KOKEN, Pal. Abh., III., 1885, p. 14(42), Pl. VI(XI)., fig. 8; V. LÓCZY, Wiss. Ergeb. d. Reise d. Graf. BÉLA SZÉCHENYI i Ostasien, Bd. III., Abt. VI., 1898, p. 14, text-figs. 4—6, Pl. XI., figs. 1 & 2; SCHLOSSER, Abh. K. Bayer. Akan. Wiss., II. Cl., Bd. XXII., 1903, p. 44, Pl. XIV., fig. 10.

Elephas meridionalis (non NESTI), BRAUNS, Zeitscher. Deut. Geol. Gess., XXXV., 1883, p. 20.
Stegodon aff. *bombifrons* (non *Elephas bombifrons* FALCOMER & CAUTLEY), KOKEN, loc. cit., p. 12(40), Pl. VII(XII)., fig. 3.

In my material, the present species is represented by fragments of a second and a last right upper molar, by a complete last left lower milk-molar and by a fragment of a second right lower molar, each of the latter two being attached to a piece of a mandible.

The fragment of a second upper molar consists of one complete and two broken ridges. The complete ridge measures 22mm. in width, 78mm. and 44mm. in length at base and at summit respectively and 35mm. in height, and contains eight well-developed and three rudimentary mamillæ. The ridge just anterior to the complete one measured 38mm. in height, and is considerably curved, as is a somewhat abnormal case observed also in V. LÓCZY's specimen. A small, low supplementary tubercle is present at the inner end of the valley just posterior to the complete ridge. The ridge just posterior to the same is 30mm. high. The valleys are about 25mm. deep. The cement is not very aboundant, and is not extended so far as to the summits of the ridges. The surface of the enamel is very rough and tubercular, being more or less vertically grooved.

The fragment of a last upper molar consists of four unworn ridges. Judging from its general appearance, it certainly belongs to the hinder portion of the molar. The ridges measure 22-25mm. and 34-37mm. in width along the outer and the inner side respectively, 93-100mm. and 54-56mm. in length at base and at summit respectively, and 46-50mm. in height. Each of them contains eight or nine mammillæ. The valleys measure about 35mm. in depth and are almost filled up with aboundant cement. The surface of the enamel is vertically grooved and horizontally striated. The exposed surfaces of the cement and enamel, as well as the interior wall of the pulp, of this and the fore-going specimens are black, while the covered surface of the enamel is whitish yellow. The two specimens mentioned are rather very slightly fossilised, bearing a small quantity of brown clay.

The last lower milk-molar is 130mm. long and contains seven ridges, besides a well-developed anterior and a very rudimentary posterior talon. The ridges are entirely fresh, except the first one, which is slightly worn. The dimensions of the ridges and talons are as follows:

	Width.	Length at base.	Ditto at summit.	Height.
Anterior talon	5 mm.	40 mm.	15 mm.	26 mm.
First ridge	14-18 „	52 „	38 „	30 „
Second ridge...	19-20 „	56 „	42 „	32 „
Third ridge	13-18 „	56 „	40 „	32 „
Fourth ridge...	15-20 „	58 „	35 „	33 „
Fifth ridge	17-20 „	58 „	33 „	35 „
Sixth ridge	17-21 „	55 „	27 „	34 „
Seventh ridge	14-18 „	48 „	24 „	32 „
Posterior talon	—	—	8 „	28 „

The anterior talon lies almost flat on the anterior surface of the first ridge and consists of several very close-set, ill-defined mammillæ, of which one distinct and two or three rudimentary ones reach the grinding surface; the distinct mammillæ just mentioned nearly corresponds to the more or less distinct median cleft of the first ridge. In the anterior surface of the talon, there is present a smooth concavity, which is evidently a trace of compression against the antecedent tooth. The first ridge is divided into four groups of mammillæ by three more or less distinct crefts, each group containing four or more close-set mammillæ, which are very irregular in size and in arrangement. This ridge, the sole worn one, is much higher inwards than outwards. The second ridge contains about sixteen mammillæ, of

which five or six are small and rudimentary. Each of the third to fifth ridges has eight or nine distinct and a few rudimentary mammillæ. The sixth ridge consists of seven, and the seventh ridge of four, very stout mammillæ. A small, low supplementary tubercle occurs at the inner end of the seventh ridge. Three exceedingly small tubercles are present on the posterior surface of the last ridge, corresponding to a very rudimentary posterior talon. The valleys are 15-20mm. deep, and contain a moderate quantity of cement. The surface of the enamel is rough and tubercular, and especially so in the posterior ridges. The piece of the mandible, to which the present premolar is attached, is about 70mm. and 40mm. high at the middle and at the posterior end of the premolar respectively. This specimen is light yellowish brown, variegated with shades of bluish gray, and is rather very slightly fossilised, bearing a small quantity of brown clay.

The fragment of a second lower molar consists of five ridges, of which the foremost one is incomplete. The foremost incomplete ridge may probably be the second ridge of the molar, judging from its position relative to the anterior surface of the root. The dimensions of the ridges are as follows:

	Width.	Length at base.	Ditto at summit.	Height at inside.	Ditto at outside.
Second ridge	18-25 mm.	66 mm.	50 mm.	36 mm.	23 mm.
Third ridge	18-26 ,,	70 ,,	50 ,,	42 ,,	27 ,,
Fourth ridge	18-27 ,,	72 ,,	47 ,,	45 ,,	28 ,,
Fifth ridge	20-26 ,,	75 ,,	45 ,,	42 ,,	29 ,,
Sixth ridge	21-28 ,,	77 ,,	40 ,,	38 ,,	35 ,,

The second to fourth ridges are moderately worn, with exposed dentine, while the rest are only slightly worn and have no exposed dentine. The ridges, especially the worn ones, are decidedly higher inwards than outwards, as shown in the foregoing table. Each ridge consists of eight or nine very stout, close-set mammillæ. The valleys, measuring 28-32mm. in depth, are very narrow and contain a moderate quantity of cement. The surface of the enamel is very rough, being vertically grooved and horizontaliy striated, and is amber-coloured, variegated with gray. The exposed surface of the cement is gray. The piece of the mandible, to which the present molar is attached, measures about 130mm. in width and 100mm. in height at the fourth ridge. The exposed surface of the same is grayish brown. This specimen is comparatively well fossilised, the inner wall of the pulp being covered over by a thick layer of calcite cristallines and it bears a quantity of hard brown clay.

The clay, in which the present species is preserved, is evidently a decomposed product of limestone. From this clay, *Aceratherium blanfordi* var. *hipparionum* which is reasonably stated by SCHLOSSER to belong to Pliocene, is also proved. From this fact and from the rather slight fossilization of the specimens, I am inclined to look upon the present species to belong to Younger Pliocene.

The present species was at first established by OWEN upon fragments of a second milk-molar and two molars from Sze-chuan, which were however subsequently provisionally referred to *Elephas insignis* by LYDEKKER. NAUMANN recorded Japanese specimens under the name of *Stegodon insignis*. BRAUNS referred the Chinese and Japanese specimens to *Elephas meridionalis*. KOKEN maintained LYDEKKER's statements, besides a questionable record of *St.* aff. *bombifrons*.

Almost all remains of *Stegodon* hitherto known from China are very fragmental, and especially no fair molars with worn ridges have ever been recorded. In my opinion, LYDEKKER's statements about OWEN's and V. Lóczy's specimens as to their being quite indistinguishable from the teeth of *St. insignis* may not be very important, because those specimens represent only unworn ridges and the mode of wearing can not be observed in them. I have a specimen, which has been figured by FALCONER & CAUTLEY under the name of *St. ganesa* (Fauna Antiqua Sivalensis, Pl. xxv. A, figs. 6 & 6a), for comparison. Referring to this specimen, as well as FALCONER & CAUTLEY's abundant figures and LYDEKKER's

descriptions of *St. insignis* and *gancsa*, certain differences between *St. orientalis* and the Indian forms are recognisable as follows:

(1) The worn ridges of lower milk-molars and molars of *St. orientalis* are much higher inwards than outwards, while those of *St. insignis* and *ganesa* are either slightly higher outwards than inwards or almost equally high outwards as well as inwards.

(2) The ridges of milk-molars and molars of *St. orientalis* begin to wear from the very outer side, but those of *St. insignis* and *gancsa* from the inner side or at least from the middle part.

(3) The anterior and posterior surfaces of ridges of milk-molars and molars of *St. orientalis* are fairly even, while those of *St. insignis* and *gancsa* are very uneven, being conspicuously undulated.

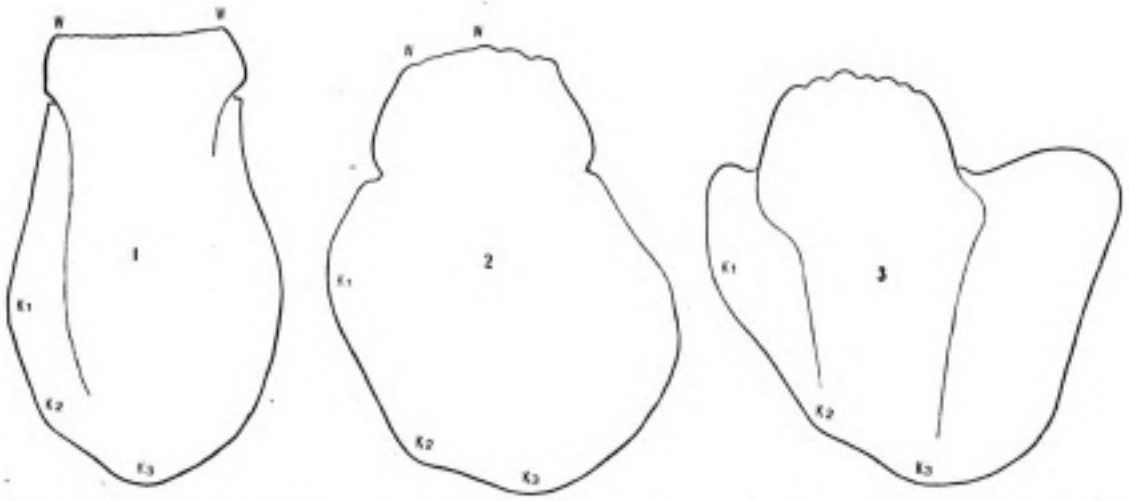


Fig. 1. Transverse sections of a transverse bar of a mandible of *St. gancsa*: 1—at the anterior part, 2—at the middle part, and 3—at the posterior part. ×$\frac{1}{2}$

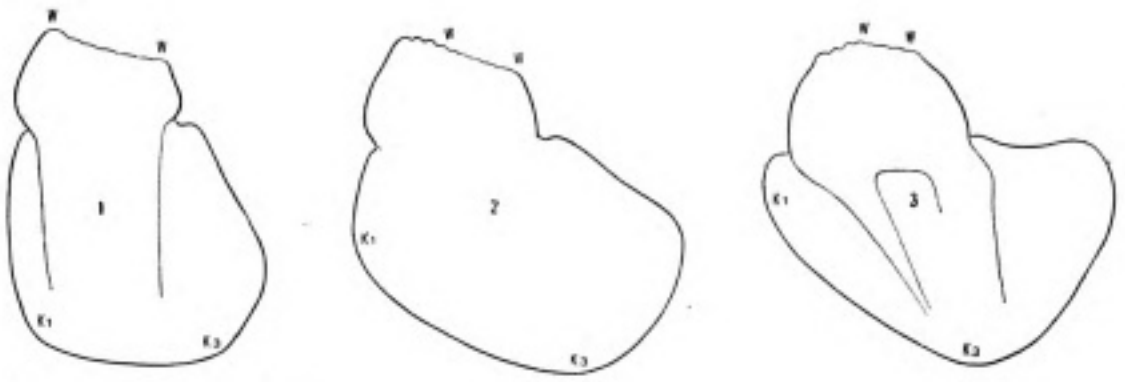


Fig. 2. Ditto of *St. orientalis*. ×$\frac{1}{2}$
The inner and lower side of the bar of *St. gancsa* is divided into three surfaces by two keels (K_1 and K_2), while that of *St. orientalis* into two surfaces by a single keel (K_1).
The worn part of ridges is shown by W W: it will be clearly seen, that the mode of wearing is quite different in the two species.

As to the mandibles of *St. orientalis*, I am able to point out their differences from those of *St. gancsa* as follows:

(1) The transverse bars of mandibles of *St. orientalis* are very low and wide while those of *St. gancsa* are very high and narrow.

(2) The inner aud lower side of the transverse bars of mandibles of *St. orientalis* is divided into two—inner and inner lower—surfaces by a single keel, the inner lower surface being uniformly

convex, while that of *St. ganesa* is divided into three—inner, inner lower and lower—surfaces by two keels, the inner lower and lower surfaces being slightly concave.

Further, I was able to find a very important characteristic of *St. orientalis* upon certain Japanese specimens, which belong to the Imp. Mus. of Uyeno, Tôkyô. In the original specimen of NAUMANN's Pl. III., which presents a lower jaw, the plane of wear of the milk-molars distinctly inclines from inwards to outwards. In another specimen, which is not yet described, from Mitsugoshima, near Shôzushima, Sanuki, the plane of wear of the upper molars distinctly inclines from outwards to inwards. Thus, it is proved, that the present species, as well as *St. cliftii*, belongs to the Mastodont type as to the plane of wear, but not to the Elephantine type, which includes *St. insignis* and most other species. This fact naturally corresponds to the fact that, the worn ridges of lower milk-molars and molars of the present species are much higher inwards than outwards, as mentioned in the first article of the previous paragraph.

NAUMANN's Pl. III., in which the crowns of the milk-molars are shown to be faced not entirely upwards but obliquely inwards and the first ridges of the last milk-molars to be slightly worn at the very outer side, and SCHLOSSER's fig. 10, Pl. XIV., in which the anterior ridges are shown to be more worn outwards than inwards, correspond well to what I find in my specimens; while the abundant milk-molars and molars of *St. insignis*, as well as of *St. ganesa* and *bombifrons*, figured in Fauna Antiqua Sivalensis have the ridges either more worn inwards than outwards or equally worn inwards as well as outwards. I, therefore, consider that, the contrast of the Chinese, as well as Japanese, form to the Indian species in the mode of wearing of milk-molars and molars is fairly constant. Again, NAUMANN's Pl. III., in which the transverse bars of a mandible are shown to be very wide, and V. LÓCZY's text-fig. 6, in which the inner lower surface of the transverse bar is shown to be uniformly convex, both agree with my observations.

KOKEN's specimen represented in his fig. 3, Pl. VII (XII)., under the name of *St. bombifrons* much resembles the last upper molar in my material in its lower view. The posterior parts of the upper molars of Stegodonts, as well as of elephants, are frequently very low, and are especially markedly so, when the molars are very young. There may, therefore, be insufficient proof to refer this hindmost portion of an upper molar to *St. bombifrons* merely because of the low ridges.

The present species, here recognised to be distinct, is represented by OWEN's, NAUMANN's, KOKEN's, V. LÓCZY's, SCHLOSSER's and my specimens. To summarise them, the dimensions of the milk-molars and molars may be shown as follows:

Upper dentition.	Mm_3 (NAUMANN).	M_1 (NAUMANN).	M_2 (V. LÓCZY).	M_3 ‡
Length	90 mm.	145 mm.	ca. 213 mm.; —	— ; 200 mm. + a
Width	51 „	69 „	92 „ ; 78 mm.	100 mm.; 86 „

Lower dentition.	Mm_2 (OWEN).	Mm_3 (NAUMANN).	M_2	M_3 (NAUMANN).
Length	—	— ; 130 mm.	—	ca. 220 mm.
Width	38 mm.	55 mm.; 58 „	77 mm.	ca. 88 „

Hab.: Sze-chuan, Yun-nan, Kan-su, Fo-kien and Japan; Upper Pliocene and (?) Lower Pleistocene.

Stegodon sinensis OWEN.

(Pl. I., figs. 4 & 5)

Stegodon sinensis, OWEN, Quart. Journ. Geol. Soc. London, XXVI., 1870, p. 417, Pl. XXVII.; BRAUNS,

‡ I refer here to an undescribed specimen, which belongs to the Imp. Geol. Surv., Tôkyô, from Shôzushima, Sanuki.

Zeitschr. Deut. Geol. Ges., XXXV., 1883, p. 44; MARTIN, Samml. Geol. Reichs-Mus. Leiden, Ser. 1, Bd. IV., 1884, p. 11.

Elephas cliftii (pars; non FALCONER & CAUTLEY), LYDEKKER, Mem. Geol. Surv. India, Ser. 10, Vol. I., 1880, p. 257, Pl. XLV., fig. 2; LYDEKKER, Brit. Mus. Cat. Foss. Mamm., Pt. IV., 1886, p. 80.

Stegodon cliftii, NAUMANN, Palæontogr., XXVIII., 1882, p. 9, Pls. I & II.; KOKEN, Pal. Abh., III., 1885, p. 11 (39); SCHLOSSER, Abh. K. Bayer. Akad. Wiss., II. Cl., Bd. XXII., 1903, p. 43.

A fragment of a second left lower molar in my material represents the present species.

This fragment contains two worn ridges and an unworn posterior talon, which measure as follows:

	Width.	Length at base.	Ditto at summit.	Height at inside.	Ditto at outside.
Penultimate ridge ...	24-28 mm.	88 mm.	77 mm.	22 mm.	35 mm.
Last ridge	23-26 „	86 „	68 „	27 „	38 „
Posterior talon	18 „	68 „	42 „	32 „	25 „

The ridges are very low, forming a very large angle between two neighbouring ridges for a very shallow valley. The penultimate ridge is strongly worn, with largely exposed dentine; the foldings of the enamel-layer at the grinding surface are very fine, about six folds being contained in 10mm. at the middle parts of the ridge. The last ridge is moderately worn. There are seventeen to nineteen folds of the enamel-layer on either side of the ridge; five or six of them are more or less conspicuous. The posterior talen is very well-developed and consists of seven stout mammiliæ, of which two reach the grinding surface. In the posterior surface of the posterior talon, there is a smooth concavity, which is evidently the trace of compression against the last molar. The ridges are higher outwards than inwards, and the worn surface of each ridge is wider inwards than outwards. The enamel-layer is very thin, measuring 2.5-3mm. in thickness at the anterior and posterior sides of the ridges. The surface of the enamel is rather smooth, being very faintly grooved vertically, except in the proximal parts of the crown, where it is distinctly tubercular. The valleys are almost free of cement.

The roots are well separated from each other, except the last two, which are united together in the outer parts. Thus, they remind us of those of NAUMANN's specimen from Shôzushima, Japan, but not of those of the last lower molar of *St. cliftii* from Burma (FALCONER & CAUTLEY's, fig. 5, Pl. XXX).

The present specimen is rather well fossilised, being embedded in hard brown clay. The exposed surface of dentine is very sticky to the tongue, while that of the specimens of *St. orientalis* is not so. The present specimen may probably belong to Younger Pliocene.

I was at first in serious doubt as to the ridges of the present specimen, which are higher outwards than inwards. So that, I have had measured the height of the ridges of NAUMANN's original specimen, which belongs to the Geol. Inst., Tokyo, for comparison. Following MESSRS. Ts. OGURA and R. AOKI, who kindly measured the specimen in question for my use, the height of the ridges at both inner and outer sides is as follows:

	Inner side.	Outer side.
First ridge	31 mm.	30.5 mm.
Second ridge...	32 „	28 „
Third ridge	28.5 „	25 „
Fourth ridge...	29 „	24 „
Fifth ridge	30.5 „	26 „
Sixth ridge	31.5 „	32.5 „
Seventh ridge	30 „	34 „
Posterior talon	11.5 „	25 „

Thus, we see that, the first to fifth ridges are higher inwards than outwards, while the rest are the inverse. As my specimen from Sze-chuan represents only the hindmost portion of a molar, it may not be out of the way, though the ridges are higher outwards than inwards, instead of being higher inwards than outwards.

The present species was at first founded by OWEN upon a second upper milk-molar from Shang-hai. But, the type specimen was afterwards provisionally referred to *Elephas cliftii* by LYDEKKER. NAUMANN has recorded a last lower molar from Shôzushima, Japan, under the name of *Stegodon cliftii*, while the same specimen was referred to *St. sinensis* by BRAUNS, who maintained the distinctiveness of the latter species. KOKEN, opposing BRAUNS, emphatically maintained LYDEKKER's and NAUMANN's statements.

In my opinion, *St. cliftii* and *St. sinensis* may probably be not strictly identical, though they are unquestionably very close. As far as I can, the common characters of the two species may be enumerated as follows:

(1) The ridges of milk-molars and molars are very low, and the valleys are very shallow and largely open.

(2) The worn surface of the ridges of milk-molars and molars is wider inwards than outwards (except that of NAUMANN's specimen, which is rather elongatedly oval.

(3) There is very little cement.

Now, let me first compare the Chinese specimens with *St. cliftii* from India and Burma. Their differences from the latter are as follows:

(1) The folding of enamel of the Chinese specimens are very fine and numerous, indicating numerous and close-set mammillæ, which are bordered by feeble furrows; while in *St. cliftii*, they are rather few, corresdonding to rather few and very stout mammillæ, which are bordered by very prominent furrows.

(2) The median cleft is altogether indistinct in the Chinese specimens, while in *St. cliftii*, the same is more or less, or strongly, well-developed (even in those specimens stated by FALCONER and by LYDEKKER to have a scarcely distinct median cleft, the cleft is shown to be more or less tracable in their figures).

(3) In OWEN's type, the wearing of the anterior ridges is not much stronger than that of the posterior; while in milk-molars, as well as molars, of *St. cliftii*, that of the anterior is much stronger than that of the posterior, and those milk-molars with the first ridge worn in almost similar degree as that of OWEN's type, have unworn posterior ridges (e. g. FALCONER & CAUTLEY's figs. 1, 2 and 4, Pl. XXX). These facts correspond to the fact that, the grinding surface of milk-molars and molars of the Cninese form is nearly parallel to the base of the crown, while that of *St. cliftii* is much inclined forwards.

(4) In the Chinese specimens, the ridges bend at first distinctly backwards and then slightly forwards, the anterior side of a ridge being mucn larger than the posterior; while in *St. cliftii*, the ridges bend decidedly forwards, the anterior side of a ridge being much smaller than the posterior.

(5) The enamel-layer of the Chinese specimens is very thin, measuring 2.5-3mm. at the anterior and posterior sides of ridges; while that of *St. cliftii* appears to be much thicker.

(6) The roots of my specimen are well separated from each other, while those of the lower molar of *St. cliftii* from Burma are united together so as to form a single piece.

Then, if one takes NAUMANN's specimen from Shôzushima, Japan, in consideration, one may find that, all the differences of the Chinese specimens from *St. cliftii* hold true also in the same, with additional peculiarities, which may be added as follows:

(7) The Japanese specimen is much shorter and narrower than the last lower molar of *St. cliftii* from Burma (223.5mm./90mm. : : 317mm./112mm.).

(8) The Japanese specimen is widest at the first ridge, gradually tapering posteriorly; while the specimen from Burma is widest at the middle, tapering both anteriorly and posteriorly.

The contrast of the Japanese specimen to the last lower molar of *St. cliftii* from Burma in every detail, such as size, general outline, bending of the ridges, number and size of the mammillæ, presence or absence of a median cleft, the separated or united rooots, &c., appears to me to be too marked to allow their being included in one and the same species. Especially, noticeable is the fact that, the grinding surface of the Japanese specimen is concave, instead of being inclined forwards, the first and the last two ridges being almost equally high and much higher than the ridges of the middle parts, as is clearly shown in the foregoing table, and that the wearing of the anterior ridges is not much stronger than that of the posterior; while in the specimen from Burma, the grinding surface is decidedly inclined forwards, the posterior ridges being entirely unworn, notwithstanding that the anterior ones are more strongly worn than those of the Japanese specimen. In short, the Japanese specimen differs much from *St. cliftii*, but almost coincides with the Chinese form in many characteristics.

We see certain cases, in which two distinct species with different types of skull have quite indistinguishable dentition. The differences of the milk-molars and molars of the Chinese and Japanese form from those of *St. cliftii* are never trifling. Therefore, I am obliged to consider *St. sinensis* to be a distinct species.

Following PILGRIM, *St. cliftii* and *St. bombifrons* are the oldest species of the Stegodonts and are contemporaneous with *Hipparion* and certain Mastodonts. It is almost certain, that the Chinese Stegodonts, as far as hitherto known, are younger than *Hipparion* and Mastodonts, as stated by SCHLOSSER; and in my opinion, they are probably contemporaneous with such Bovines as *Bibos geron* and *Buffelus* sp. a, which are described in the following pages. Thus, there is very little probability that, *St. sinensis* is identical with *St. cliftii*, from a geological view, also.

The present species here recognised to be distinct is represented by OWEN's, NAUMANN's and my specimens, of which the dimensions are as follows:

	Upper Mm_2 (OWEN).	Lower M_2	Lower M_2 (NAUMANN).
Length	70 mm.	—	225.5 mm.
Width	52 „	88 mm.	90 „

Hab. Sze-chuan, Shang-hai and Japan; Upper Pliocene and (?) Lower Pleistocene.

Rhinocerotidæ.

Aceratherium blanfordi LYDEKKER

var. **hipparionum** KOKEN.

(Pl. V., figs. 1 & 2)

Aceratherium blanfordi var. *hipparionum*, KOKEN, Pal. Abh., III., 1885, p. 18 (46), Pl. V (X)., figs. 9 & 10; SCHLOSSER, Abh. K. Bayer. Akad. Wiss., II. Cl., Bd. XXII., 1903, Pl. IV., figs. 1-5, 9-11, 13-18, Pl. VII , figs. 4 & 5.

Rhinoceros blanfordi, LYDEKKER, Brit. Mus. Cat. Foss. Mam., Pt. III., 1886, p. 154.

Rhinoceros sp., SUESS, Verh. K. Russ. Mineral. Ges. St. Petersburg, XXXVI., 1899, p. 171, fig. 3.

In my material, the present species and variety is represented by a fragment of a right ramus of a mandible, which bears the first two molars.

The first lower molar is slightly worn and is 52mm. long, 32mm. and 22mm. wide at base and at

summit respectively, and 45mm. high above the upper margin of the jaw. The second molar remains almost within the alveolus and is 55mm. long, 34mm. and 22mm. wide at base and at summit respectively, and 55mm. high without the root. The outer costæ of the molars are not very acutely angular, but are more or less perfectly rounded, and especially so in the posterior lobe. The anterior and posterior cingula are rather well-developed. The surface of the enamel is feebly tubercular. The enamel-layer is rather thick, measuring 1.5-2mm. in thickness. The molars are light yellowish.

The fragment of a mandible measures 52mm. in width and 85mm. in height at the second molar. The present specimen is rather well-fossilised, being embedded in hard brown clay.

Hab. of the present species: Persia, Belutchistan, India and China; Upper Miocene and Pliocene.

Hab. of the present variety: Yun-nan, Sze-chuan, Shan-si, Shen-si and Mongolia; Pliocene.

Rhinoceros sinensis OWEN.

(Pl. V., figs. 5 & 6)

Rhinoceros sinensis, OWEN, Quart. Journ. Geol. Soc, London, XXVI., 1870, p. 424, Pl. XXIX., figs. 1-3; KOKEN, Pal. Abh., III., 1885, p. 24 (52), Pl. III (IX)., fig. 1, Pl. VI (XI), fig. 1; SCHLOSSER, Abh., K. Bayer. Akad. Wiss., II. Cl., Bd. XXII., 1903, p. 52.

Rhinoceros sivalensis (non FALCONER & CAUTLEY), KOKEN, loc. cit., p. 30 (58), Pl. VI (XI)., figs. 3-5; LYDEKKER (pars), Brit. Mus. Cat. Foss. Mam., Pt. III., 1886, p. 130.

Rhinoceros simplicidens, KOKEN, loc. cit., p. 32 (60), Pl. V (X)., figs. 7 & 8.

A second left upper molar and a fragment of a first right lower molar in my material represent the present species.

The second upper molar is moderately worn and measures 51mm. in length, 52mm. in width and 30mm. in height. The posterior side of the posterior lobe is strongly excavated by the posterior valley, of which the entry is much narrowed by the presence of the posterior cingulum. The inner and outer posterior lobes send each a promontory forwards and inwards respectively into the main valley, the two promontories meeting each other so as to cut off a part from the main valley. A quite similar structure occurs also in the last upper milk-molar figured by KOKEN. Three small, spur-like projections are present in the isolated part of the valley mentioned. As a characteristic of an upper molar of the present species, there is a well-developed anterior talon on the anterior side of the anterior lobe, forming a terrace-like ridge. The enamel-layer is very thin, thinnest along the borders of the outer parts of the main valley, measuring about 0.4mm., and thickest at the inner ends of the inner lobes, measuring about 1.2mm. The surface of the enamel is very finely, vertically striated and is light yellowish brown. The exposed surface of the dentine is also yellowish brown, being however variegated with black.

The fragment of a first lower molar consists only of the posterior lobe, is strongly worn and measures 29mm. in width and 17mm. in height. The outer and posterior sides of the posterior lobe lie almost at a right angle to each other, the outer posterior angle of the lobe being however perfectly rounded. The enamel-layer is about 0.8mm. and 1.4mm. thick along the border of the posterior valley and along the outer and posterior sides of the lobe respectively. The exposed surfaces of the present specimen are black.

The two specimens above described are very feebly fossilised and bear some quantities of cave-loam. I am quite satisfied as to SCHLOSSER's statements about the age of the present species.

The upper molars hitherto known of the present species have been the first and the last; the second is now supplied by my first specimen. The dimensions of a series of the upper molars may be given as follows:

	Length.	Width.
M_1 :	45 mm.	46 mm.
M_2 :	51 „	52 „
M_3 :	43 „ (at the inner side)	52 „

Hab.: Sze-chuan, Yun-nan and Shang-si (?); Lower Pleistocene.

Rhinoceros plicidens Koken.

(Pl. V., figs. 3 & 4)

Rhinoceros plicidens, Koken, Pal. Abh., III., 1885, p. 22 (50), Pl. VI (XI), figs. 6 & 7; Schlosser, Abh. K. Bayer. Akad. Wiss., II. Cl., Bd. XXII., 1903, p. 56.

Rhinoceros sivalensis (non Falconer & Cautley), Koken, loc. cit., p. 30 (58), Pl. V (X)., fig. 11, Pl. VI (XI)., fig. 2.

Rhinoceros sp., Koken, loc. cit., p. 34 (62), Pl. III (VIII)., fig. 3.

In my material, the present species is represented by a left lower molar, which may probably be the first.

The molar is entirely unworn and measures 46mm. in length, 27mm. in width and 62mm. in height. The outer posterior flexure of the anterior lobe is very acute, being less than a right angle. The costa of the same flexure is most prominent at the part, which corresponds to the upper half of the posterior lobe. The outer posterior flexure of the posterior lobe is almost a right angle, the costa being however perfectly rounded. The unworn upper edges of both lobes are irregularly tubercular. The anterior and posterior cingula are very prominent and also tubercular. A small accessory tubercle is present at the entry of the posterior valley. The surfaces of the molar are very finely, vertically striated; in the interior walls of the valleys, the striations are radiated from the bottom. The molar is yellowish brown in general, but many parts are tinted with shades of black. The surface of the molar is very sticky to the tongue, this being a proof that the present fossil belongs to a young age. Indeed, this specimen is very feebly fossilised, bearing a small quantity of cave-loam.

Hab.: Yun-nan, Sze-chuan, Ho-nan and Yang-tze-kiang R.; Lower Pleistocene.

Bovidæ.

Proboselaphus, gen. nov.

This new genus is very near *Bosclaphus*, the pneumatic skull-bones, the widely separated small horn-cores, which point backwards and are triangular in a transverse section, the "bovine," hypselodont molars, the surfaces of which are rough, and the presence of three roots to each upper molar being almost similar in both genera. But, the former differs from the latter chiefly in the much more convex apical surface of the skull, in the more slender horn-cores, which are not very close to the orbits, in the very feeble lateral ridges of the *parietale*, in the comparatively large parietal surface of the *supra-occipitale*, in the upwardly curved zygomatic arches, in the presence of a median keel and a very feeble median groove on the *basi-occipitale*, and in the much less hypselodonty of the molars. In certain characteristics by which *Proboselaphus* is distinguished from *Bosclaphus*, the same genus reminds us of *Tetraceros* on the one hand and of *Anoa* on the other. *Proboselaphus* however differs from *Tetraceros* chiefly in the remarkably larger size, in the horn-cores, which are entirely marginal to the skull, in the absence of

additional, anterior horns, and in the very complex, rough, "bovine" molars; and from *Anoa* chiefly in the less convex apical surface of the skull, in the horn-cores, which do not lie very flat to the skull, and in the presence of spurs to the upper molars and of outer accessory columns to the lower molars. Further, *Proboselaphus* differs from *Paraboselaphus*, which has been founded by SCHLOSSER upon a certain type of teeth, in the larger size and in the presence of accessory columns to the molars. It is my great regret, that I am not able to observe the lacrymal region, owing to the imperfectness of the unique skull.

Proboselaphus watasei, sp. nov.

(Pl. VI., figs. 1–3; Pl. VII., figs. 1–4)

This species is represented by a skull, associated with a mandible and with an atlas. The skull, as well as mandible, is rather strongly distorted, certain parts being broken off, so that the anterior parts of the snout, the parts anterior to the orbits, the right zygomatic arch and the left horn-core are not present.

SKULL:—The dimensions of the skull are as follows:

Length	280 mm. + a (probably no less than 300 mm.)
Ditto from the anterior border of D_2 backwards	265 „
Width at the zygomatic arches	120 „
Ditto at the upper borders or orbits	100 „
Ditto at the horn-cores	85 „
Ditto of the occipital region	90 „
Distance of the horn-cores	50 „
Height just behind the horn-cores	80 „
Ditto of the occipital region	85 „
Ditto above the upper margin of *foramen magnum*	58 „

The skull is long and slender, with considerably convex apical surface, the convexity nearly corresponding to that of *Tetraceros*, being greater than that of *Boselaphus* and *Duboisia* and smaller than that of *Anoa*. The *frontalia*, measuring 110mm. + a in length and 45mm. in width, are slightly depressed at the region between the orbits, but distinctly convex in the posterior parts. Just above each orbit, there is a raised zone, being bounded inwards by a distinct groove, which is very conspicuous just above the

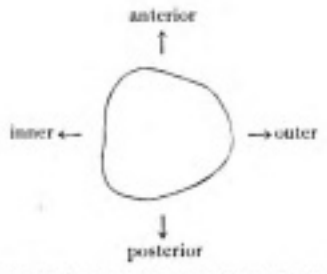


Fig. 3. Transverse section of the right horn-core at base; nat. size.

anterior end of the orbit. The surface of the *frontalia* appears to be smooth, not tuberculated as in *Boselaphus* and *Duboisia*. The horn-cores arise from the posterio-lateral corners of the *frontalia*, pointing backwards and very slightly upwards, and are very small, slender, irregularly triangular in transverse section, which measures 70mm. in circumference. The bases of horn-cores extend anteriorly as far as to connect with the raised zones just above the orbits. The *parietale* is well-developed, measuring 70mm.

in length, as well as in the width of the anterior part. The surface of the *parietale* is markedly convex and smooth. The lateral ridges are feebly developed, being not so prominent as in *Boselaphus* and *Duboisia*. The parietal surface of the *supra-occipitale* is comparatively large, forming an irregular triangle, which is 25mm. long and 60mm. wide. The posterior surface, i. e. occipital region, of the skull is comparatively high and not very wide. The part just above the *foramen magnum* is strongly projected. The occipital condyles are very large, measuring 42mm. in length and 26mm. in width at the base. The distance from the outer angle of the base of one condyle to that of the other is 70mm. So that, the extent of the condyles compared with the width of the occipital region is much greater than that of *Duboisia*, but nearly corresponds to that of *Boselaphus*. The *foramen magnum* is more or less trapezoidal, with rounded angles, and measures 30mm. and 33mm. in length in the median line and along the lateral sides respectively, and 35mm. and 9mm. in width along the upper and the lower side respectively. The zygomatic arches are not so straight as in *Boselaphus*, but are moderately curved upwards like those of *Tetraceros*. In the middle part of the median line of the *basi-occipitale*, there is present a small median keel, which is bordered on either side by an insignificant depression; these two depressions meet each other, just anterior to the keel, so as to form a very feeble median groove. In the feebleness of the median groove, *Proboselaphus* reminds us of *Tetraceros*, but not of *Boselaphus* and *Duboisia*. The lower ends of the *bullæ tympanicæ* rest almost in the level of the *basi-occipitale*.

Mandible :—The dimensions of the mandible are as follows :

Length	200 mm. + a (probaly no less than 220 mm.)
Ditto from the anterior border of D_2 backwards	190 „
Height	130 „
Ditto below the mandibular condyle	90 „
Distance from the mandibular condyle to the mandibular angle.	75 „

The transverse bars of the mandible are moderately bent upwards and have very convex outer surfaces, which give a robust appearance to the bars. They are very thick at the molars, corresponding to the stout bases of the latter, but peculiarly low at the first molar, where they are 30mm. high and 22mm. thick, while they are higher and thicker anteriorly, measuring 34mm. in height and 12mm. in thickness at the second milk-molar. The coronoidal processes are wide and very thin, measuring 28mm. in width and 2-3mm. in thickness above the zygomatic arches and are 40mm. high. The cheeks are flattened and slightly concave. The mandibular angles are projected posteriorly. The part just anterior to the same is markedly projected downwards, so that the ventral side of the transverse bar is concave at the portion anterior to the projected part.

Teeth :—Milk-molars, except the first, and molars, except the last, of upper and lower jaws are present, belonging to the type-specimen. They measure as follows :

	Length.	Width.	Ditto at the grinding surface.	Height outside the jaw.	Ditto of the crown.
Upper D_2 :	18 mm.	11 mm.	10 mm.	7 mm.	ditto
„ D_3 :	20 „	16 „	12 „	8 „	„
„ D_4 :	21 „	20 „	14 „	15 „	„
„ M_1 :	26 „	22 „	10 „	21 „	26 mm.
„ M_2 :	28 „	20 „	9 „	18 „	31 „
Lower D_2 :	14 „	7 „	5 „	6 „	ditto
„ D_3 :	20 „	9 „	7 „	10 „	„
„ D_4 :	30 „	13 „	12 „	12 „	„
„ M_1 :	26 „	16 „	10 „	19 „	25 mm.
„ M_2 :	28 „	15 „	7 „	16 „	30 „

The milk-molars are strongly worn, with largely exposed dentine and very narrow crescents. Each of the third and last upper milk-molars has a large inner accessory column, while the second lacks it. The last upper milk-molar has a spur on the inner posterior border of the posterior crescent. The second and third lower milk-molars have narrow grinding surfaces and extremely narrow crescents, without accessory columns, while the last has a wide grinding surface and very small and narrow crescents, with two inner and two outer accessory columns, of which the outer are exceedingly large and directly connected with the tooth proper in the grinding surface, while the inner are small and free.

The surfaces of the molars are very rough, as in *Boselaphus*. The costæ of the outer surface of the upper molars and of the inner surface of the lower molars are rather feeble, while the folds of the same are very prominent. The first upper molar has a moderately large inner accessory column and has a distinct spur on the outer posterior border of the posterior crescent and a rudimentary one on the inner posterior border of the anterior crescent and another on the outer posterior border of the posterior crescent. The same molar has three roots, of which the outer two are 12mm. high, are slender and are anterior-posteriorly compressed, the posterior side of the anterior one and the anterior side of the posterior one being vertically grooved, while the inner root is 10mm. high, is bifurcated distally and has a vertical groove on the outer side. The second upper molar has a distinct spur on both the inner anterior and the inner posterior border of the anterior crescent and on the inner posterior border of the posterior crescent, besides a rudimentary one on the outer posterior border of the posterior crescent. In this molar, the roots are also three in number; the outer two are 5mm. high, are rather stout and are oval in transverse section, while the inner one is very large and exceedingly low, being almost liable to be taken merely as a long opening of the pulp. The lower molars are narrow and have each two rather slender outer accessory columns, of which one is situated just outside between the two lobes and the other at the outer anterior corner of the anterior lobe. Each of the first and second molars has two roots, which are very stout and anterio-posteriorly compressed; the roots of the first molar measure 10mm. in height at the outer side, and those of the second molar 6mm. in same.

Atlas:—The dimensions of the atlas are as follows:

Length	65 mm. + a	(probably about 75 mm.)
Ditto along the lower median line ...	35 „ + a	(probably about 40 „)
Width at the anterior articular processes...	2 × 45 = 90	„
Ditto at the narrowest middle part	65	„
Height	52	„
Width of the central canal at the anterior side	33	„
Ditto at the posterior side...	43	„
Height of the central canal at the anterior side	25	„
Ditto at the posterior side...	35	„

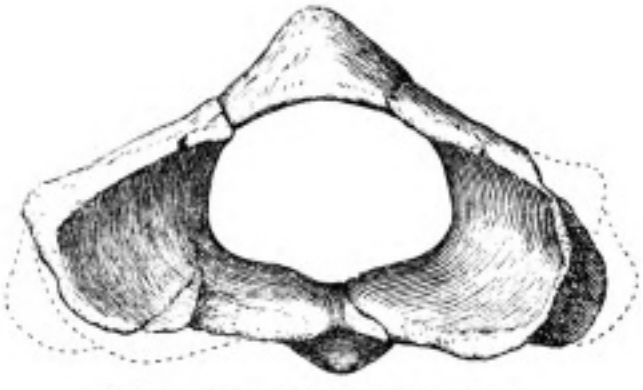


Fig. 4. Anterior view of the atlas; nat. size.

Though it is almost impossible to give here exact dimensions and precise descriptions of the atlas, owing to the imperfectness of the specimen, I am able to point out, at least, two points of differences from that of *Duboisia:* the anterior articular processes are very strongly stretched laterally, being much more so than those of *Duboisia*, and the central canal is much wider downwards than upwards, while that of *Duboisia* is wider upwards than downwards. The anterior parts of the wings, just behind the anterior articular processes, are exceedingly thin.

The present specimen is very well fossilised, being embedded in hard brown clay, so that I consider that, it belongs to Younger Pliocene.

Proboselaphus liodon, sp. nov.

(Pl. VII., figs. 5–8)

Another species of *Proboscelaphus* is represented by one first right upper and one first left upper molar and probably by a right lower milk-molar.

The dimensions of these teeth are as follow:

	Length.	Width.	Ditto at the grinding surface.	Height.
Right upper M_1 :	27 mm.	20 mm.	9 mm.	29 mm.
Left „ M_1 :	28.5 „	21 „	10 „	29 „
Right lower D_4 :	32 „	16.5 „	15 „	12 „

The molars are very little worn. The costæ and folds of the outer surface are very prominent, the former being much more so than those of the genotype. The crescents are rather large. The spurs are not well-developed; in the right molar mentioned, they are represented by two very feeble ones on the inner posterior border of the posterior crescent and by a very insignificant one on the inner anterior border of the same crescent, while the left molar mentioned, has no spurs. The inner accessory column is higher and stouter than that of the genotype, is prismatic, with tringular transverse section, and has a vertical groove on the inner side. The inner surface of the molars is rather rough, but the outer surface is nearly smooth, the costæ and folds being especially so.

The last lower milk-molar, which is probably referrable to the present species, is strongly worn, with largely exposed dentine. The crescents are very narrow. The worn surfaces of the outer cones are much wider than those of the inner. There are two outer and two inner accessory columns; the worn surfaces of the former are small and oval, while those of the latter are very large and triangular, being continued with the worn surface of the tooth proper.

All the three specimens above described are rather feebly fossilised, bearing a small quantity of brown clay. The interior walls of the pulps are covered over by a thin layer of calcite crystallines. So that, the present species may probably belong to Younger Pliocene.

Several comparisons of the first upper molar of the present species to that of the genotype are made in the following table:

Upper M_1 of *P. watasei:*	Upper M_1 of *P. liodon:*
(1) One distinct and three rudimentary spurs present.	(1) No spurs, or a single rudimentary one may be present.
(2) Inner accessory column low; the inner surface rounded.	(2) Inner accessory column high; the inner surface flat, with a vertical median groove.
(3) Outer costæ rather feebly projected, and especially less so near the tip.	(3) Outer costæ strongly projected throughout the entire height.

(4) Folds of the outer surface strongly projected, the median fold being especially so and strongly curved and turned up backwards.

(5) Vertical grooves between the costæ and folds rather shallow, the groove just anterior to the median fold narrowing downwards to an acute point.

(6) Inner, as well as outer, surface very rough.

(4) Folds of the outer surface strongly projected, the median fold being almost equally as much as the others and not strongly curved and turned up.

(5) Vertical grooves between the costæ and folds very deep, the groove just anterior to the median fold retaining almost the same width above as well as below.

(6) Inner surface very rough, but outer surface less so, especially the costæ and folds being perfectly smooth.

Following PILGRIM, his *Bosclaphus lydekkeri* from the Indian Pliocene may not belong to *Bosclaphus*; there are certain possibilities that it is referable to *Proboselaphus*, though it is at once distinguished from my two species by its larger molars.

Comparison of **Proboselaphus** to the allied genera.

The apical surface of the skull of *Boselaphus* and *Duboisia* is not very convex but nearly flat, while that of *Tetraceros*, *Proboselaphus* and *Anoa* is markedly convex, the convexity being most prominent in the last genus. The posterior parts of the *frontalia* of *Anoa* are especially, strongly raised, but are not so in the other genera.

The horn-cores of *Proboselaphus* are irregularly triangular in transverse section, like those of *Bosclaphus* and *Duboisia*, but are much more slender than, and about half as wide as, the same. The bases of the horn-cores of *Proboselaphus* are not so close to the orbits as in *Boselaphus* and *Duboisia*, but are situated rather far from them, somewhat reminding us of those of *Anoa*.

The orbits of *Duboisia* are very low in position, the upper side lying much lower than the frontal surface of the skull, while those of *Bosclaphus*, *Proboselaphus*, *Tetraceros* and *Anoa* are not so, the upper surface of the roof of the orbits lying almost in the same level as the frontal surface of the skull.

The *parietale* of *Tetraceros* and *Anoa* is rather short, but that of *Bosclaphus*, *Duboisia* and *Proboselaphus* is long and well-developed. In *Duboisia*, as well as in *Bosclaphus*, the lateral ridges of the *parietale* are very prominent, while they are very feeble in *Tetraceros* and *Proboselaphus*. The parietal surface of the *supra-occipitale* of *Tetraceros*, *Proboselaphus* and *Anoa* is comparatively large, but that of *Boselaphus* and *Duboisia* appears to be exceedingly small.

The proportion of height to width of the occipital region, i. e. the posterior surface of the skull, of *Proboselaphus* is much greater than that of *Boselaphus* and *Duboisia*. The proportion of the extent of the occipital condyles to the width of the occipital region of *Proboselaphus*, as well as of *Boselaphus*, is much greater than that of *Duboisia*.

The median groove of the *basi-occipitale* of *Tetraceros* is very feeble, while that of *Boselaphus* and *Duboisia* is very prominent. In *Proboselaphus*, the *basi-occipitale* has a median keel in the middle part of the median line and a very feeble median groove anterior to the keel. Thus, *Proboselaphus* reminds us of *Tetraceros* in the feebleness of the median groove, and of certain Bovines in the presence of a median keel.

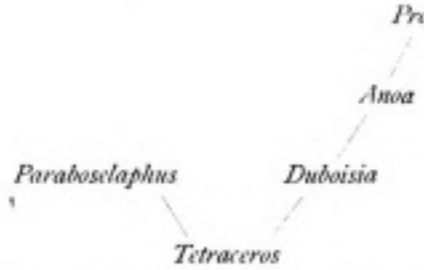
The *bullæ tympanicæ* of *Tetraceros* and *Duboisia* project downwards below the level of the *basi-occipitale*, while those of *Bosclaphus* and *Proboselaphus* end almost on the same level.

The surfaces of the molars of *Bosclaphus* and *Proboselaphus*, as well as of the lower molars of

Paraboselaphus, are very rough, while those of *Tetraceros*, *Duboisia* and *Anoa* are slightly rough or nearly smooth. Each upper molar of *Boselaphus* and *Proboselaphus* has three roots, while that of *Tetraceros* and *Duboisia*, as well as of the other antilopes, has two roots. The spurs are well-developed in the upper molars of *Boselaphus*, *Proboselaphus*, *Duboisia* and *Paraboselaphus*. The presence of accessory columns in the molars of several allied genera is shown in the following table:

	Tetraceros.	Paraboselaphus.	Duboisia.	Proboselaphus.	Boselaphus.	Anoa.
Upper M_1 :	1	0	1	1	1	1
„ M_2 :	1	0	1	1	1	1
„ M_3 :	1	0	1	?	0	0
Lower M_1 :	1	0	1	2	2	1
„ M_2 :	0	0	0	2	2	0
„ M_3 :	1	1	0	?	0	0

Duboisia resembles *Tetraceros* in having an accessory columns on the upper molars and on the first lower molar, but differs from it in lacking the same on the last lower molar. The relation of *Paraboselaphus* to *Tetraceros* is quite a contrast, the first resembling the second in having an accessory column on the last lower molar, and differing from the same in the absence of accessory columns on the upper molars and on the first lower molar. *Anoa* is nearly similar to *Duboisia* in the accessory columns, but differs from it in having none on the last upper molar. *Boselaphus* is similar to *Anoa* in the accessory columns of the upper molars, but differs from it in having two accessory columns to both the first and second lower molars. *Proboselaphus* is quite similar to *Boselaphus*. Having merely the accessory columns in mind, we may arrange these genera as follows:



To summarise the common characteristics of *Proboselaphus* and *Boselaphus*, distinguishing them from *Duboisia*, we may enumerated the following:

Proboselaphus & Boselaphus:

(1) The orbits are high, the upper surface of the roof lying on the same level with the frontal surface of the skull.

(2) The proportion of the extent of the occipital condyles to the width of the occipital region is great, being about 0.8.

(3) The *bullæ tympanicæ* are not much projected downwards, ending almost on the level of the *basi-occipitale*.

(4) The molars are very rough; each upper molar has three roots.

(5) Each of the first and second upper molars has an accessory column, and each of the first and second lower molars has two.

Duboisia:

(1) The orbits are low, the upper side lying on a much lower level than the frontal surface of the skull.

(2) The proportion of the extent of the occipital condyles to the width of the occipital region is small, being a little more than 0.6.

(3) The *bullæ tympanicæ* are much projected downwards, as far as below the level of the *basi-occipitale*.

(4) The molars are rather smooth; each upper molar has two roots.

(5) Each of the first and second upper and the first lower molars has an accessory column.

The common characteristics of *Boselaphus* and *Duboisia*, distinguishing them from *Proboselaphus*, are as follows:

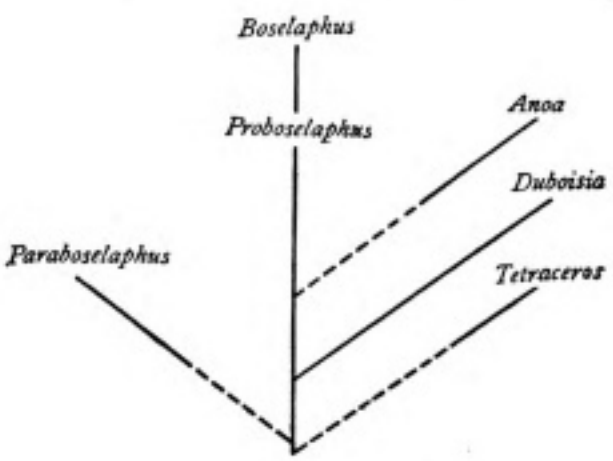
Boselaphus & Duboisia:	*Proboselaphus.*
(1) The apical surface of the skull is not very convex.	(1) The apical surface of the skull is very convex.
(2) The horn-cores are not very slender.	(2) The horn-cores are very slender.
(3) The *parietale* has prominent lateral ridges.	(3) The *parietale* has very feeble lateral ridges.
(4) The *basi-occipitale* has a very distinct median groove.	(4) The *basi-occipitale* has a very feeble median groove, besides a median keel.

Comparing these two sets of tables, one may incline to consider that, the common characteristics of *Proboselaphus* and *Boselaphus* are more important than those of *Boselaphus* and *Duboisia*. Then, it is almost unquestionable, that the mutual relation of *Proboselaphus* and *Boselaphus* is more intimate than that of *Boselaphus* and *Duboisia*.

In my opinion, *Proboselaphus* is more primitive than *Boselaphus* in many characteristics, e. g. the very slender horn-cores, the less hypselodonty of the molars, and certain generalized characteristics, in which this genus is nearer to *Tetraceros*, *Anoa*, &c. than *Boselaphus* is to the same.

It is believed by certain authors, that *Boselaphus* is a near ally of the Bovines. Now, my new genus is more "bovine" than *Boselaphus* in certain respects. The apical surface of the skull of *Proboselaphus* is much more convex than that of *Boselaphus*, showing an approximation to the more convex apical surface of the skull of *Anoa*, as well as of young Bovines. The horn-cores are not so close to the orbits as those of *Boselaphus*, but are situated rather far from the same, somewhat reminding us of those of *Anoa*. The parietal surface of the *supra-occipitale* of *Proboselaphus*, as well as *Anoa*, is larger than that of *Boselaphus*. The zygomatic arches of *Proboselaphus* are not so straight as those of *Boselaphus*, but are curved upwards like those of many Bovines. The *basi-occipitale* of *Proboselaphus* has a median keel, as in certain Bovines.

The probable interrelationship of *Proboselaphus* and the allied genera may be shown as follows:



Buffelus sp. a.

(Pl. IX., figs. 4 & 5)

A fragment of a left ramus of a mandible, bearing two milk-molars and a piece of a first molar, and two isolated last lower milk-molars in my material represent a large species of buffaloes characterised by very rough teeth, like *B. platindicus*.

The milk-molars and molars attached to the ramus of a mandible measure as follows:

	Length.	Width.	Ditto at the grinding surface.	Height above the margin of the jaw.
D_3 :	25 mm.	13 mm.	11 mm.	21 mm.
D_4 :	45 „	16 „	9 „	25 „
M_1 ; anterior lobe :	17 „	17 „	5 „	—

The milk-molars are slightly worn. The outer costæ of the last milk-molars are wide and very prominent. The outer accessory columus of the same are rather slender. The first molar is not fully grown, only the tip reaching above the margin of the jaw. The inner costæ and folds are very prominent, the former being considerably wide. The vertical groove just anterior to the anterior costa of the inner surface retains an almost constant width above and below, being not so narrowed downwards as in the next species. The surface of the teeth is exceedingly rough.

The fragment of the mandible measures 48mm. in height, and 24mm. in width at the middle lobe of the last milk-molar. Both the teeth and the fragment of the mandible are whitish, the latter being however insignificantly patched with light bluish shades. This specimen is highly fossilised, being embedded in hard brown clay. The pneumatic spaces of the same are stuffed with calcite crystallines.

One (left) of the two isolated last milk-molars quite coincides in every feature to that of the first specimen, while the other (right) is much smaller than the same and has a less rough inner surface. The latter appears rather to belong to an intermediate form between the present and the next species. The dimensions of the two milk-molars are as follows:

	Length.	Width.	Ditto at the grinding surface.	Height.
Left D_4 :	44 mm.	16 mm.	9 mm.	41 mm.
Right D_4 :	40 „	14 „	11 „	35 „

Both milk-molars are yellowish, with patches of grayish shades. They are rather feebly fossilised, bearing a small quantity of brown clay. This species may probably belong to Younger Pliocene.

This species is characterised by large and very rough teeth, like *Bufflus palæindicus* (Falconer) of the Indian Pliocene and Pleistocene. There may be some possibility of these two being identical, though I am not able to state this with certainty, because the latter species is described chiefly by skulls, and not by teeth.

Buffelus sp. b.

(Pl. VIII., figs. 1–5)

? *Bubalus* sp., Koken, Pal. Abh., III., 1885, p. 67 (95), Pl. II (VII)., figs. 14 & 20; Schlosser, Abh. K. Bayer. Akad. Wiss., II. Cl., Bd. XXII., 1903, p. 158.

Another species of buffaloes is represented by a set of right upper molars, by a right ramus of a mandible, which bears a last milk-molar and the first two molars, and by an isolated first right lower molar.

The upper molars measure as follows:

	Length.	Ditto just at the base.	Width just at the base.	Ditto at the grinding surface.	Height.
M_1 :	32 mm.	22 mm.	27 mm.	17 mm.	50 mm.
M_2 :	35 „	25 „	30 „	13 „	63 „
M_3 ; anterior lobe :	16 „	—	30 „	9 „	—

The first molar is moderately worn, and the second is only slightly so. The outer costæ and folds are prominent. The inner accessory columns are very stout and have a rounded inner surface. The

crescents are large, more or less quadrangular, with much compressed inner and outer borders. The surfaces of the molars are nearly smooth and are covered over by a considerable amount of cement.

The teeth attached to the fragment of the mandible mentioned measure as follows:

	Length.	Width.	Ditto at the grinding surface.	Height.	Ditto above the margin of the jaw.
D_4 :	31 mm.	14 mm.	10 mm.	26 mm.	23 mm.
M_1 :	30 „	15 „	6 „	57 „	20 „
M_2 :	33 „	16 „	7 „	—	—

The inner costæ and folds are very well-developed, the former being especially prominent. The outer accessory columns are rather slender. The anterior lobe of either molar is provided with two very distinct spurs, which rise nearly from the tip of the outer cone, diverge inwards and extend as far as to meet the outer surfuce of the inner cone. The surfaces of the molars are more or less rough, but much less so than in the preceeding species, and especially the costæ and folds are almost perfectly smooth, while those of the preceeding species are very rough.

The isolated first lower molar, measuring 31mm. in length, 16mm. in width and 55mm. in height, differs from that of the foregoing specimen in the total absence of spurs.

The ramus of the mandible mentioned measures as follows:

Length	215 mm. + a.
Height at the middle lobe of D_4	50 „
Ditto at the anterior lobe of M_2	70 „
Width at the middle lobe of D_4	23 „
Ditto at the anterior lobe of M_2	28 „

The teeth are yellowish, the exposed surfaces of the dentine and cement being however black. The ramus of the mandible is grayish white. All the specimens referred to are slightly fossilised, the tooth-sockets and the crescents and pulps of the molars being stuffed with a quantity of brown clay.

Hab.: China (Sze-chuan and Yun-nan); Upper Pliocene.

Bibos geron, sp. nov.

(Pl. IX., figs. 1–3; Pl. X., figs. 1–3)

A piece of an upper jaw with a last left molar and an incomplete left ramus of a mandible with a last premolar and all the three molars, in my material represent a very ancient species of gaurs.

The teeth measure as follows:

	Length.	Width.	Ditto at the grinding surface.	Height outside the jaw.
Upper M_2 (cast in the jaw):	—	39 mm.	—	—
„ M_3 :	35 mm.	25 „	11 mm.	32 mm.
Lower P_3 (cast in the jaw):	20 „	13 „	—	—
„ P_4 :	25 „	16 „	9 mm.	28 mm.
„ M_1 :	32 „	18 „	17 „	30 „
„ M_2 :	35 „	19 „	17 „	30 „
„ M_3 :	47 „	19 „	16 „	28 „

The last upper molar is entirely unworn and measures 85mm. in height of the crown. The cement is very abundant, almost covering the entire surface of the molar and perfectly filling up the crescents. The outer costæ and folds are very prominent; the former have very distinct boundaries, the vertical

grooves bordering the posterior side of the anterior costa and the anterior side of the posterior costa being ν-shaped in horizontal section. The inner accessory column is very stout, with rounded inner surface, which is more projected inwards than the molar proper. The inner surface of the molar is very rough, but the outer surface is nearly smooth, and especially the costæ and folds are perfectly so.

The lower premolar and molars are strongly worn. The cement is exceedingly abundant, the costæ, folds and accessory columns being almost perfectly covered over. The inner costæ and folds are very prominent, the former having very distinct boundaries. The middle vertical groove of the inner side is sharply notched along the boundary between the anterior and posterior lobes, being **V**-shaped in horizontal section. The outer accessory column is rather slender. The outer surface is very rough, but the inner surface is only slightly so. The total length of the last two premolars and three molars is 180mm. and that of the molars only, is 115mm.

The transverse bar of the mandible is very stout and exceedingly high, corresponding to the very great hypselodonty of the molars. The dimensions are as follows:

Length	210 mm. + a.
Width at the P_3	26 „
Ditto at the posterior lobe of M_1	35 „
Ditto at the posterior talon of M_3	30 „
Height at the P_3	45 „
Ditto at the posterior lobe of M_1	75 „
Ditto at the posterior talon of M_3	90 „

The teeth, as well as the fragments of the jaws, are white in colour and are strongly fossilised, being embedded in hard brown clay. The interior walls of the pulps of the teeth, as well as of the pneumatic spaces of the jaws, are covered over by a layer of calcite crystallines. It is very probable, that the present specimens belong to Younger Pliocene.

The present new species may possibly be not strictly identical with that described as *Bibos* sp. by Koken and by Schlosser, though both are undoubtedly very close. Following Schlosser, the latter belongs to old Pleistocene and his specimens are black in colour, so that the environment may be entirely different from that of mine. In the present species, both sides of the middle fold of the outer surface of the upper molar slope forwards and hindwards respectively, till they reach the anterior and posterior costæ, forming there sharply notched vertical grooves, which are ν-shaped in horizontal section. This characteristic is not well indicated in Koken's figs. 16 & 17, Pl. II (V). The vertical groove between the two costæ of the inner surface of a lower molar of the present species is sharply notched along the boundary between the anterior and posterior lobes, being distinctly **V**-shaped in horizontal section. This characteristic is also not indicated in Koken's fig. 1.

The present species, Koken's *Bibos* sp., *B. palæogaurus* (Falconer) Rütimeyer and *B. gaurus* Smith are very gigantic. The second and third belong to Pleistocene, while the last belongs to recent times. Unfortunately, *B. palæogaurus* is little known, being based upon an imperfect specimen, with no figures and no precise descriptions, and following Rütimeyer, it is quite indistinguishable from *B. gaurus*. The spresent species differs from *B. gaurus* almost in the same characteristics, by which Koken's *Bibos* sp. is distinguished from the same, e. g. the smaller teeth and the better developed costæ and folds. There is some possibility that the present species is congeneric with some of the Indian fossil forms described as *Probubalus*, *Amphibos* and *Leptobos*, but none of the latter is very gigantic. Judging from Rütimeyer's description and figures, the united length of the premolars and molars of *Leptobos falconeri* from the Indian Pliocene appears to be much shorter than that of the present species.

Summary.

The fossil mammals included in the present paper may be divided into two groups according to their environments. The first group consists of those occurring in brown clay, which is evidently a decomposed product of lime-stone. The species belonging here are as follows:

Stegodon orientalis.
St. sinensis.
Accratherium blanfordi var. *hipparionum.*
Proboscliphus watasei.
P. liodon.
Bufficlus sp. a.
B. sp. b.
Bibos geron.

Among this group, the specimens of *St. orientalis* (pars), *St. sinensis*, *A. blanfordi* var. *hipparionum*, *P. watasei*, *B.* sp. a (pars) and *Bib. geron* are very well fossilised, with the interior walls of the pulps and pneumatic spaces covered over by a thick layer of calcite crystallines, and are embedded in hard clay; while those of *St. orientalis* (pars), *P. liodon*, *B.* sp. a (pars) and *B.* sp. b are rather feebly fossilised, with the interior walls of the pulps and pneumatic spaces covered over by a thin layer of crystallines, and are attached by a quantity of loose clay. These differences may probably be due to the fact that the former were entirely embedded in the strata, while the latter were more or less exposed to the air. The worn surface of dentine of the present group is usually very sticky to the tongue. As a comparison, I tested a number of teeth of *Accratherium blanfordi* var. *hipparionum* and *Hipparion richthofeni*, which were obtainsd from *red* clay, and I have confirmed the fact that, the worn surface of dentine of these teeth is not at all or only slightly sticky to the tongue. So that, the present group may very probably be younger than the *Hipparion*-fauna, as the much more sticky dentine indicates. On the other hand, the present group may probably be older than the next group preserved in cave-loam, because it is better fossilised than the latter. I am convinced that, this group, being typified by the associated occurrence of *Accratherium blanfordi* var. *hipparionum* and the Stegodonts, may probably belong to Younger Pliocene.

The second group consists of those occurring in cave-loam, including the following species:

Hyæna ultima.
Rhinoceros sinensis.
Rh. plicidens.

The specimens of this group are very feebly fossilised, the pulps and pneumatic spaces being free of calcite crystallines and the teeth being strongly coloured. This group probably belongs to Older Pleistocene.

A comparison of the species of the Stegodon-fauna of Sze-chuan with the allied ones of that of India and of Java is made as follows:

Sze-chuan.	Siwalik.	Narbada.	Java.
Stegodon orientalis.	*St. bombifrons*, (*insignis* and *ganesa*).	(*St. insignis* and *ganesa*).	(*St. airawana*).
St. sinensis.	*St. cliftii.*	(*St. insignis* and *ganesa*).	*St. trigonocephalus.*
Accratherium blanfordi var. *hipparionum.*	*A. blanfordi.*	—	—

Sze-chuan.	Siwalik.	Narbada.	Java.
Probosolaphus watasei and *liodon.*	*Bosclaphus*(?) *lydekkeri.*	*B. namadicus.*	(*Duboisia krausnii*).
Buffelus sp. a and sp. b.	*B. palæindicus* and *platyceros.*	*B. palæindicus.*	*B. palæokerabau.*
Bibos geron.	(*Leptobos falconeri*).	*Bibos palæogaurus.*	(*Bib. protocavifrons* and *palæosondaicus*).

We see that, the *Stegodon*-fauna much resembles that of India and of Java, consisting chiefly of the Stegodonts, bovine antilopes and Bovines. In India, the *Stegodon*-fauna follows the *Hipparion*-fauna; and the same holds true also in China.

Judging from the foregoing table, the *Stegodon*-fauna of Sze-chuan is probably nearer to that of Siwalik than to that of Narbada and of Java. This fact yields a reason for referring the *Stegodon*-fauna of Sze-chuan as Pliocene.

The *Stegodon*-fauna of Sze-chuan is probably related to the steppe fauna of the *Hipparion*-fauna, or else to the forest fauna of the same, though the fauna itself is evidently a forest fauna, as may be judged from the animals belonging to it. There are three data for this view. In the first place, *Aceratherium blanfordi* var. *hipparionum* is common to the steppe fauna and *Stegodon*-fauna. In the second place, *Mastodon latidens*, which is a near ally of *Stegodon*, is more frequent in the steppe fauna than in the forest fauna. In the third place, *Paraboselaphus* of the steppe fauna is represented by an allied genus, *Probosclaphus*, in the *Stegodon*-fauna. The hard brown clay, in which the *Stegodon*-fauna is preserved, very much resembles the hard reddish clay, in which the steppe fauna is preserved. I imagine that the brown clay may probably correspond to a younger stage of the reddish clay.

As to particular genera and species, my conclusions may be given as follows:

Besides *Hyæna sinensis*, another species, viz. *H. ultima*, occurs in the Chinese Pleistocene. The latter is characterised by the most diminished anterior and the most increased posterior lobe of the last upper premolar.

Stegodon orientalis and *St. sinensis* may not strictly be identical with *St. insignis* and *St. cliftii*, respectively, as far as certain differences are observed between them. Both of the Chinese species may probably belong to Younger Pliocene.

Aceratherium blanfordi var. *hipparionum* belongs to both the *Hipparion*-fauna and *Stegodon*-fauna, i. e. probably to both Older and Younger Pliocene. *Rhinoceros sinensis* and *Rh. plicidens* belong to Older Pleistocene, as is reasonably stated by Schlosser.

Probosclaphus is very near *Bosclaphus*, and is more primitive and more "bovine" in certain characteristics. The discovery of *Probosclaphus* may be an additional fact for the hypothesis that the Bovines originated in the Oriental Region, where the Bovines and bovine antilopes were abundant in Pliocene and later ages. *Probosclaphus watasei* and *liodon* probably belong to Younger Pliocene.

Buffaloes and gaurs occur probably since Younger Pliocene in China. Those of the successive ages may be tabled as follows:

Pliocene.	Pleistocene.	Holocene (Prehistric).
Buffelus sp. a & b.	*Buffelus* sp. 2, Koken.	*Buffelus bubalus*, Schlosser.
Bibos geron.	*Bibos* sp., Koken.	*Bibos gaurus*, Schlosser.

Some of them may possibly have been blood relations, though I am not able clearly to make out at the present, because the material is too imperfect for this purpose.

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