On some Fossil Bisontines of Eastern Asia.

BY

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With eleven Plates and three Text-figures.

Introductory.

In the New World, a number of species of fossil bisons were early distinguished, while in the Old World, the Pleistocene bisons were long referred almost at random to a single species, viz. *Bison priscus* (BOJANUS). Thus, Siberian, Chinese, Japanese and, above all, American bisons were sometimes recorded as the species just mentioned, notwithstanding that certain important differences from the European fossil bisons, as well as differences among themselves, were actually observed. The idea that, all, or the most of the Pleistocene bisons are referable to a single species, is typically represented by LYDEKKER's opinion, which I should like to quote here. The last-named author in pp. 61–63 of his "Wild Oxen, Sheep and Goats," 1898, states the following.

"This species (*B. priscus*) occurs typically in the Plistocene deposits of Europe, ranging from the date of the Norfolk forest-bed to the Ilford brick-earth. A series of skulls in the British Museum shows considerable variation in individual size, and also in the curvature of the horn-cores, but none of the specimens display differences apparently worthy of specific distinction. Among these specimens are a skull and a detached horn-core obtained by Captain BEECHEY from Eschscholtz Bay, Alaska, which were figured by DEAN BUCKLAND, and subsequently made the types of *B. crassicornis* by Sir J. RICHARDSON. One of these has been identified by American writers with LEIDY's *B. antiquus*, while the second has been referred to yet another species under the name of *B. alaskensis*. The British Museum has other specimens from the Plistocene deposits of the Porcupine river, Canada; and taking European and American specimens together, the whole series, in my opinion, should unquestionably be referred to a single species. Moreover, so far as I can see, the American specimens present no closer approximation to the living New World bison than do those from Europe to its relative of the Old World. It may also be pointed out that during the Plistocene period Asia and North America were almost certainly connected by way of Bering Strait, so that it would be natural to expect to find identical animals on both sides of the line of these straits. And, as a matter of fact, no one has disputed that the remains of the horse, mammoth, and musk-ox found in the northern parts of the two hemispheres are specifically identical.

"Possibly there may be sub-specific differences, but it appears to me necessary to accept the conclusion that the Plistocene bison was a circumpolar species, whose somewhat degenerate descendants developed on the two sides of the Pacific respectively into the living European and American bisons....."

The American writer, LUCAS,[1] has already expressed the opinion that two or more species might have been confounded under the name of *B. priscus* in Europe. His supposition is now proved by the separation of *B. uriformis* by HILZHEIMER[2] and of *B. schœtensacki* by FREUDENBERG[3] from the European *B. priscus*. Thus, LYDEKKER's first point of view that the European fossil bisons show individual variation in a considerable degree, is not sufficient as a reason for referring the fossil bisons of various lands to a single species.

LYDEKKER has compared the distribution of the Pleistocene bisons to that of the horse, mammoth and musk-ox as a proof of the conspecifity of the former. It is very evident that the more variable group displays the more divergency. So that we meet with many examples, in which the extent of distribution of a single species of one group corresponds to that of a number of species of another. Therefore, LYDEKKER's second point of view appears to me to be not very important. I do not consider it, by any means, to be un-scientific to say that, the Pleistocene bisons in many species, each of which had a definite geographical and geological range, were circumpolar as a whole.

HILZHEIMER[4] has maintained that the living European bison, *B. bonasus*, existed already in Pleistocene time together with *B. priscus*, the former being a forest type and the latter a steppe type. *B. schœtensacki*, lately established, appears also to be a forest type. On the other hand, the living American bison, *B. bison*, is also recorded from Pleistocene. Therefore, LYDEKKER's opinion that somewhat degenerate descendants of the Pleistocene bison, as a single species, as he believes, developed into the living European and American bisons, appears not to hold true. It may be trustworthy to say that the bison-group displayed a considerable divergency so as to form several evolutionary phyla already in Older Pleistocene, thus giving rise to many species, the majority of which are extinct, while a few have survived into the present time. I think the relation of *B. priscus* to *B. schœtensacki* may be parallel to that of *B. crassicornis* to *B. occidentalis* and the relation of *B. bonasus* to *B. schœtensaki*, to that of *B. bison* to *B. occidentalis*.

LYDEKKER has expressed the possibility that there may be subspecific differences among the Pleistocene bisons, though he did not dare to subdivide them. In my opinion it is not a problem of primary importance to discuss whether certain differences are worthy to be considered specific or sub-specific distinctions, but it is important to distinguish various forms—either species or subspecies—according to the differences actually present and make out their inrerrelationships as clearly as possible. From this point of view, it has been of great interest to me to see the attempts to subdivide the Pleistocene bisons of the Old World, as exemplified by HILZHEIMER and FREUDENBERG.

As to the Eastern Asiatic bisons, the Japanese bison has been referred to *B. priscus* by BRAUNS,[5] the Chinese, to the same by V. LÓCZY[6] and SCHLOSSER[7] and the Siberian to the same by many earlier writers of Europe. We do not yet have a fixed type for *B. priscus*. But, if we follow certain later writers of Europe—HILZHEIMER and FREUDENBERG—as to the form of *B. priscus*, then we may see that the majority—probably all—of the Eastern Asiatic bisons are not referred to this species.

The occurrence of *B. crassicornis* in Eastern Siberia has been suggested by LUCAS[8] and HAY,[9] and

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1) Proc. U. S. Nat. Mus., XX., No. 1172, 1899, p. 764.
2) Sitzungsber. Ges. Naturf. Frende, Berlin, 1910, p. 138, figs. 3 & 4.
3) Geol. U. Pal. Abh. N. F., XII., Hft. 4/5, 1914, pp. 82(534)-96(548), text-fig. 46, Pl. III(XXXI)., fig. 6, Pl. IV(XXXII)., figs. 2-8, Pl. V(XXXIII)., figs. 1-3, Pl. VI(XXXIV)., figs. 9 & 10.
4) Mstteil. K. Naturalienkabinett, Stuttgart, No. 66, 1909, p. 257.
5) Zeitschr. Deut. Geol. Ges., XXXV., 1883, p. 49, Pl. 1., fig. 5.
6) Wissenschaftliche Ergebn. d. Reise d. Grafen BÉLA SZÉCHENYI in Ostasien, Bd. III., Abteil. 6, 1899, p. 12, text-figs. 1-3.
7) Abh. K. Bayer. Akad. Wiss., II. Cl., Bd. XXII., 1903, p. 159.
8) Loc. cit., p. 761.
9) Proc. U. S. Nat. Mus., XLVI., No. 2021, 1913, pp. 179 & 181, Pl. XV., figs. 1 & 2.

that of *B. occidentalis* by the last named author.[1] Again, HILZHEIMER has established *B. primitivus*[2] and *B. bonasus lenensis*[3] based on certain Eastern Siberian specimens. Finally, I[4] have expressed my disbelief in the occurrence of *B. priscus* in Eastern Asia and recorded *B. exiguus* from China.

The bisons actually described in this paper are the Japanese and the Eastern Siberian, besides the wild yak from the loess of Mongolia, while the Chinese bison has been reviewed within the limit of the records of "*B. priscus*." As a result of the present study, the nomenclature accepted in this paper is as follows.

The Japanese bison is referred to *B. occidentalis*.

One of the Eastern Siberian bisons is also *B. occidentalis*, and another which corresponds to HILZHEIMER's *B. primitivus* is *B. crassicornis*.

V. LOCZY's "*B. priscus*" from China is not a genuine bison at all, but may be either the wild yak or a *Bibos*—probably the former. Then, *B. exiguus* is the only bison named from China.

The yak from the loess of Mongolia is referred to the living wild race, *Poëphagus grunniens mutus*.

Bison occidentalis, LUCAS.

Pl. XXIV., figs. 1–4; Pl. XXV., figs. 1–3; Pl. XXVI., figs. 1 & 2;
Pl. XXVII., figs. 1–3; Pl. XXVIII., figs. 1 & 2.

PALLAS, Nova Comment. Acad. Petropol., XIII., 1769, p. 462, Pl. XI., figs. 1 & 2; CUVIER, Rech. Oss. Foss., 4. Edit., Pt. VI., 1836, p. 220, Pl. CLXXXIII., figs. 4 & 5.

Bison priscus (pars): RICHARDSON, Zool. Voy. Herald, 1859, p. 34, Pl. VII., fig. 1; BRAUNS, Zeitschr. Deut. Geol. Ges., XXXV., 1883, p. 49, Pl. I., fig. 5; TSCHERSKI, Mèm. Acad. Imp. Sci. St. Petersb., Ser. 7, XL., 1893, p. 76; DYDEKKER, Wild Oxen, Sheep and Goats of All Lands, 1898, p. 61.

Bison antiquus (non LEYDY): STEWART, Kansas Univ. Quart., VI., 1897, p. 127, Pl. XVII.

Bison occidentalis: LUCAS, Science, 1898, p. 678; LUCAS, Kansas Univ. Quart., VIII., 1899, p. 17; LUCAS, Proc. U. S. Nat. Mus., XXI., 1899, p. 758, Pls. LXV. & LXVI.; HAY, Proc. U. S. Nat. Mus., XLVI., 1913, p. 167, Pl. VIII., fig. 3, Pl. IX., figs. 3 & 4, Pls. X.–XIII.

Bison crassicornis (pars): LUCAS, Proc. U. S. Nat. Mus., XXI., 1899, p. 760, Pl. LXXVI.

Two imperfect skulls of fossil bisons from the Inland Sea near Shôzu-shima, Prov. of Sanuki, are preserved in the Geological Institute of Tôkyô Imperial University, and another imperfect skull and one broken horn-core from the same locality in Konkai-Kômyôji Temple at Kurotani, Kyôto. The former have been submitted to me by Prof. YOKOYAMA and the latter by Nen-yo Karaki Esq.; and my hearty thanks are due to both gentlemen. I am convinced that all these Japanese specimens are referred to the present pecies, notwithstanding one of them has been identified by BRAUNS to *B. priscus*. Besides, there is another, isolated horn-care from Transbaikalia, Siberia, at hand, which is, in my opinion, also to be referred to the present species.

The present species has been well diagnosed and described by LUCAS and HAY. Based upon the statements of these two author's and my own observations, it may be re-diagnosed as follows.

Fore-head flat (except in PALLAS's specimen from Siberia and HAY's, shown in his figs. 1 & 2, Pl. X., from Alaska); *parietale* large and triangular. Occiput nearly vertical, not inclined backwards. Horn-cores short and stout, the percentage of the length along upper curve to the distance between bases of horn-

1) Loc. cit., p. 177, Pl. VIII., fig. 3.
2) Loc. cit., 1909, p. 254, Pl. VII., figs. 6 & 6a; loc. cit., 1910, p. 142.
3) Loc. cit., 1910, p. 144, figs. 8 & 9.
4) This volume, pp. 32–34, Pl. XII., fig. 10, Pl. XIII., figs. 4–8.

cores being 76–113 and that of the same to the circumference at base 78–111; subtriangular in cross section, not very flattened vertically, the transverse diameter at base exceeding the vertical very slightly; feebly and regularly curved, the index of curvature, viz., the percentage of the length along the lower curve to the distance between base and tip on the upper side, being 120–150; decidedly flared backwards, not at all or only slightly dipped downwards (except in PALLAS's specimen and mine from Siberia and HAY's, shown in his figs. 1 & 2, Pl. X., from Alaska); anterior lower surface much narrower than posterior lower (as far as my specimens are concerned).

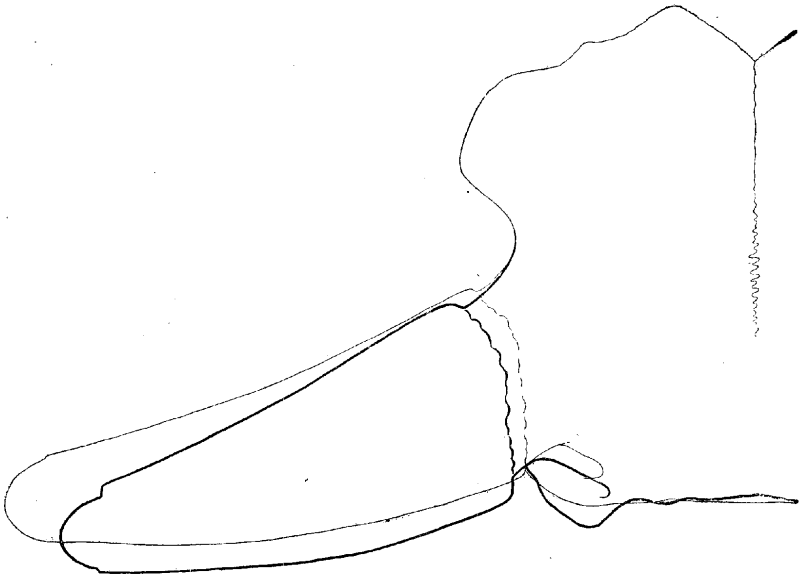

Fig. 1. Skulls of the Japanese and Siberian bisons, viewed from above. The heavy line distinguishes *Bison occidentalis* and the light line *Bison crassicornis*. $\times\frac{1}{4}$.

One of the specimens belonging to the Geological Institute of Tôkyô Imperial University, which was once described by BRAUNS, represents the greater posterior part of the skull. The fore-head is nearly flat, without any prominent convexity, but with a distinct depression, the centre of which corresponds to the junction of the trio of the *frontalia* and *parietale*. Judging from the position of this depression, the *parietale* is very probably large and triangular, with the apex extending so anteriorly as to reach the frontal plane which passes the middle of the bases of the horn-cores. The axis of the hore-core forms an obtuse angle with that of the pedicle; but this tendency is not so strongly marked as in the skull of *B. crassicornis* at hand. The occiput is nearly vertical, not inclined backwards, so that it is partly visible in frontal view. The concavity of the occiput at the part between its upper border and the upper side of *foramen magnum* is distinctly less than in the skull of *B. crassicornis* at hand. The *basi-occipitale* is wider and its median groove less prominent than in this same skull. These and the additional characteristics of the occiput and *basi-occipitale* of the present species are farther discussed in the two following specimens.

The horn-cores of this skull are strongly flared backwards, so that their posterior sides touch the plane which passes the edges of the occiput at about 50mm. outside their bases; not dipped downwards, so that the lowest part of their upper side is only about 15mm. below the horizontal plane tangential to the frontal surface; short and very stout, the percentage of their length along upper curve to the distance

between their bases being about 112 and that of the same to their circumference at base about 99 (right) and 95 (left); subtriangular in cross section, with much rounded angles and convex sides; not very flattened vertically, so that the horizontal diameter exceeds the vertical very slightly; feebly and regularly curved, the index of curvature, viz., the percentage of their length along lower curve to the distance between their base and tip on upper side being about 120, so that their tips are not directed strictly upwards but obliquely upwards and outwards. The upper surface is nearly smooth, while the anterior lower and posterior lower surfaces are very conspicuously grooved longitudinally. The posterior lower surface is the widest and the anterior lower the narrowest.

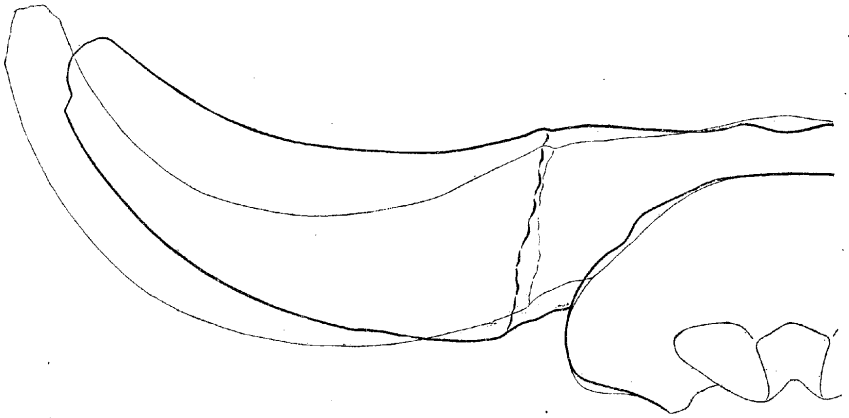

Fig. 2. Skulls of the Japanese and Siberian bisons, viewed from behind. The heavy line distinguishes *Bison occidentalis* and the light line *Bison crassicornis*. $\times \frac{1}{4}$.

The other specimen belonging to the Geological Institute of Tôkyô Imperial University represents the posterior part of the skull bearing only the left horn-core. The fore-head is nearly flat, but slightly less so than in the preceding skull. There is present also a distinct depression at the junction of the trio of the *frontalia* and *parietale*; it is wider and better marked than in the preceding skull. The *parietale* is large and triangular. The axis of horn-core forms an obtuse angle with that of the pedicle. The occiput is nearly vertical, so that it, as well as the occipital condyles, is partly visible in frontal view. The concavity of the occiput at the part between its upper border and the upper side of *foramen magnum* is also very feeble. The upward divergency of the two occipital condyles is very strong, so that the upper sides of the two condyles do not form an open angle upwards, but lie in a feeble curve which closes downwads; the straight line tangential to the upper sides of the two condyles cuts the *foramen magnum*, instead of lying entirely above it. Judging from the left condyle which is completely represented in this skull, the backward projection of the condyles is evidently very strong, so that the common curve formed by the posterior sides of the two condyles is much stronger than that formed by the antererior sides in lower view. The *basi-occipitale* is almost similar to that of the preceding skull, being comparatively wide and provided with a comparatively feeble median groove. All the characteristics of the occiput and *basi-occipitale* just mentioned are very distinctive in contrast to those of the skull of *B. crassicornis* at hand.

The left horn-core which is represented in this skull is flared backwards, but less strongly so than in the preceding skull, so that its posterior side hardly touches the plane which passes the edges of the occiput; not dipped downwards, quite as in the preceding skull, so that the lowest part of its upper side

is only about 15 mm. below the plane tangential to the frontal surface; short but not so stout as in the preceding skull, the percentage of its length along the upper curve to the estimated distance between the bases of the two horn-cores being about 103 and that of the same to its circumference at base about 109; subtriangular in cross section, with much rounded angles and convex sides; not very flattened vertically, so that the horizontal diameter exceeds the vertical very slightly, as in the preceding skull; feebly, but slightly more, curved than in the preceding skull, the index of curvature being about 131; its tip also is not directed strictly upwards, but obliquely upwards and outwards. The anterior lower and posterior lower surfaces are also very conspicuously grooved longitudinally; the former is also distinctly narrower than the latter, though not the latter, but the upper surface, is the widest.

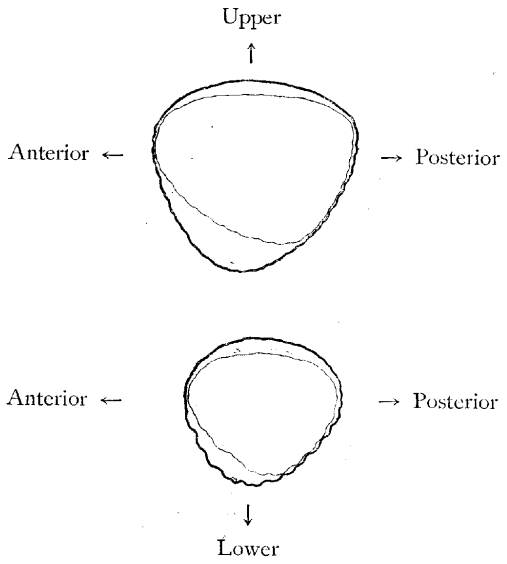

Fig. 3. Horn-cores of the Japanese and Siberian bisons. Transverse section at the base (upper figure) and at about the middle (lower figure). The heavy line distinguishes *Bison occidentalis* and the light line *Bison crassicornis*. $\times \frac{1}{4}$.

The skull belonging to Konkai-Kômyôji Temple reprensents only its posterior part, the horn-cores being entirely broken off. The fore-head is flat. The depression at the junction of the trio of the *frontalia* and *parietale* is narrower than in the two skulls just described, but is very well marked. The *pariatale* is fairly triangular, but is not so large as in the second specimen. The occiput and *basi-occipitale* are very complete and are almost similar to those of the two preceding skulls within the limit of the parts present in the latter. The occiput is almost vertical, not inclined backwards, so that it, as well as the occipital condyles, is partly visible in the frontal view. The concavity of the occiput at the part between its upper border and the upper side of the *foramen magnum* is also very feeble. In the posterior view, the upward divergency of the two occipital condyles is very strong, so that the upper sides of the two condyles do not form an open angle upwards, but lie almost in a feeble curve which closes downwards. The straight line tangential to the upper sides of the two condyles nearly touches the upper side of the *foramen magnum*. The condyles project backwards very strongly, so that the common curve formed by their posterior sides is distinctly much stronger than that formed by their anterior sides in the lower view. The *basi-occipitale* is also wide and provided with a feeble median groove. The anterior pair of the protuberance of the *basi-occipitale* are also more widely separated from each other than in the skull of *B. crassicornis* at hand. The dimensions of *basi-occipitale* of this and the next species are as follows.

	B. occidentalis			*B. crassicornis*
Length from the lower border of *foramen magnum* to the anterior sides of anterior protuberances	—	89 mm.	95 mm.	96 mm.
Ditto from the posterior sides of posterior protuberances to the same	ca. 80 mm.	78 „	82 „	80 „
Maximum width	ca. 75 „	77 „	72 „	64 „
Width at the middle of posterior protuberances	48 „	47 „	49 „	45 „
Ditto at the middle of anterior protuberances	32 „	33 „	32 „	27 „
Depth of median groove from the level of tips of posterior protuberances	—	7 „	7 „	10 „
Ditto of the same from the level of tips of anterior protuberances	—	8 „	7 „	10 „

The isolated horn-core belonging to Konkai-Kômyôji Temple represents only the distal part, being broken at about 250 mm. from the tip. It is rather slender, like the horn-core of the second skull, and also curves very feebly. The transverse section is subtriangular, with much rounded angles. The vertical diameter at the broken part slightly exceeds the transverse. The surfaces are evidently very strongly water-worn; the upper surface is provided with a few irregular longitudinal grooves, while the anterior lower and posterior lower surfaces are nearly smooth, as a result of secondary wearing.

The isolated horn-core from Transkaibalia belongs to the left side. Judging from the relative direction of its axis to the parts of *frontale*, an orbit and a temporal fossa present fragmentarily in this specimen, it is evidently flared backwards and dipped downwards, quite as in PALLAS's specimen from Siberia and HAY's, shown in his figs. 1 & 2, Pl. X., from Alaska, as well as in *B. crassicornis*. The outer half of the pedicle is strongly rugged, as observed by HILZHEIMER in his type-specimen of *B. primitivus*. The axis of the horn-core forms an obtuse angle with that of the pedicle. The horn-core is short and very stout, the percentage of its length along the upper curve to its circumference at base being about 109; subtriangular in cross section, with the much rounded anterior and lower angles and the moderately rounded posterior angle; moderately flattened vertically, but not so strongly so as in the skull of *B. crassicornis* at hand, so that the horizontal diameter at base distinctly exceeds the vertical; more or less strongly curved, the index of curvature being about 137, so that its tip is directed nearly upwards. The upper surface is smooth, while the anterior lower and posterior lower surfaces are conspicuously grooved longitudinally. The anterior lower surface is distinctly narrower than the posterior lower, though not the latter but the upper surface is the widest.

The skulls and horn-cores measure as follows.

	Shôzu-shima, Japan				Transbaikalia, Siberia
Width at the posterior sides of orbits	—	2×160mm. =320 „	—	—	—
Ditto at the contraction just behind the orbits	2×150mm. =300 „	2×140 „ =280 „	—	—	—
Width of the occiput at the auditory openings	2×140 „ =300 „	2×135 „ =270 „	280mm.	—	—
Ditto between the two temporal fossæ	200 „	162 „	193 „	—	—
Distance between the bases of horn-cores	2×170 „ =340 „	2×175 „ =350 „	—	—	—
Height of the occiput above the lower side of *foramen magnum*	150 „	150 „	165 „	—	—
Ditto above the upper side of the same	100 „	100 „	115 „	—	—
Distance between the tips of horn-cores	915 „+a (1010 „ ±)	980 „+a (1030 „ ±)	—	—	—
Circumference of the horn-cores at base	R. 383 „ L. 392 „	330 „	—	232mm. (at the broken part	330mm.
Transverse diameter of the same at base	R. 120 „ L. 123 „	105 „	—	70 „ (ditto)	108 „
Vertical diameter of the same at base	R. 108 „ L. 115 „	100 „	—	73 „ (ditto)	90 „
Length of the same along upper curve	R. 300 „+a L. 310 „+a (380 „ ±)	320 „+a (360 „ ±)	—	255 „+a	320 „+a (360 „ ±)
Ditto along lower curve	R. 330 „+a L. 350 „+a (420 „ ±)	385 „+a (440 „ ±)	—	280 „+a	378 „+a (425 „ ±)
Straight extent of the horn-cores from the upper side of base to the tip	R. 290 „+a L. 305 „+a (350 „ ±)	315 „+a (335 „ ±)	—	245 „ (from the upper side of broken part)	305 „+a (310 „ ±)

All these measurements do not essentially differ from those of the North American representatives of the present species. Following HAY, the index of the horn-cores of the latter correspondents to 122–150. This value is very near to the 120–137 obtained in the Japanese and Siberian specimens at hand. Again from HAY's measurements, the percentage of the length along the upper curve to the distance between the bases of the horn-cores is calculated to be 76–113, and that of the same to the circumference at the base of the horn-cores to be 78–111. These values wholley include those obtained in the Japanese and Siberian specimens at hand, which correspond to 103–112 and 95–109 respectively.

PALLAS's specimen from one of the tributaries of the Yenisei River, Siberia, is somewhat atypical in the very convex fore-head and in the downwardly dipped horn-cores. I, as well as HAY, believe that these two characteristics are correlated to each other. The horn-core from Siberia at hand also dips downwards. And I do not doubt that PALLAS's specimen and mine are very near to each other morphologically. HAY's specimen, shown in his figs. 1 & 2, Pl. X., from Alaska is also characterized by the

convex fore-head and the downwardly dipped horn-cores, though in a less degree. These three specimens may, in may opinion, represent a variant of the present species, more or less approaching to *B. crassicornis* in the two characteristics just mentioned.

The present species much resembles both *B. antiquus* of the North American Mid-Pleistocene and *B. schœtensacki* of the European Older Pleistocene, but differs from them (if the last-named species be specially different from the present species at all) in its horn-cores decidedly flared backwards. Further, the present species differs from *B. sivalensis* of the Indian Uppermost Pliocene in its larger size, in the relatively wider and lower occiput (see p. 98) and in the less compressed horn-cores.

Geographical and geological distribution of B. occidentalis.

This species has hitherto been recorded from the Yukon Territory and Point Barrow, Alaska; from Kansas and the Ohio River, U.S.A.; and from one of the tributaries of the Yenesei River, Siberia. In Kansas, it is stated to belong to one of the later phases of the *Equus*-zone (Older Pleistocene). In Alaska, it is suggested by OSBORN to belong probably to Younger Pleistncene. His suggestion may hold true also in Siberia, because there are indications there, as well as in Alaska, that the present species was comtemporaneous with *Elephas primigenius* and some other Mammals of the Arctic aud Tundra Period.

As to the specimens of the present species at hand, I am obliged to recognise the unequality of the geological ages between the representatives from Shôzu-shima, Japan, and from Transbaikalia, Siberia. The faunæ of the two localities are as follows.

Shôzu-shima:—This fossil Mammalian fauna consists, besides the present bison, chiefly of the following species.

Cervus (*Sika*) cfr. *nippon* [= *C.* (*Pseudaxis*) cfr. *sika*].[1] See pp. 46–47 of this Volume.

Stegodon orientalis. See pp. 3–7 of this Volume.

St. sinensis. See pp. 7–10 of this Volume.

Elephas namadicus. See pp. 39–41 of this Volume.

Fragments of antlers, which are almost indistinguishable from those of the Recent Japanese sika, are frequently found from this fossil locality. I have already pointed out that this sika has occurred from the Older Pleistocene of Tsukinoki and probably also of Tabata. Again, I have already referred *St. orientalis* and *St. sinensis* from Sze-chuan, China, to Younger Pliocene. On the other hand, *E. namadicus* is very probably a characteristic of Older Pleistocene. Thus the fauna of Shôzu-shima is certainly not older than Younger Pliocene and not younger than Older Pleistocene. Now, let me refer here to PILGRIM's statements[2] as to the geological duration of several representatives of *Stegodon* and *Elephas*.

1) The subgeneric and specific names have been altered by LYDEKKER: Brit. Mus., Catalogue of Ungulate Mammals, Vol. III., 1915.
2) Correlation of the Siwaliks with Mammal Horizons of Europe; Rec. Geol. Surv. India, XLIII., Pt. 4, 1913.

	Dhok Pathan (Upper Miocene)	Bhandar (Lowest Pliocene)	Tatrot (Lower Pliocene)	Pinjor (Middle to Upper Pliocene)	Boulder conglomerate (Uppermost Pliocene)	Narbada (Lower Pleistocene)
St. cliftii and *bombifrons*				(?)[1]		
St. insignis and *ganesa*						
E. planifrons						
E. hysudricus						
E. namadicus						

From this table, it is very evident, that *Elephas* is more variable and consequently a better horizon-determiner than *Stegodon*. It appears to me very probable, that *Elephas* is not strictly the last evolutionary phase of *Stegodon*, but corresponds to a lateral branch with higher potentiality which arose from a comparatively earlier stage of *Stegodon*, while the latter had lower potentiality and lasted to Pleistocene as *Stegodon*, itself essentially unaltered. Thus, *St. insignis* and *ganesa* co-existed with such a comparatively higher species of elephants as *E. namadicus*, and *St. airawana* and *trigonocephalus*, also with *E. hysudrindicus* and *namadicus*. From these considerations, I am obliged to lay more weight upon *E. namadicus* than upon the two species of *Stegodon* as to the geological determination of the fauna of Shôzu-shima. Then, the fauna in question may very probably be referred to Older Pleistocene. Thus, *Bison occidentalis* as a member of this fauna is very probably younger than *B. sivalensis*, nearly as old as *B. schœtensacki*, nearly as old as, or slightly older than *B. occidentalis* of Kansas, and older than *B. priscus*, *B. crassicornis*, *B. exiguus*, &c., as well as *B. occidentalis* of Alaska and Siberia.

Transbaikalia:—All the specimens of the collection from Transbaikalia at hand, to which the isolated horn-core of the present species above described belongs, are scarcely fossilised and bear similar matrix, which is brownish loose sand evidently of fluvial deposit. They consist, beside the present bison, of the following species.

Bison crassicornis. Pl. XXVIII., figs. 1 & 2.

Elephas cfr. *primigenius*. Pl. XXX., figs. 1 & 2.

Diceros antiquitatis. Pl. XXX., fig. 3; Pl. XXX., figs. 1–3.

The first species is desbribed in the following pages. The second is represented merely by a single vertebra approximately of the twenty-seventh. It is very large and measures 85 mm., 143 mm. and 130 mm. in the length, width and height of the centre respectively. The third is represented by one skull and one right *humerus*. The skull, lacking the palate and the very anterior parts of the *nasalia*, shows no signs of the presence of a bony narial septum, which is an important characteristic of *D. antiquitatis*. Nevertheless, that it belongs to this species but not to *Dicerorhinus mercki* is distinctly indicated by the other characteristics, of which the more important are as follows.

(1) This skull is distinctly larger than that of *D. mercki*, but coincides in size with that of *D. antiquitatis* to a certain degree of juvenility. Its dimensions are as follows.

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1) PILGRIM did not mention the species of the Stegodonts of the Pinjor horizon, so that it is not clear to us whether to *St. cliftii* and *bombifrons* or to *St. insignis* and *ganesa* the Stegodonts of that horizon belong, though in many respects the fauna of that horizon appears to me, as judged from PILGRIM's statements, to resemble more closely that of the Tatrot horizon than to that of the boulder conglomerate.

Straight length from the anterior border of the broken *nasalia* to the occipital crest...	750mm.
Ditto from the posterior border of the narial sinus to the same (lateral)	605 „
Ditto from the anterior border of the orbits to the same (lateral)...	435 „
Width of the *nasalia*	160 „
Ditto of the *frontalia*	240 „
Maximum width of the skull at the zygomatic arches	350 „
Width of the parietal surface at the narrowest part between the temporal fossæ ...	110 „
Ditto of the occiput at the crest	180 „
Maximum width of the occiput at the *periotica*...	280 „
Height of the occiput along the median line, including the *foramen magnum*	250 „
Distance between the outer ends of the occipital condyles	150 „

(2) The bases of the anterior and posterior horns are not well separated from each other, but connected with each other by a rough median ridge. This is a characteristic of *D. antiquitatis* but not of *D. mercki.*

(3) The distance from the narial sinus to the orbit is characteristically great, being much greater than in *D. mercki.*

(4) The zygomatic arches are slender in lateral view.

(5) The occiput is much inclined backwards, so that the occipital condyles are invisible in the upper view, being anterior in position to the occipital crest.

From these characteristics, I am satisfied in referring the skull at hand to *D. antiquitatis*, notwithstanding the fact that a bony narial septum is not proved to be present in it. WÜST[1] has recorded a skull of a young animal of *D. antiquitatis*, in which a bony narial septum is not well-developed. Indeed, the skull at hand appears to greatly resemble WÜST's specimen in every respect. The *humerus* at hand measures 410mm. in length, 160mm. in the width at the lower end and 120mm. in the width of the *trochlea.* It especially much resembles the *humerus* illustrated by CUVIER in his figs. 1 & 2, Pl. XLVI. (Recherches sur les Ossemens Fossiles).

Though the specific determination of *Elephas primigenius* by the single vertebra might be very insufficient, that of *Diceros antiquitatis* by the skull and the *humerus* is evidently reliable. And the latter determination increases in turn the probability of the former. Therefore it is very probable, that *B. occidentalis* as a member of the fauna of Transbaikalia belongs to Younger Pleistocene.

To summarise, we see the present bison ranging from Older to Younger Pleistocene in both the Old and the New World.

Bison crassicornis RICHARDSON.

Pl. XX., figs. 1 & 2; Pl. XXIX., figs. 1–3.

Bison crassicornis: RICHARDSON, Zool. Voy. Herald, 1852–1854, p. 40, Pl. IX., Pl. XI., fig. 6, Pl. XII., figs. 1–4, Pl. XIII., figs. 1 & 2, Pl. XV., figs. 1–4; LEIDY, Proc. Acad. Nat. Sci., Philadelphia, 1854, p. 210; LUCAS, Proc. U. S. Nat. Mus., XXI., 1899, p. 760, Pls. LXXIII–LXXV.; HAY, Proc. U. S. Nat. Mus., XLIX., 1913, p. 179, Pl. XIV., figs. 1–5, Pl. XV., figs. 1 & 2.

Bison alaskensis: RHOADS, Proc. Acad. Nat. Sci., Philadelphia, 1897, p. 490.

Bison primitivus: HILZHEIMER, Mitteil. K. Naturalienkabinett, Stuttgart, No. 66, 1909, p. 254, Pl. VII., figs. 6 & 6a; HILZHEIMER, Sitzungsber. Ges. Naturf. Freunde, Berlin, 1910, p. 142.

Bison occidentalis (pars): HAY, loc. cit. p. 177.

In our institute, the present species is represented by one incomplete skull from the districts of the

1) Zwei bemerkenswerte Rhinoceros-Schädel aus dem Plistozän Thüringens; Palæontogr., LVIII., 1911, p. 135, Pl. X., figs. 1–3.

Lena River and one isolated horn-core from Transbaikalia. These specimens appear to me to belong evidently to *B. primitivus* of HILZHEIMER. I quite agree with HILZHEIMER in regarding *B. primitivus* to be distinct from *B. priscus*. HILZHEIMER has compared his species with *B. priscus*, *B. bonasus*, *B. caucasius* and *B. bison*, but not with *B. occidentalis* or *B. crassicornis*. HAY has referred HILZHEIMER's species to *B. occidentalis*. But my opinion is that *B. primitivus* is district from *B. occidentalis* but identical with *B. crassicornis*.

B. crassicornis has been well diagnosed and described by LUCAS and HAY. Based upon these author's as well as HILZHEIMER's statements and my own observation, it may be re-diagnosed as follows.

Fore-head very convex; *parietale* large and triangular. Occiput inclined backwards. Horn-cores long, stout, the percentage of the length along upper curve to the distance between bases of horn-cores being 124–140 (170 only in TSCHERSKI's specimen referred to the present species by HAY) and that of the same to the circumference at base 120–140; triangular in cross section, flattened vertically, the transverse diameter much exceeding the vertical; feebly and regularly curved, the index of curvature, viz., the percentage of the length along the lower curve to the distance between base and tip on the upper side being 119 (TSCHERSKI)–142 (HILZHEIMER's second specimen); decidedly flared backwards and dipped downwards; anterior lower surface much wider than posterior lower (as far as my specimens are concerned).

From HAY's measurements, the percentage of the length of the horn-core along the upper curve to the distance between the bases of the horn-cores is calculated to be 124–140 in four Alaskan specimens and 170 in TSCHERSKI's specimen. In the skull at hand this percentage corresponds to 138 (left) and 139 (right). Again from HAY's measurements, the percentage of the length of the horn-core along the upper curve to the circumference at base is calculated to be 121-140. This percentage is calculated to be 126 in HILZHEIMER's first and second specimens, and 120–130 in my specimens. The index of curvature is stated to be 125 in some of HAY's specimens and 119 in TSCHERSKI's. This index is calculated to be 142 in HILZHEIMER's second specimen (i.e. LA BAUME's specimen from Vologda) and 120–136 in my specimens. *B. occidentalis* and *B. crassicornis* overlap each other in the index of curvature of horn-cores, but not in the percentage of the length along the upper curve to the distance between the bases of the horn-cores and in the percentage of the same to the circumference at base. By the way, it may be recognised that some of the Siberian representatives of *B. crassicornis* (HILZHEIMER's and my specimens) have relatively shorter and more strongly curved horn-cores and the other (TSCHERSKI's specimen) relatively longer and less curved horn-cores than the Alaskan representatives.

The skull at hand belongs no doubt to an adult animal, as may be judged from the not very distinct sutures. The frontal region is markedly convex; the centre of the convexity nearly corresponds to the midway from the posterior end of the *nasalia* to the occiput. Just behind the convexity, there is present a well marked depression, the centre of which corresponds to the junction of the trio of the *frontalia* and *parietale*. The *parietale* is comparatively large and triangular, extending so anteriorly as to reach the middle of the bases of the horn-cores. The axis of the horn-core forms a certain angle with that of the pedicle, so as to introduce a tendency of the backward flare and downward dip of the horn-core. The outer half of the pedicle is rough, but possibly not so much so as in HILZHEIMER's type. Such a structure may not be very important, because it probably varies, primarily, according to the age of the animal and, secondarily, according to the degree of wearing of the specimen.

The occiput is inclined backwards, so that it as well as the occipital condyles is not seen in frontal view. It is very strongly concave at the part between its upper border and the upper side of the *foramen magnum*. In posterior view, the upward divergency of the two occipital condyles is comparatively (as compared with that of *B. occidentalis*) slight, so that the upper sides of the two condyles form an open angle upwards and the common curve formed by the lower sides of the same is comparatively very strong; the straight line tangential to the upper sides of the two condyles lies much above the upper side of the *foramen magnum*. In lower view, the anterior sides of the occipital condyles are distinctly concave,

so as to form continuous curves with the lateral borders of the *basi-occipitale*. The four protuberances of the *baci-occipitale* are very prominent and rather closely set in pairs, so that the median groove is also very conspicuous and narrow.

The horn-cores of this skull are decidedly flared backwards and dipped downwards, so that their posterior sides touch the plane formed by the edges of the occiput at about 50 mm. outside their bases, and their upper sides are at the lowest parts about 55 mm. lower than the horizontal plane tangential to the frontal surface; long and stout, the percentage of their length along the upper curve to the distance between their bases being about 138 (left) and 139 (right) and that of the same to the circumference at base about 120 (left) and 126 (right); triangular in cross section, with rounded angles and convex sides, of which the upper is the largest and the least convex; flattened vertically at their bases, so that their transverse diameter at base much exceeds the vertical; feebly and regularly curved, the index of curvature being about 136, so that their tips are not directed perfectly upwards but upwards and slightly outwards. The upper surface is nearly smooth, while the anterior lower and posterior lower surfaces are very conspicuously grooved longitudinally. The posterior lower is the narrowest, being much narrower than the anterior lower.

The isolated horn-core is of the left side. It much resembles in essential features, the horn-cores of the skull just described, but is smaller and more feebly curved. The percentage of its length along the upper curve to its circumference at base is about 130, and the index of curvature about 120.

The skull and horn-cores at hand measure as follows.

	Lena River	Transbaikalia
Width at the posterior sides of orbits	375 mm.	—
Ditto at the contraction just behind the orbits	305 ,,	—
Width of the occiput at the auditory openings	290 ,,	—
Ditto between the two temporal fossæ	200 ,,	—
Distance between the bases of horn-cores	330 ,,	—
Height of the occiput above the lower side of *foramen magnum*	140 ,,	—
Ditto above the upper side of the same	100 ,,	—
Distance between the tips of horn-cores	995 ,,	—
Circumference of the horn-cores at base	R. 374 ,, L. 378 ,,	285 mm.
Transverse diameter of the same at base	R. 115 ,, L. 117 ,,	92 ,,
Vertical diameter of the same at base	R. 95 ,, L. 93 ,,	75 ,,
Length of the same along upper curve	R. 428 ,, +a (460 ,, ±) L. 396 ,, +a (455 ,, ±)	358 ,, +a (370 ,, ±)
Ditto along lower curve	R. 493 ,, +a (530 ,, ±) L. 455 ,, +a (515 ,, ±)	400 ,, +a (420 ,, ±)
Straight extent of the horn-cores from the upper side of base to the tip	R. 375 ,, +a (390 ,, ±) L. 358 ,, +a (380 ,, ±)	335 ,, +a (350 ,, ±)

Almost all measurements, except the distance between the tips of the horn-cores, of the skull at hand fall within the limits of those of the Akaskan representatives described by HAY. The distance between the tips of the horn-cores of the present skull, as well as of HILZHEIMER's type, is slightly smaller. It may be due to the fact that the horn-cores of the present skull, probably as well as of HILZHEIMER's type, are more strongly curved. The small dimensions of the isolated horn-core at hand may possibly be due to the youngness of the animal.

Geographical and geological distribution of B. crassicornis.

This species has hitherto been reported from Alaska in the New World and from the districts of the Lena River, Siberia, and from Vologda, Eastern Russia (as far as HILZHEIMER's identification of the Vologda specimen with his *B. primitivus* is correct at all), in the Old World. In Alaska, it is suggested by OSBORN to belong probably to Younger Pleistocene. There are indications also in Siberia that this species was contemporaneous with *Elephas primigenius* and *Dicoros antiquitatis*, as already stated in the Transbaikalian specimen of the preceding species. Any indication of the occurrence of the present species in Older Pleistocene is not yet known.

Records of "Bison priscus" from China.

I have already described *B. exiguus* from China. On the other hand, such an idea that *B. priscus* occurs in China appears to have prevailed among several palæontologists. Within the limit of my knowledge, the records of "*B. priscus*" from China are V. LÓCZY's[1] and SCHLOSSER's.[2] The latter reads partly as follows.

"Aus dem Löss von J'tschang erhielt Herr Dr. HABERER ein Basioccipitale eines riesigen Bovidenschädels, die distale Partie eines Radius, einen Femurcondylus und ein Cuboscaphoid, alles vielleicht dem nämlichen Individuum angehörig. ------

"Da nun *Bison priscus* BOJANUS wirklich bereits fossil in China nachgewiesen ist,—in dem Reisewerk des Grafen SZECHENYI beschreibt L. V. LÓCZY 1898 p. 12 eines Hornzapfen dieses Bison aus dem Löss von Tsing-tschou in Kansu,—so wäre es nicht ausgeschlossen, dass auch diese Knochen von J'tschang von *Bison priscus* stammen."

It is very evident that SCHLOSSER's material is too fragmental to identify the species. SCHLOSSER himself had serious doubt apparently in referring the Chinese bison to *B. priscus*, as will be judged from his statements and especially from the interrogation-mark applied to the specific name on p. 218 of his paper. Probably, he has merely followed V. LÓCZY as to the species of the bison in question. Then, a question arises: is V. LÓCZY's specific identification reliable?

V. LÓCZY's material is a broken horn-core. Judging from his description and figures, this horn-core hardly appears to me to belong to a genuine bison. Assuming that V. LÓCZY was correct in the orientation of this horn-core, its more important characteristics may be as follows.

(1) The transverse section is irregularly elliptical, instead of being subcircular or subtriangular.

(2) The transverse diameter is much smaller than the vertical, instead of being the opposite.

(3) The upper surface is not smooth but grooved longitudinally, and the lower and posterior surfaces are not grooved but smooth.

(4) The tip directs upwards, outwards and slightly forwards, but not backwards.

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1) Loc. cit.

2) Loc. cit.

The horn-core with these characteristics evidently much more resembles that of *Bibos* than that of *Bison*. I remember here the fact that the horn-core described as *Bison sivalensis* by MARTINS has been correctly referred to *Bibos* by STREMME; and I fear that V. LÓCZY might have been mistaken in the same way.

Further, we may next assume that, V. LÓCZY's orientation of this horn-core was not correct in some ways. Then the horn-core may resemble that of the wild yak, *Poëphagus grunniens mutus*. In my opinion, it is more probable that V. LÓCZY's material ought to be referred to either *Bibos* or *Poëphagus* rather than to *Bison*.

In short, the idea that *Bison priscus* occurs in China is thoroughly groundless, being based upon very imperfectly stated records. Then, *B. exiguus* is the only bison named in China for the present.

Poëphagus grunniens mutus (PRZEWALSKI).

Pl. XXXII., figs. 1–3.

Poëphagus mutus: PRZEWALSKI, Reis. in Tibet, 1884, p. 72; PRZEWALSKI, Cat. Zool. Coll., 1887, p. 13.

Bos grunniens ferus: LECHE, SVEN HEDIN's Sci. Res. of a Journ. in Central Asia, Vol. VI., Pt. 1, Stockholm, 1904, p. 12, text-figs. 8–11, 13 & 15, Pl. III.

Bos (*Poëphagus*) *grunniens mutus*: LYDEKKER, Brit. Mus., Cat. Ungulate Mamm., I., 1913, p. 33, text-fig. 14.

The specimen to be described here is a broken skull from the lœss of Mongolia. It beings to Mr. K. IGUCHI of the College of Agriculture at Sapporo. The possessor and I in co-operation have just prepared another report on this skull to be published in another journal.

The wild yak in comparison with the Eastern Asiatic genuine bisons may be diagnosed as follows.

Dolicocephalic. Fore-head comparatively narrow, slightly convex. Greater part of *parietale* lying on the posterior surface of skull. Pedicles of horn-cores corresponding to the posterior outer corners of *frontalia*. Occiput inclined backwards. Horn-cores long, stout, the length along upper curve exceeding both the distance between their bases and their circumference at base; oval in cross section, with a distinct keel along the posterior lower side; flattened vertically, the transverse diameter at base much exceeding the vertical; feebly and regularly curved, decidedly flared backwards, not at all or very little dipped downwards.

The present skull is much worn. The fore-head is rather flattened; in the region corresponding to the contraction just behind the orbits, there is observed a median longituninal convexity, which is bordered by a concavity on either side; both the convexity and the concavities are feeble. The median convexity just mentioned ends posteriorly in a boss-like protuberance just above the occiput, the presence of which is characteristic of yaks. The pedicles of the horn-cores correspond to the posterior outer corners of the *frontalia*, instead of situating more anteriorly, also as characteristic of yaks in contrast to bisons. The occipital region, consisting of the occiput proper and the most part of the *parietale*, is shaped like an inversed V, the summit of which corresponds to the boss-like protuberance already mentioned, as characteristic of yaks. It is much inclined backwards, so that the occiput proper and the occipital condyles are not seen in upper view. The occiput proper as well as the occipital region is comparatively higher and narrower than that of most bisons except *B. sivalensis*. The relative width and height of the occiput proper of some representatives of bisons, yaks and *Bibos* at hand, in comparison with those of *B. sivalensis*, are tabulated as follows.

	Bison crassicornis	*Bison occidentalis*			*Poëphagus grunniens mutus*	Domesticated hybrid yak	*Bison sivalensis* (LYDEKKER)[1]	*Bibos banteng*
I. Maximum width	290mm.	300mm.	270mm.	280mm.	250mm.	160mm.	6.8inches	250mm.
II. Distance between the posterior ends of the two temporal fossæ	200 „	200 „	162 „	193 „	165 „	90 „	4.0 „	113 „
III. Height	140 „	150 „	150 „	165 „	160 „	105 „	4.8 „	135 „
IV. Lateral extension of the two occipital condyles	145 „	—	2×75 „ =150 „	152 „	138 „	78 „	3.9 „	100 „
Percentage I/II.	145	150	167	145	152	178	170	221
„ I/III.	207	200	180	170	156	152	121	188
„ I/IV.	200	—	180	184	181	205	174	250
„ II/III.	143	133	108	117	103	86	83	84

As far as this table is concerned, the wild yak stands structurally between *B. sivalensis* and *B. occidentalis*. This fact may throw a light on the problem of the descent of yaks. In the occiput proper, there is a very conspicuous depression just below the boss-like protuberance already mentioned; and a distinct protuberance is present in the lower part of this depression. In posterior view, the upward divergency of the two occipital condyles is not so strong as to approach a straight angle, so that the upper sides of the two condyles form together an obtuse angle upwards; the straight line tangential to the upper sides of the two condyles lies distinctly above the upper side of the *foramen magnum*. In lower view, the common curve formed by the posterior sides of the two condyles is much stronger than that formed by the anterior sides of the same. The *basi-occipitale* is very wide and rapidly tapers forwards. On the lower surface of the *basi-occipitale*, there are present two pairs of protuberances and one median longitudinal groove; the anterior pair of protuberances is more prominent than the posterior; a very feeble median keel is present in the median groove just mentioned, just between the anterior halves of the anterior protuberances. The relative dimensions of the occipital condyles and the *basi-occipitale* of some representatives of bisons, yaks and *Bibos* at hand are shown in the following table.

	Bison crassicornis	*Bison occidentalis*			*Poëphagus grunniens mutus*	Domesticated hybrid yak	*Bibos banteng*
I. Lateral extension of the two occipital condyles	145mm.	—	2×75mm. =150 „	152mm.	138mm.	78mm.	100mm.
II. Maximum width of the *basi-occipitale*	64 „	ca. 75mm.	77 „	72 „	86 „	50 „	72 „
III. Width of the same at the middle of anterior protuberances	45 „	48 „	47 „	49 „	50 „	25 „	32 „
Percentage I/II.	227	—	195	211	160	156	139
„ I/III.	322	—	319	310	276	312	313
„ II/III.	142	152	164	147	172	200	225

1) Palæontologia Indica, Ser. X., Vol. I., Pt. 3, 1880, pp. 35(122)–40(127), Pl. XV., Pl. XVII., fig. 1.

As far as this table is concerned, the wild yak stands on one side of *B. occidentalis* and *B. crassicornis* on the other. This fact may also throw a light on the problem of the descent of yaks. Unfortunately, the *basi-occipitale* of *B. sivalensis* is not yet known; and it is my great regret that it is impossible to prove here whether the wild yak stands structurally between *B. sivalensis* and *B. occidentales* in the relative dimensions of the occipital condyles and the *basi-occipitale*.

The horn-cores are decidedly flared backwards, so that their posterior sides lie entirely posterior to the plane formed by the edges of the occiput; they are scarcely dipped downwards, so that the lowest part of their upper side is only about 15 mm. below the plane tangential to the frontal surface; stout at the base, tapering rather rapidly; oval in cross section, with a more or less distinct anterior upper and a prominent posterior lower keel; the upper surface, which may correspond to the upper and posterior lower surfaces of the horn-core of a bison, is more convex in cross section than the lower surface, which may correspond to the anterior lower surface of the same. The upper surface has a few, and the lower numerous, very conspicuous longitudinal grooves. In the genuine bisons' specimens at hand, the grooves of this kind are confined to the anterior lower and the posterior lower surface. The horn-cores of the present specimen are much compressed at the proximal part, the transverse diameter at the base being much greater than the vertical. As the horn-cores are represented only by their proximal parts, their length is not exactly known. But it is estimated that they are certainly not shorter than the horn-core of *B. crassicornis* from Transbaikalia at hand.

The dimensions of the present skull, in comparison with those of the modern wild yak measured by LECHE, as well as with those of the domesticated hybrid yak and *Bibos* at hand, are shown in the following table.

	Poëphagus grunniens mutus		Domesticated hybrid yak	*Bibos banteng*
	Present	(LECHE)		
Length, from the anterior end of *premaxillaria* to the occipital crest	—	610 mm. 540 mm. 560 mm. 580 mm.	430 mm.	495 mm.
Width at the posterior sides of orbits	—	289 „ 262 „ 267 „ 267 „	187 „	232 „
Ditto at the contraction just behind the orbits	2 × 143 mm. = 286 „	242 „ 229 „ 212 „ 219 „	155 „	205 „
Width of the occiput at the auditory openings	250 „	239 „ 228 „ 247 „ 230 „	160 „	250 „
Distance between the bases of horns	—	190 „ 233 „ 167 „ 189 „	140 „	155 „
Ditto between the bases of horn-cores at their anterior sides	365 „	— — — —	210 „	330 „
Ditto between the same at their posterior sides	305 „	— — — —	160 „	170 „
Height of skull at the occiput, including the occipital condyles	190 „	— — — —	130 „	220 „
Ditto above the upper side of *foramen magnum*	155 „	— — — —	90 „	185 „
Height of the occiput proper	160 „	?(158 „ 146 „ 158 „ 141 „)	118 „	135 „

Distance between the tips of horns	—	730	„	400	„	355	„	315	„	580 „	515 „
Circumference of the horns at base	—	510	„	355	„	375	„	365	„	140 „	365 „
Ditto of the horn-cores at base	320 „	—		—		—		—		120 „	—
Transverse diameter of the same at base	115 „	—		—		—		—		41 „	—
Vertical diameter of the same at base	90 „	—		—		—		—		35 „	—

It is evident from this table, that the present skull exceeds that of the modern wild yak in the width of the contraction just behind the orbits, as well probably as in the distance between the bases of the horn and horn-cores. Unfortunately, it is not clear whether LECHE meant by his "grösste Höhe des Occiput" the height of the occiput proper or that of the occipital region, i.e., the whole posterior surface of the skull. If the former is the case, the present skull exceeds that of the modern wild yak only very slightly in the width and height of the occiput proper. If the latter case is meant, the present skull exceeds that of the modern wild yak very slightly in the width of the occiput proper and very much in the height of the occipital region.

As already pointed out, there is a possibility that V. LÓCZY's specimen referred by him to *Bison* cfr. *priscus* from Kan-su belongs to the wild yak. One might wonder whether the wild yak and *Bison exiguus* are identical. But, the transverse bar of the mandible of the latter is strongly bent upwards, probably indicating that it belongs to a brachycephalic type. So that its belonging to such a dolichocephalic type as *Poëphagus* appears to me improbable. Moreover, the height of the mandibular ramus at the first premolar (P_2), as well as that at the part just anterior to it, of *B. exiguus* is slightly less than in the domesticated hybrid yak at hand and, judging from LECHE's photographs, much less than in the modern wild yak.

The occurrence of the wild yak in the lœss of Mongolia may indicate that its distribution formerly extended more eastwards than it does at the present time.

Phylogeny of the Eastern Asiatic Bisontines.

We see that *B. sivalensis* of India, *B. occidentalis* of Japan and *B. crassicornis* of Siberia form together a fair series arranged geographically from south to north and geologically from Younger Pliocene to Younger Pleistocene. The upper table cited on p. 98 shows that these three, and the lower table cited on the same page shows that at least two of them (in the first species the structure in consideration is not yet known), form together a fair series structurally, also. I consider that, it is not improbable geographically, geologically and structurally that they represent a phylogenetical series.

In Europe, only a form with short horn-cores (*B. schœtensacki*) is known from Older Pleistocene, while both forms with short horn-cores (?*B. schœtensacki* or *B. bonasus*) and with long horn-cores (*B. priscus*) are known from Younger Pleistocene. In Eastern Asia also, only a form with short horn-cores (*B. occidentalis*) is known from Older Pleistocene, while both forms with short horn-cores (*B. occidentalis*) and with long horn-cores (*B. crassicornis* and *B. alleni*)[1] are recorded from Younger Pleistocene. This parallel

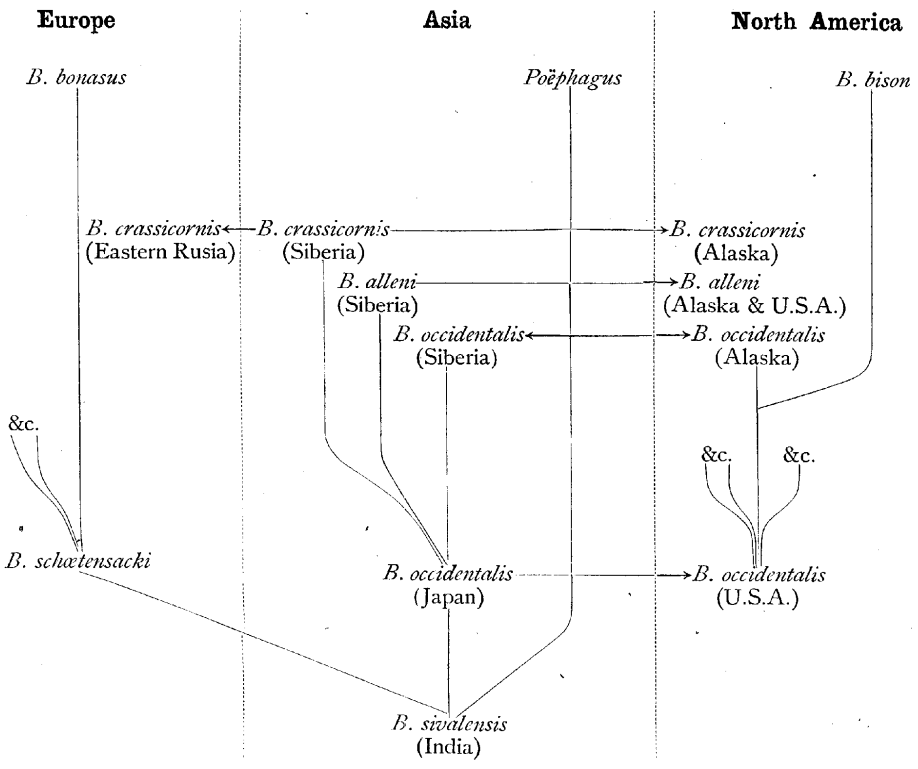
1) HAY, loc. cit., p. 192.

phenomena may indicate the probability that long-cored forms arose from short-cored ones. In North America, however, this presumed derivation of long-cored forms might have taken place earlier than in the Old World, as we see both short-cored and long-cored forms occurring in Older or Mid-Pleistocene and onwards.

All of *B. sivalensis*, *B. occidentalis*, *B. crassicornis* and *Poëphagus grunniens mutus* have backwardly flared horn-cores. So that none of them can have been derived from those forms with horn-cores not flared, such as *B. schœtensacki* and *B. antiquus*. As *B. alleni* is proved recently by HAY to occur also in Siberia, it appears to be very probable that it, as well as all the other species which occur both in Alaska and Siberia, is of Asiatic origin. *B. alleni* can be derived from *B. occidentalis* through the prolongation of horn-cores, and *B. crassicornis* from *B. alleni* through the downward dipping of horn-cores or from *B. occidentalis* through the prolongation and downward dipping of horn-cores.

The upper table cited on p. 98 shows that *Poëphagus grunniens mutus* stands structurally between *B. sivalensis* and *B. occidentalis*, and the lower table cited on the same page shows that the same stands structurally before *B. occidentalis*. Thus, it is proved, at least partially, that the wild yak is a post-*sivalensis* and pre-*occidentalis* Bisontine. I agree perfectly with LYDEKKER's opinion[1] that the yak is a direct descendant of *B. sivalensis*.

In my opinion, the descent and migration of the Bisontines, especially of those of Eastern Asia, may be shown diagrammatically as follows.



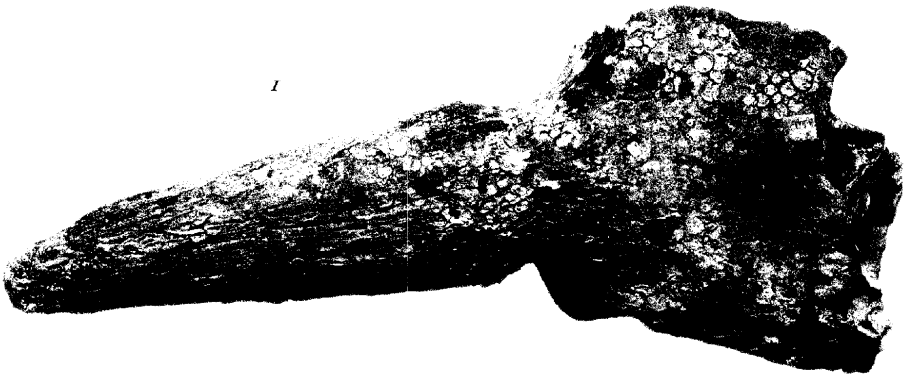
As *B. exiguus* is very imperfectly known, its interrelationships to the other Bisontines are yet to be made clear in future.

1) Loc. cit., p. 40 (127); Wild Oxen, Sheep and Goats of All Lands, 1898, pp. 56, 60 & 61.

Explanation of the Plates.

Pl. XXIV., fig. 1. *Bison occidentalis.* Skull from the Inland Sea, viewed from above. ×$\frac{1}{4}$.
,, fig. 2. Ditto, viewed from behind. ×$\frac{1}{4}$.
,, fig. 3. Right horn-core of the same skull, viewed from above. ×$\frac{1}{3}$.
,, fig. 4. Ditto, viewed from behind. ×$\frac{1}{3}$.
Pl. XXV., fig. 1. *Bison occidentalis.* Skull from the Inland Sea, viewed from above. ×$\frac{1}{4}$.
,, fig. 2. Ditto, viewed from behind. ×$\frac{1}{4}$.
,, fig. 3. Ditto, viewed from below. ×$\frac{1}{4}$.
Pl. XXVI., fig. 1. *Bison occidentalis.* Skull from the Inland Sea, viewed from above. ×$\frac{1}{2}$.
,, fig. 2. Ditto, viewed from behind. ×$\frac{1}{2}$.
Pl. XXVII., fig. 1. *Bison occidentalis.* Same skull as that shown in Pl. XXVI., viewed from below. ×$\frac{1}{2}$.
,, fig. 2. Imperfect horn-core from the Inland Sea, viewed from above. ×$\frac{1}{2}$.
,, fig. 3. Ditto, viewed from anterior or posterior side. ×$\frac{1}{2}$.
Pl. XXVIII., fig. 1. *Bison occidentalis.* Horn-core from Transbaikalia, viewed from above. ×$\frac{1}{3}$.
,, fig. 2. Ditto, viewed from behind. ×$\frac{1}{3}$.
,, fig. 3. *Bison crassicornis.* Horn-core from Transbaikalia, viewed from above. ×$\frac{1}{3}$.
,, fig. 4. Ditto, viewed from behind. ×$\frac{1}{3}$.
Pl. XXIX., fig. 1. *Bison crassicornis.* Skull from a tributary of the Lena River, viewed from above. ×$\frac{1}{6}$.
,, fig. 2. Ditto, viewed from below. ×$\frac{1}{6}$.
,, fig. 3. Ditto, viewed from behind. ×$\frac{1}{6}$.
Pl. XXX., fig. 1. *Elephas* cfr. *primigenius.* About twenty-sixth vertebra from Transbaikalia, viewed from behind. ×$\frac{1}{2}$.
,, fig. 2. Ditto, viewed from left side. ×$\frac{1}{2}$.
,, fig 3. *Diceros antiquitatis.* Left *humerus* from Transbaikalia, viewed from behind. ×$\frac{1}{3}$.
Pl. XXXI., fig. 1. *Diceros antiquitatis.* Skull from Transbaikalia, viewed from above and somewhat right side. ×$\frac{1}{5}$.
,, fig. 2. Ditto, viewed from left side. ×$\frac{1}{5}$.
,, fig. 3. Same *humerus* as that shown in Pl. XXX., fig. 3, viewed from anterior side. ×$\frac{1}{3}$.
Pl. XXXII., fig. 1. *Poëphagus grunniens mutus.* Skull from Mongolia, viewed from above. ×$\frac{1}{4}$.
,, fig. 2. Ditto, viewed from below. ×$\frac{1}{4}$.
,, fig. 3. Ditto, viewed from behind. ×$\frac{1}{4}$.
Pl. XXXIII., fig. 1. Domesticated hybrid yak. Skull, viewed from above. ×$\frac{1}{4}$.
,, fig. 2. Ditto, viewed from behind. ×$\frac{1}{4}$.
Pl. XXXIV., fig. 1. *Bibos banteng,* Recent. Skull, viewed from above. ×$\frac{1}{5}$.
,, fig. 2. Ditto, viewed from behind. ×$\frac{1}{5}$.

1



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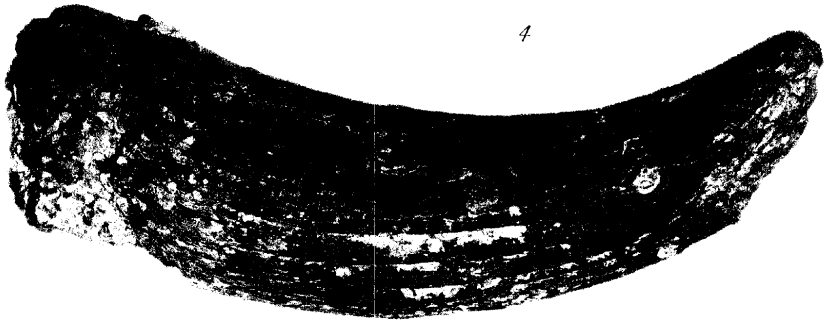

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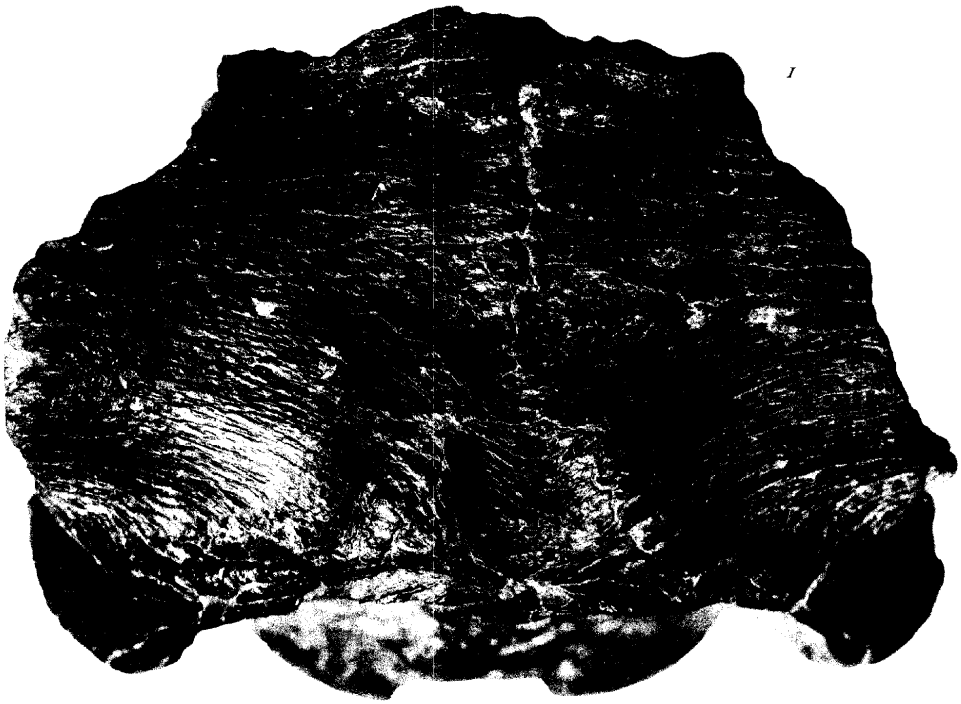

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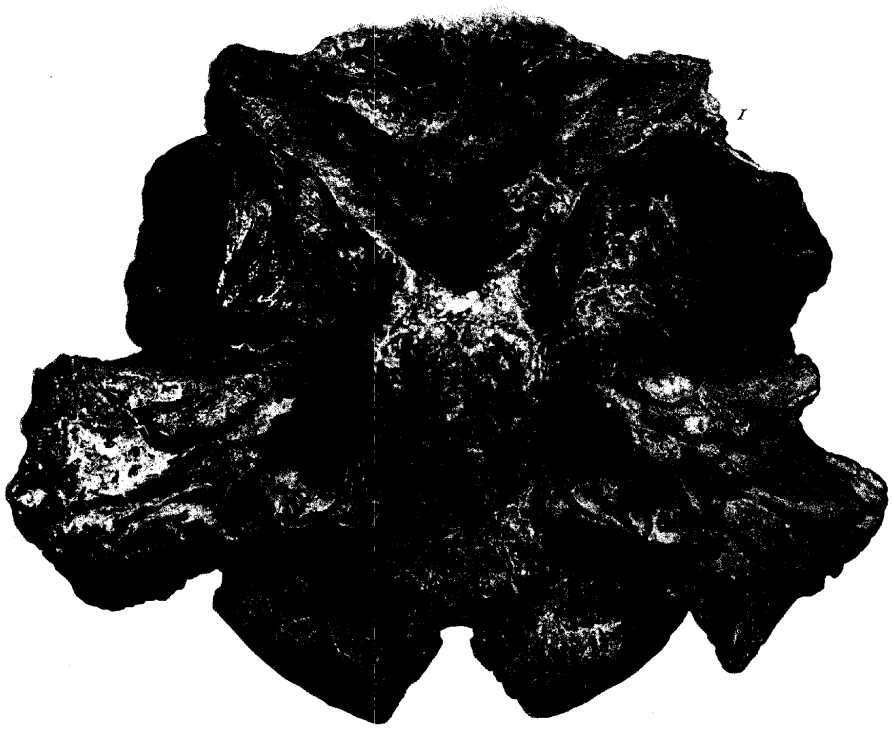

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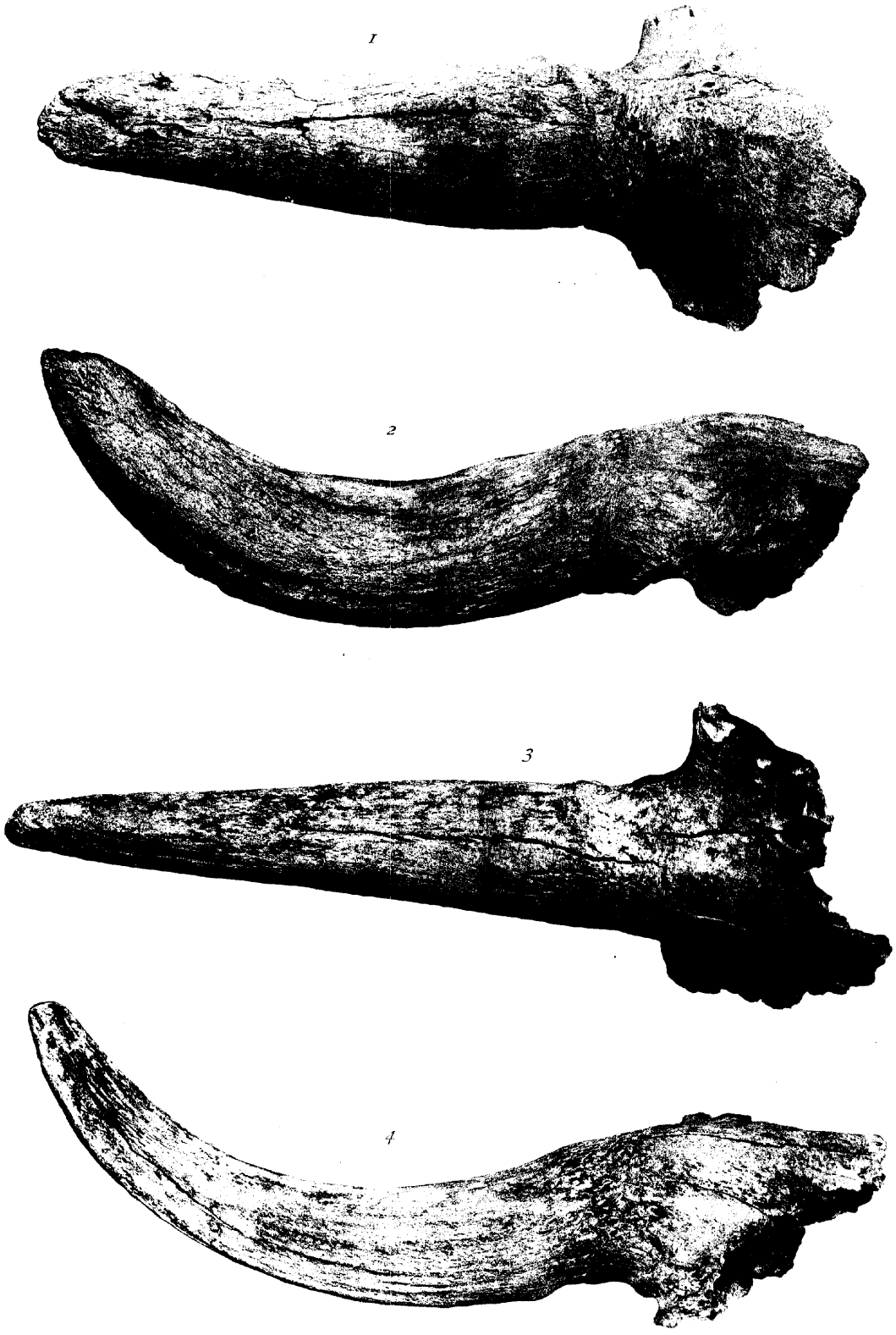

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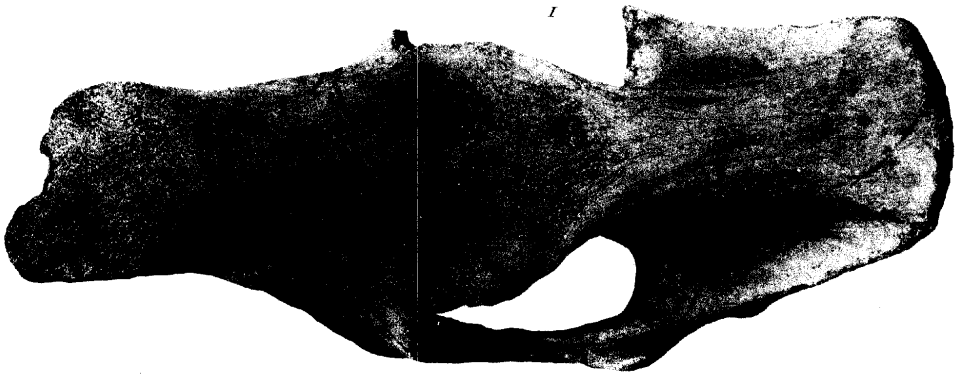

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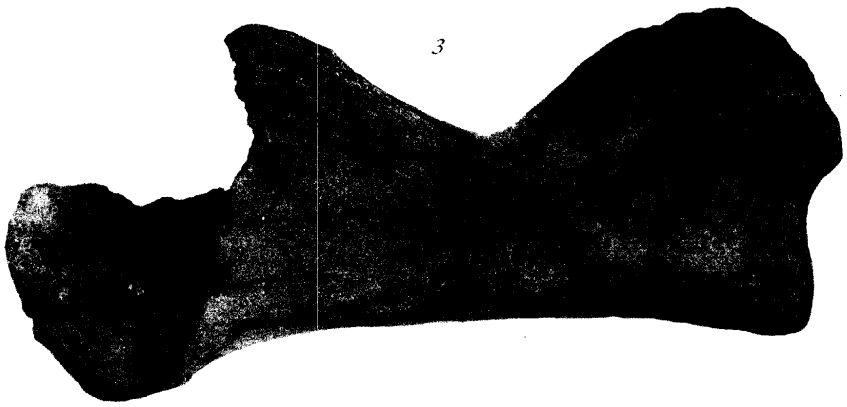

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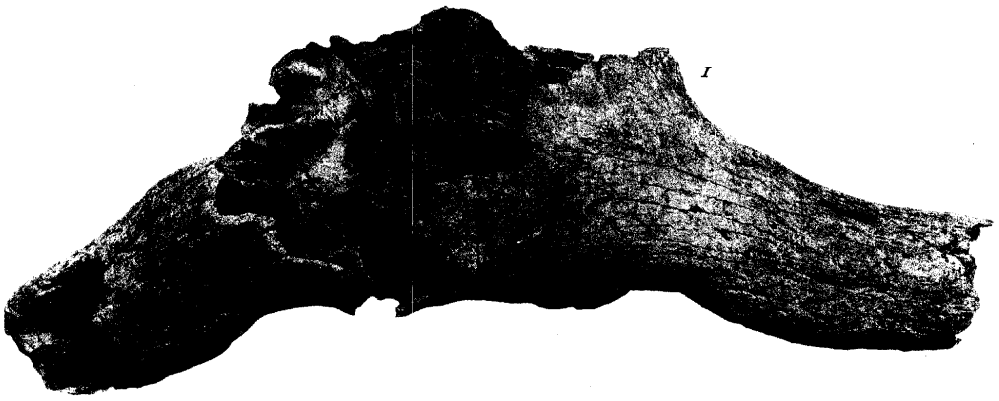

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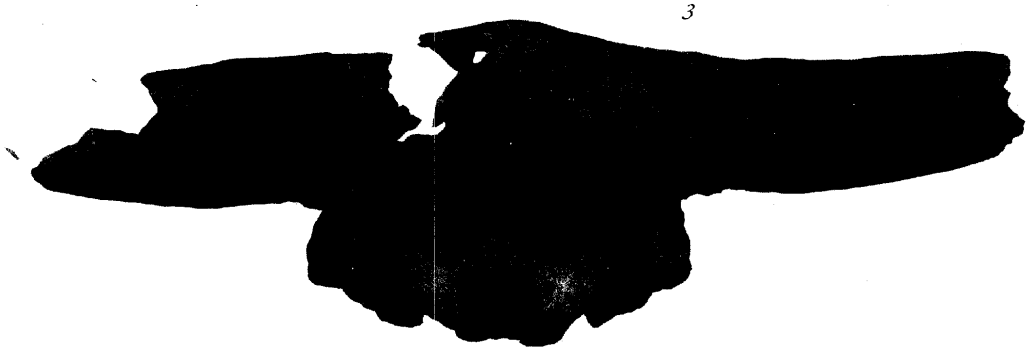

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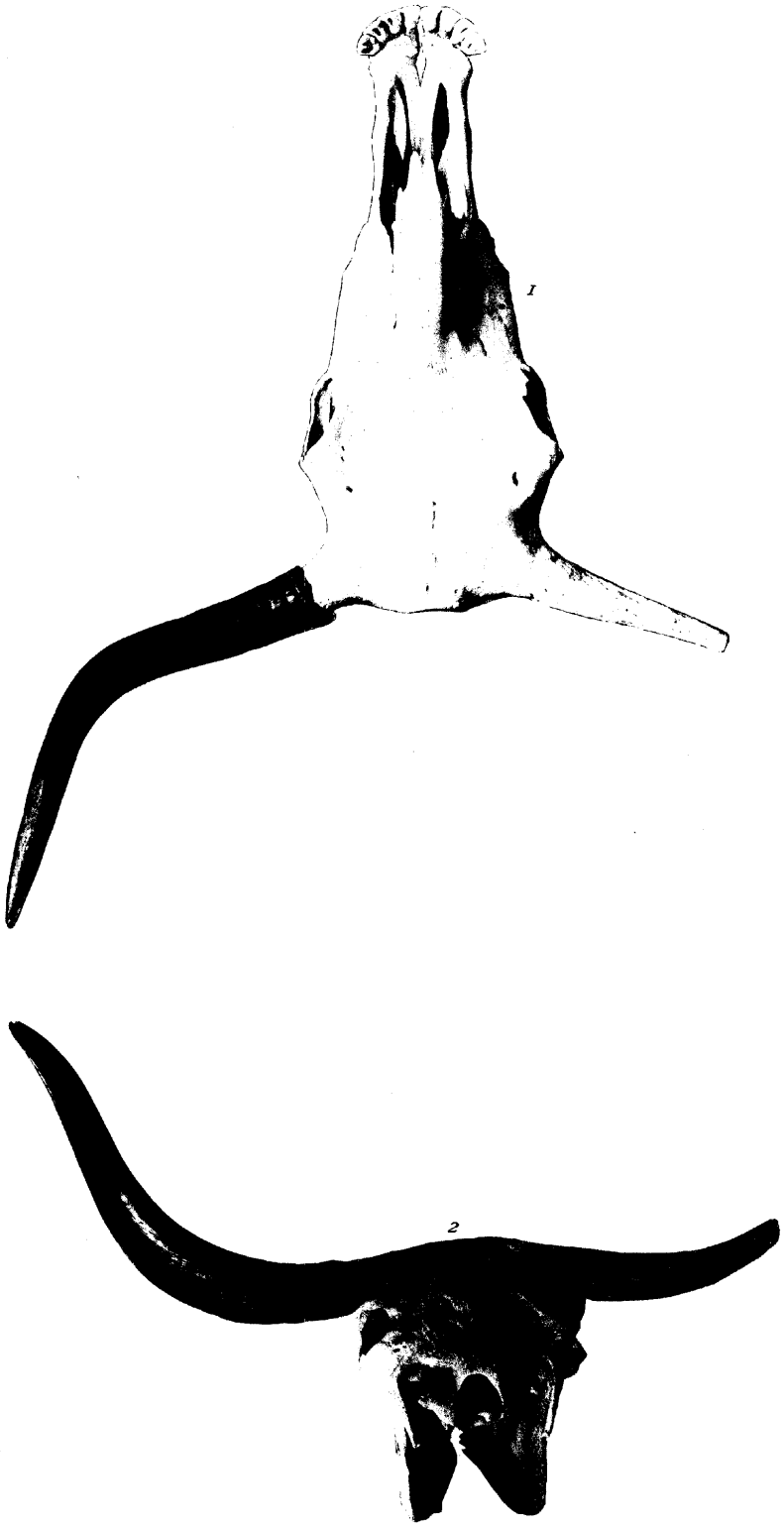

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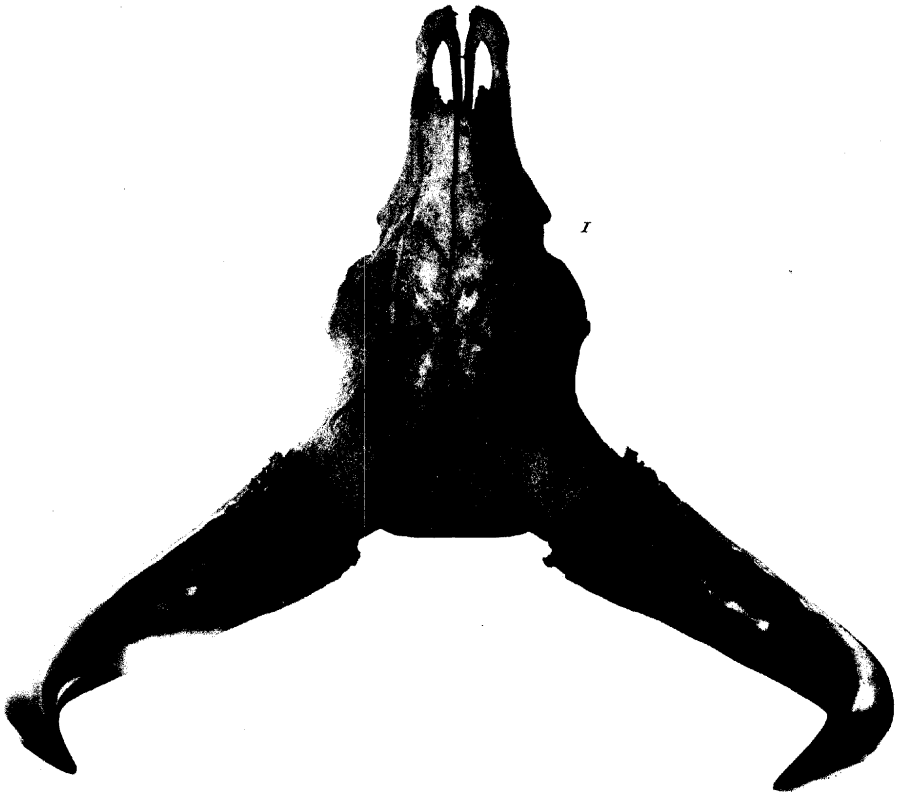

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