

SCAPHOCEROS TYRRELLI, AN EXTINCT RUMINANT FROM THE KLONDIKE GRAVELS

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While engaged in work for the U. S. Biological Survey in the summer of 1904, I spent some days in Dawson, Yukon Territory. During this time I was so fortunate as to make the acquaintance of Mr. J. B. Tyrrell, formerly of the Geological Survey of Canada, and well known for his long and difficult trips through the great Barren Grounds west of Hudson Bay. Mr. Tyrrell's interest in natural history led him to preserve certain fossils found by himself and others in the Klondike region. Among these were two imperfect skulls of supposed musk oxen which he very generously presented to me for deposit in the U. S. National Museum. One of these is extremely well preserved. The characters of practically the entire skull are well shown, the chief missing parts having been lost from one side only. The molars and premolars of the left side and the second and third molars of the right side are intact. The skull is evidently that of a very old individual, as the teeth are much worn. The bone is lightly scratched by gravel over much of its surface, but the spaces between the scratches are smooth and evidently in original condition, so it does not appear that the form and dimensions of any of the bones have been materially altered. The bone is of a dark brown color and not impregnated to any degree with mineral matter. The second specimen is much less complete, comprising only the posterior part of a skull and one attached horn core.

These specimens represent an animal evidently related to the existing genus *Ovibos*, but sufficiently different to rank as a separate genus, for which a name is here proposed. The species called *O. cavifrons* by Leidy is closely related and falls in the same genus. *O. maximus* of Richardson possibly belongs here also, but for the present can only be considered indeterminate. The genus *Boötherium*, in which *O. cavifrons* was included by Leidy, is recognized as distinct, with *Bos bombifrons* Harlan as the type.

For the privilege of describing this interesting fossil, I am indebted to Dr. C. Hart Merriam, Chief of the U. S. Biological Survey. In connection with the study, I have been greatly assisted by the loan of specimens from Dr. F. W. True, of the U. S. National Mu-

seum, Mr. Witmer Stone, of the Academy of Natural Sciences of Philadelphia, and Dr. J. A. Allen, of the American Museum of Natural History. To Mr. Stone I am particularly grateful for the loan of the valuable types of *O. cavifrons* and *B. bombifrons*. For assistance in handling specimens, thanks are due Mr. Walter L. Hahn, Aid, Division of Mammals, U. S. National Museum.

SCAPHOCEROS TYRRELLI gen. et sp. nov.

Type from 70 feet below the surface in gravels in Lovett Gulch, Bonanza Creek, Klondike District, Yukon Territory, Canada. No. 2,555, U. S. National Museum. Male, old. Received from J. B. Tyrrell.

Generic Characters.—Similar to *Ovibos*, but horn cores much smaller, less compressed at base, and more divergent at tips; crown of skull between bases of horn cores surmounted by a prominent exostosis with an anterior bounding rim and a deep median excavation; orbits much less produced laterally than in *Ovibos*; facial part of skull nearly as wide as cranial; basioccipital without a high median ridge; teeth very large and relatively broad; m^1 and m^2 quadrate in transverse view.

Specific Characters.—Size smaller than in *S. cavifrons* (Leidy); horn cores much smaller and shorter; exostosis less extensive but more deeply excavated; depth of braincase and surmounting bony mass decidedly less.

Comparison with Ovibos moschatus.—Skull longer and of more uniform width than that of *Ovibos moschatus*, the facial region not abruptly narrower than the cranial. This gives the skulls of the two genera very different outlines, particularly as viewed from above, for while *Scaphoceros* is narrower than *Ovibos* across the orbits, it is wider between the maxillaries. Anterior part of skull much elongated, although not narrowed abruptly as in *Ovibos*; maxillaries and premaxillaries much longer. The ascending branch of the premaxillary apparently does not reach the nasals but ends in nearly the same relative position as in *Ovibos* but at an angle of lesser degree, since it does not turn up so abruptly. Exposed part of frontals, not covered by exostosis, much less extensive but suture with nasals apparently in same relative position in plane of front of orbits. This exposed part of the frontals is much narrower and more elevated between the orbits, but notwithstanding this, the groove between the elevated median part and the orbits is much less pronounced and does not appear to extend to the shelf

overhanging the lacrymal fossæ. Lacrymal fossæ about the same depth as in *Ovibos* but the shelves above them, instead of being at right angles to the axis of the skull, run diagonally from the orbits to the frontals, ending on the sides of the frontals in the plane of the posterior ends of the nasals. Orbits but slightly produced and scarcely projecting beyond the zygomata, even less tubular than in *Bison*, and differing widely from the much produced form of *Ovibos*.

The posterior aspect of the skull is quite different from that of *Ovibos*. This is largely produced by a more decided constriction of the bony mass of the parietals beneath the horn cores and a more highly developed lambdoid crest. The mastoid width is therefore relatively much greater than the width immediately below the horn cores. Supraoccipital more excavated and occipital condyles more projecting; foramen magnum decidedly larger both actually and relatively; the occipital condyles much larger, wider, and more produced; basioccipital widely different, its sides not parallel nor nearly so, median line grooved instead of having a high trenchant median ridge. Auditory capsules apparently smaller; meatus larger and less deflected backwards. Posterior nares much wider and more flaring, the alisphenoid walls particularly larger and apparently somewhat arcuate instead of nearly straight in posterior outline. Palatine likewise larger and more expanded laterally, decidedly swollen just behind the plane of the last molar; sphenopalatine foramen much larger and more elliptical in shape (greatest diameter 42 mm.). Vomer much larger and more swollen. Postglenoid process strongly deflected backward instead of being nearly at a right angle to the axis of the skull. The palatal parts of the maxillaries curve gently from side to side but do not show the strong depression anteriorly that is found in *Ovibos*. The divided orifice of the parietotemporal canal is very large and placed relatively far back so that it is nearly midway between the lambdoid crest and the anterior border of the glenoid facet. Malar large and heavy though not inflated about the orbit as in *Ovibos* being merely produced into a heavy roughened ridge from which it spreads out on the face to join the maxillary. Facial part of lacrymal relatively more extensive; just below the prominent lacrymal fossa and immediately in front of the rim of the orbit is a slight depression or possible tendency to a secondary fossa. Lacrymal protuberance in the bottom of the orbit much larger than that of *Ovibos* and entirely different in shape; it is flattened below and ends posteriorly in a thin lamella on a plane with the posterior border of the sphenopalatine

foramen. The flattened lower surface of this protuberance is almost horizontal and parallel to the main axis of the skull. It is evidently an important character, differing widely, as it does, from the same structure in *Ovibos*, *Bos*, *Bison*, and *Ovis*.

Horn Cores and Exostosis.—In the type specimen which is evidently a very old male, the horn cores relative to the size of the skull and in comparison with those of adult male *Ovibos* are very slender. At their bases the antero-posterior expansion is comparatively slight. Although the vertical diameter of the horn cores is less at any point than the horizontal diameter, there is in comparison with the horn cores of *Ovibos* a decided tendency toward roundness. A cross section of the horn core near the base would be elliptical but a section taken four inches from the base would be more nearly ovoid. The direction of the cores although somewhat downward is distinctly away from the skull, and the tips are directed forward.

Between the bases of the horn cores and for some distance anterior to them is a roughened and much perforated bony growth or exostosis occupying the greater part of the crown of the skull. In *Ovibos* there is a somewhat similar growth, which, however, is all on the same plane with the top of the horn cores, is but slightly produced anteriorly, and is always divided by a deep median channel the floor of which is continuous with the normal surface of the frontals. In *Scaphoceros* this exostosis is depressed between the horns forming an oblong excavation bounded laterally by the bases of the horn cores and anteriorly by a rugose shelf-like rim which is elevated like a crown over the frontals and the base of the orbits. Posteriorly the depression is open though there are evidences that it may have been inclosed by a rim similar to the anterior one. Fully a third of the exostosis and depression is anterior to the plane of the front of the bases of the horn cores so that the anterior bounding shelf reaches almost to the plane of the front of the orbits. The anterior boundary shows no evidence of a median division, but the depression appears to have been traversed by a median ridge; in *S. cavifrons* this ridge is more plainly shown. Possibly the horny sheaths that covered the exostosis in the living animal were completely united. At least it is safe to assume that the two sides were more closely apposed than in *Ovibos*, and that the horn sheaths were shaped very differently at the base.

Teeth.—The teeth of *Scaphoceros* are actually larger than those of *Bison bison*. In size and shape they differ widely from those of *Ovibos* but in structure appear to be quite similar. Their propor-

tions, without regard to size, are very different. The entire molar and premolar series is much wider relative to its length than in *Ovibos* or *Ovis*, in this respect being like *Bison*. The width of m^1 is almost as great as the length and that of the much worn m^2 is even greater than the length, though it is possible that the unworn crowns might not show the same proportions. However, the alveolus of m^1 is much wider than long. The longest tooth is m^3 , which is more than a third longer than m^2 , whereas in *Ovibos* these teeth are nearly equal in length.

The arrangement of enamel folds seems to be much the same as in *Ovibos* but this is open to question since specimens of exactly equal stages of wear are not available for comparison. The greater width of the teeth naturally allows space for a greater proportion of dentine. With the exception of m^2 , all the teeth seem to be less prolonged into a posterior loop. In *Ovibos* this posterior loop fits into a corresponding depression in the front of the next succeeding tooth. In *Scaphoceros*, where the posterior loop is scarcely or not at all developed, the corresponding depression is absent.

The accessory inner columns which are so well developed in *Bos* and *Bison* are not shown in the aged and worn teeth of the type of *Scaphoceros*. Since they occur in young *Ovibos*,¹ they may well be expected in *Scaphoceros* when young specimens are found.

Relationship.—In its important characters, *Scaphoceros* appears to be more closely related to *Ovibos* than to any other recent genus. In its departures from *Ovibos*, it shows possible approach to *Bison*; on the other hand there is nothing indicating any further ovine characters than those that are claimed for *Ovibos*. The bearing of this upon the much discussed question as to whether *Ovibos* is more bovine or ovine in its relationships is rather favorable to the former. Without attempting to review all the moot points of this case, it may

¹The positive occurrence of these accessory columns in *Ovibos* has been noted by Rutimeyer (*Die Rinder der Tertiär-Epoche*, p. 91, 1867—fide Lönnberg) and later by Lönnberg (*Proc. Zool. Soc. Lond.*, p. 712, June, 1900), but seems to have attracted little attention, since the statement that they are absent in this genus is often seen. A young skull (No. $\frac{599\frac{1}{2}}$ U. S. Nat. Mus.) of *Ovibos moschatus* from Fort Good Hope, Mackenzie River, shows the accessory column plainly. In this skull m^3 is only partly developed, being scarcely above the alveolar border; so far as can be observed under these conditions, the accessory column is not present in this tooth. In m^2 which is advanced enough to have been functional, the column is well developed and conspicuous. It is a thin column occupying the single inner re-entrant angle and apparently derived from the inner anterior fold of the tooth. In m^1 there is a trace of the same structure partly worn away, showing that continued wear would have caused it to disappear entirely.

be well to mention a few suggestive facts brought out by a study of the skull of *Scaphoceros*.

Since the accessory columns in the inner angles of the molar teeth are possessed by *Ovibos* (and probably by *Scaphoceros*) as well as *Bos* and *Bison* (see footnote, antea, p. 177) this character can only be used to separate these genera collectively from the sheep and related forms which never possess it. Without considering external characters, *Ovibos* and *Scaphoceros* may then be distinguished from *Bos* and *Bison* and their relatives by the possession of lacrymal fossæ, by the shape, direction, and manner of attachment of the horns, and by numerous less important characters. In some of these *Scaphoceros* shows more approach to *Bison* than does *Ovibos*. Among them are the size and relative width of the teeth, the grooved basioccipital, and the more nearly round horns. These similarities, however, seem to be greatly overbalanced by the differences and do not necessarily indicate a bison-like ancestor for the musk ox. It seems more reasonable that *Ovibos* came from a more remote ancestor than *Bison* and developed along lines of its own. This has been ably set forth by Lönnberg (l. c.) and there appears to be nothing in the characters of *Scaphoceros* that would argue greatly against his views.

In connection with any supposition that *Scaphoceros* may be an ancestral form of *Ovibos*, it is interesting to note that some characters of the adult *Scaphoceros* are found in the young *Ovibos*. In the young skull previously mentioned (see footnote, antea, p. 177) the basioccipital is very similar to that of the adult *Scaphoceros*, having a median depression and sides that are not parallel; also, the orbits are less produced laterally, the occipital condyles relatively wider, and the horn cores more divergent and less compressed, all of which approaches the condition of the adult in *Scaphoceros*. A still more primitive form is *Boötherium bombifrons* which, in the adult, has round horn cores, a condition only found in very immature *Ovibos*.

History and Nomenclature.—Remains of animals related to or indistinguishable from the recent genus *Ovibos* have been found in Pleistocene gravels of various parts of the world. They were first found in Siberia near the Obi River and account of them was published by Pallas in 1773. Later, others from various parts of Siberia were unearthed and then more were found in the 'ice cliffs' of Eschscholtz Bay, Alaska. In course of time specimens came to light from the Mississippi Valley and from various parts of Europe, including England, Germany, and France. Such a large number of fragments naturally elicited a few new specific names, most of

which however, have been loosely treated as synonyms of *Ovibos moschatus*. The names applied to supposed extinct species are as follows:

1825. *Bos bombifrons* Harlan, Fauna Americana, pp. 271-272, 1825.
 1827. *Ovibos pallantis* H. Smith, Griffith's Cuvier, Anim. Kingd., iv, p. 374, 1827.
 1828. *Bos pallasii* Dekay, Ann. Lyc. Nat. Hist. N. Y., ii, p. 291, 1828.
 1834. *Bos canaliculatus* Fischer, Mem. Acad. Moscou, iii, p. 287, 1834.
 1852. *Ovibos cavifrons* Leidy, Proc. Acad. Nat. Sci. Phila., p. 71, 1852.
 1854. *Ovibos maximus* Richardson, Zool. Voy. H. M. S. Herald, pp. 25-28, pl. xi, figs. 2-4, 1854.
 1865. *Ovibos priscus* Rutimeyer, Verhandl. Naturforsch. Gesellsch. Basel, iv, p. 328, 1865.
 1895. *Bison appalachicolus* Rhoads, Proc. Acad. Nat. Sci. Phila., pp. 246-248, 1895.

These various names may be treated separately as follows:

1. *Bos bombifrons* was based on a portion of a skull with the horn cores attached found at Big Bone Lick, Kentucky, near the falls of the Ohio River. It was collected at the instance of President Jefferson by no less a person than Gen. Wm. Clark, famous with his associate Lewis for their overland expedition to the Pacific. The specimen was described and figured in 1818¹ but received no scientific name until 1825 when Harlan called it *Bos bombifrons*. Apparently its relationship with *Ovibos* was not suspected until 1852, when Leidy provisionally placed it in that genus and immediately designated it, in company with *O. cavifrons*, as belonging to a new genus, *Boötherium*. In the same year Leidy published a complete description and new figures² of the original specimen under the name *Boötherium bombifrons*.

Rutimeyer in 1865 (l. c.), basing his conclusions on Leidy's figures, announced the opinion that the type of *bombifrons* was the skull of a female animal, the male being the one called *cavifrons*. A few years later, Boyd Dawkins, without reference to Rutimeyer, expressed the same belief.³ More recent authors, have therefore accepted this conclusion and placed *cavifrons* as a synonym of *bombifrons*.⁴

2. *Ovibos pallantis* was proposed for remains of parts of skulls of musk oxen found in the 18th century along the Obi River in

¹ Caspar Wistar, *Trans. Am. Philos. Soc.*, i, pp. 375-380, pl. xi, figs. 10-11, 1818.

² *Mem. on Extinct Species of Am. Ox*, Smiths. Cont. Knowl., v, pp. 17-19, pl. iv, fig. 2, pl. v, figs. 1-2, 1852.

³ *Palcontog. Soc.*, vol. xxv, pt. v, p. 20, 1871.

⁴ E. g., Lydekker, *Wild Oxen, Sheep, and Goats of All Lands*, p. 148, 1898.

western Siberia. They were described and figured by Pallas in 1773¹ but no name was given until 1827 when Hamilton Smith proposed *Ovibos pallantis*, mentioning the specimens described by Pallas, and also certain others from the region of the Lena River previously figured by Ozeretkofsky. The figures published by Pallas indicate an animal very similar to or identical with *Ovibos moschatus*. Much reduced copies of these figures were reproduced by Cuvier.²

3. *Bos pallasii* was based on the same specimens as *Bos pallantis* and is therefore a synonym. It is, moreover, preoccupied by *Bos pallasii* Baer 1823, proposed for a different animal. In the same paper in which DeKay proposed the name *pallasii*, he described a specimen from New Madrid, Missouri, which evidently belongs to the species later called *cavifrons* by Leidy.

4. *Bos canaliculatus* was based on skulls found in Siberia, doubtless the same species that was named *Ovibos pallantis* by Smith, and likewise not satisfactorily distinguished from *Ovibos moschatus*. The name *canaliculatus* refers to the narrow median groove or channel between the bases of the horn cores.

5. *Ovibos cavifrons* was based on a cranium and attached horn cores from the vicinity of Fort Gibson, Indian Territory. It was included with *Bos bombifrons* in the genus *Boötherium* when that name was proposed. Later it was thought to be a synonym of *bombifrons* on the supposition that the differentiating characters were those of male and female. If this supposition is not correct, as I believe, the specific name *cavifrons* must be used for the species described by Leidy. Specimens similar in general to the type of *cavifrons* have been found in various parts of the Mississippi Valley, one particularly complete having been reported from Council Bluffs, Iowa.⁴

6. *Ovibos maximus* was based on an imperfect cervical vertebra, the axis or dentata. Whether this is actually different from the same bone in *Ovibos moschatus* has not been conclusively shown. In fact, Richardson himself admitted some doubt. Leidy, in answering certain remarks by Richardson, was quick to notice this, and in one place makes the following pointed comment: "Sir J. R. then says, 'The size of Dr. Leidy's specimen of *cavifrons* does not exceed that of the skull of an aged musk-ox bull, and the dentata of

¹ *Novi Comment. Acad. Sci. Imp. Petrop.*, xvii, pp. 576-606, pl. xvii, figs. 1-3, 1773.

² *Oss. Foss. Quad.*, iv, pl. III, figs. 9-10, 1812.

³ *Foss. Mamm. Prussia*, p. 27. 1823—fide Lydekker.

⁴ McGee, *Am. Jour. Sci.*, xxxiv, pp. 217-220, 1887.

maximus is of corresponding dimensions.' If this be the case I would ask, as the 'dentata of *maximus*' was found in the country of 'the musk-bull,' and is of the same size as the corresponding bone in that animal, what evidence is there that it does not belong to it?'¹

The dentata described as *O. maximus* may represent the same species as the one here described as *tyrrelli*, but there seems to be no material now available by which this can be determined. At least it is certain that the dentata shows no generic characters. As it is necessary to have a species for the type of a genus, the only specimen which shows generic characters should be taken as the type of both species and genus. By so doing, the genus becomes established and will not be affected should later developments prove that the type species is a synonym.

7. *Ovibos priscus* is a substitute name for both *B. bombifrons* and *O. cavifrons*, which by some esoteric method of reasoning was supposed to be necessary, when it was assumed that *cavifrons* represented the male and *bombifrons* the female of one species.

8. *Bison appalachicolus* was based on a rather small fragment of the base of a horn. It was at first placed in the genus *Bison*, and considered as an intermediate form between *Bison* and *Ovibos*. Later it was transferred to the genus *Ovibos* by the same author.²

The Genus Boötherium.—*Boötherium*, when originally proposed by Leidy³ included two species, *Bos bombifrons* Harlan and *Ovibos cavifrons* Leidy. Since that time neither of these has been removed as the type of a new genus. If it is now concluded that these species are not congeneric, one of them must be designated or fixed as the type of *Boötherium*. I have therefore selected *Bos bombifrons* Harlan as the type of *Boötherium* and referred *O. cavifrons* Leidy to the new genus *Scaphoceros*, of which the type is *S. tyrrelli*. As justifying this fixing of the type, it may be said that at the time *Boötherium* was proposed, *Bos bombifrons* had been thoroughly described and figured, whereas *O. cavifrons* had received only slight preliminary mention. Moreover *B. bombifrons* was the species first mentioned in the paper in which *Boötherium* was first published.

Since *bombifrons* and *cavifrons* have been considered by several authors as being not only congeneric but conspecific, the establishment of a separate genus for each may appear surprising. While it may be possible, from examination of figures only, to construct a hypothesis to the effect that *cavifrons* represents the male and *bombi-*

¹ *Proc. Acad. Nat. Sci. Phila.*, pp. 209-210, 1854.

² *Proc. Acad. Nat. Sci. Phila.*, p. 492 (1897), Jan. 18, 1898.

³ *Proc. Acad. Nat. Sci. Phila.*, p. 71, 1852.

frons the female of one species, it is inconceivable that any modern taxonomist would reach such a conclusion after comparing the original types. These are now before me and with them are specimens of *S. tyrrelli* and of both sexes and young of *Ovibos moschatus*. From comparisons of these it is evident that, unless the disparity between the sexes in this case was vastly greater than in the recent genus *Ovibos*, *cavifrons* and *bombifrons* do not respectively represent the male and female of one species. Neither is *bombifrons* the young of any species, for the type gives every evidence of maturity.¹

The horn cores of the female *Ovibos* are essentially of the same character as those of the male. They are excessively flattened and directed downward close to the skull just as those of the male. Their bases approach each other over the top of the frontals increasing with age as in the male, the space between them being merely relatively greater than in the male.² They are attached to the frontals only it is true, but this is the case with the immature male. Therefore the skull of the female has all the essential characters of the male but they are not as highly developed. The skull of *Boötherium bombifrons*, on the contrary, differs not in degree but in actuality from that of *Scaphoceros cavifrons* and *S. tyrrelli*. The horn cores are not flattened but are actually round or as nearly round as may be in a rough surfaced structure; they are directed away from the skull at a different angle; their attachment to the skull is entirely different; their bases do not approach each other in the least but on the contrary stand out from the skull on pedicels and have a distinct burr as in *Bison*. The frontal region between the horn pedicels is not flattened as in the female *Ovibos*, but is elevated and convex. The under side of the skull of the type of *bombifrons* is much injured but one conspicuous character is shown in which it differs from all the other species. This is found in the basisphenoid which is not deflected but has its lower surface in the same horizontal plane as that of the basioccipital and it has a sharp median ridge. The horn cores of *bombifrons* are essentially like those of *Bison* except that they turn downward instead of upward. However, other characters, notably the possession of deep lacrymal fossæ, serve to distinguish it from *Bison*. In consideration of these various characters, the genus *Boötherium* with *Bos bombifrons* as the type seems to merit

¹This was pointed out by Leidy, who says, "the interfrontal, fronto-parietal, and occipito-parietal sutures are completely obliterated" (*Jour. Acad. Nat. Sci. Phila.*, 2d ser., VII, p. 374, 1869).

²This is well shown by Richardson's figure, often cited.—*Zool. Voy. Herald*, pl. IV, fig. 1, 1854.

recognition. Thus far, only one specimen of this genus, the original type, has been found. Specimens of *S. cavifrons* and *S. tyrrelli*, however, have been secured at various localities among which are the following: Fort Gibson, Indian Territory; Council Bluffs, Iowa; New Madrid, Mo.; St. Louis, Mo.; Benton Co., Mo.; Trumbull Co., Ohio; Brook Co., W. Va.; Pennsylvania; Anvik, Alaska,¹ and Bonanza Creek, near Dawson, Yukon Territory. In this large number of specimens, if there were any females at all it is probable that there would be more than one. In order to give any semblance of certainty to the supposition that the differences between *bombifrons* and *cavifrons* are sexual, it is necessary to show that these differences are relatively the same that obtain between the sexes in living species. This cannot be done, therefore it seems safer to treat the two animals as distinct. A much more reasonable assumption would be that *S. cavifrons* represents the male and *S. tyrrelli* the female of one species. The present objection to this is the fact that both have not been found in the same region.

In order to make clear all the points under discussion, photographs are reproduced herewith of skulls of *Ovibos moschatus*, *Boötherium bombifrons*, *Scaphoceros cavifrons*, and *S. tyrrelli*.

¹ A horn core of *S. tyrrelli* collected by Dr. Arthur Hollick at this locality in 1903 is in the U. S. National Museum.

TABLE OF MEASUREMENTS

	<i>S. tyrrelli</i>	<i>S. cavifrons</i>	<i>O. moschatius</i>	<i>B. bomlifrons</i>
Depth of braincase, from superior lip of foramen magnum to top of skull midway between horns	117	181	123	99
Mastoid width	197	212	180	
Interorbital width	191 ¹	213 ¹	232	150
Width between paroccipital processes at level of tops of protuberances of basioccipital.....	133	140		
Zygomatic width	211	210 ¹		
Width of braincase measured just above the orifices of the temporal canal.....	118	130	103	105
Inferior lip of foramen magnum to tip of premaxillary	516		462	
Length of palate from interpterygoid fossa to exposed part of vomer.....	209		186	
Width of palate at m ²	84		79	
Inferior lip of foramen magnum to palatine... ..	184		177	
Inferior lip of foramen magnum to alveolus of m ²	218		217	
Tip of premaxillary to alveolus of pm ¹	158		127	
Tip of premaxillary to anterior border of orbit	355		281	
Antero-posterior diameter of orbit.....	73		63	
Greatest width of basioccipital.....	72	87	64	64
Length of exostosis from outside of anterior rugose boundary	214	262		
Greatest width of exostosis anterior to bases of horn cores	114			
Width between bases of horn cores across frontals	90	135		137
Antero-posterior diameter of horn core at base.. ..	95	110	138	
Antero-posterior diameter of horn core 10 cm. from base	57	88	83	71
Vertical diameter of horn core at base.....	72	70	68	45
Vertical diameter of horn core 10 cm. from base	44	62	42	46
Width between broken tips of horn cores.....	367	553	288	430
Circumference of horn core 10 cm. from base.. ..	160	254	220	144
Length of crowns of entire upper toothrow....	168		135	
Length of pm ¹	19		12	
“ “ pm ²	19		19	
“ “ pm ³	19		20	
“ “ m ¹	22.5		25.5	
“ “ m ²	34		31.5	
“ “ m ³	49		33	
Width of pm ¹	19.5		12	
“ “ pm ²	25.3		14	
“ “ pm ³	26.2		14	
“ “ m ¹	28		19	
“ “ m ²	32		19	
“ “ m ³	33		18	

¹ Approximate.

EXPLANATION OF PLATES

(About one-fifth natural size)

PLATE XXXVII

- FIG. 1. Upper surface of skull of *Ovibos moschatus*. Adult male, No. 14413, U. S. National Museum.
- FIG. 2. Upper surface of skull of *Scaphoceros tyrrelli*. Type, No. 2555, U. S. National Museum.

PLATE XXXVIII

- FIG. 1. Under surface of skull of *Ovibos moschatus*. Adult male, No. 14413, U. S. National Museum.
- FIG. 2. Under surface of skull of *Scaphoceros tyrrelli*. Type, No. 2555, U. S. National Museum.

PLATE XXXIX

- FIG. 1. End view of skull of *Scaphoceros tyrrelli*. Type, No. 2555, U. S. National Museum.
- FIG. 2. End view of skull of *Boötherium bombifrons*. Type, from collection of Academy of Natural Sciences, Philadelphia.
- FIG. 3. End view of skull of *Ovibos moschatus*. Adult male, No. 14413, U. S. National Museum.

PLATE XL

- FIG. 1. End view of skull of *Scaphoceros cavifrons*. Type, from collection of Academy of Natural Sciences, Philadelphia.
- FIG. 2. Side view of skull of *Scaphoceros tyrrelli*. Type, No. 2555, U. S. National Museum.

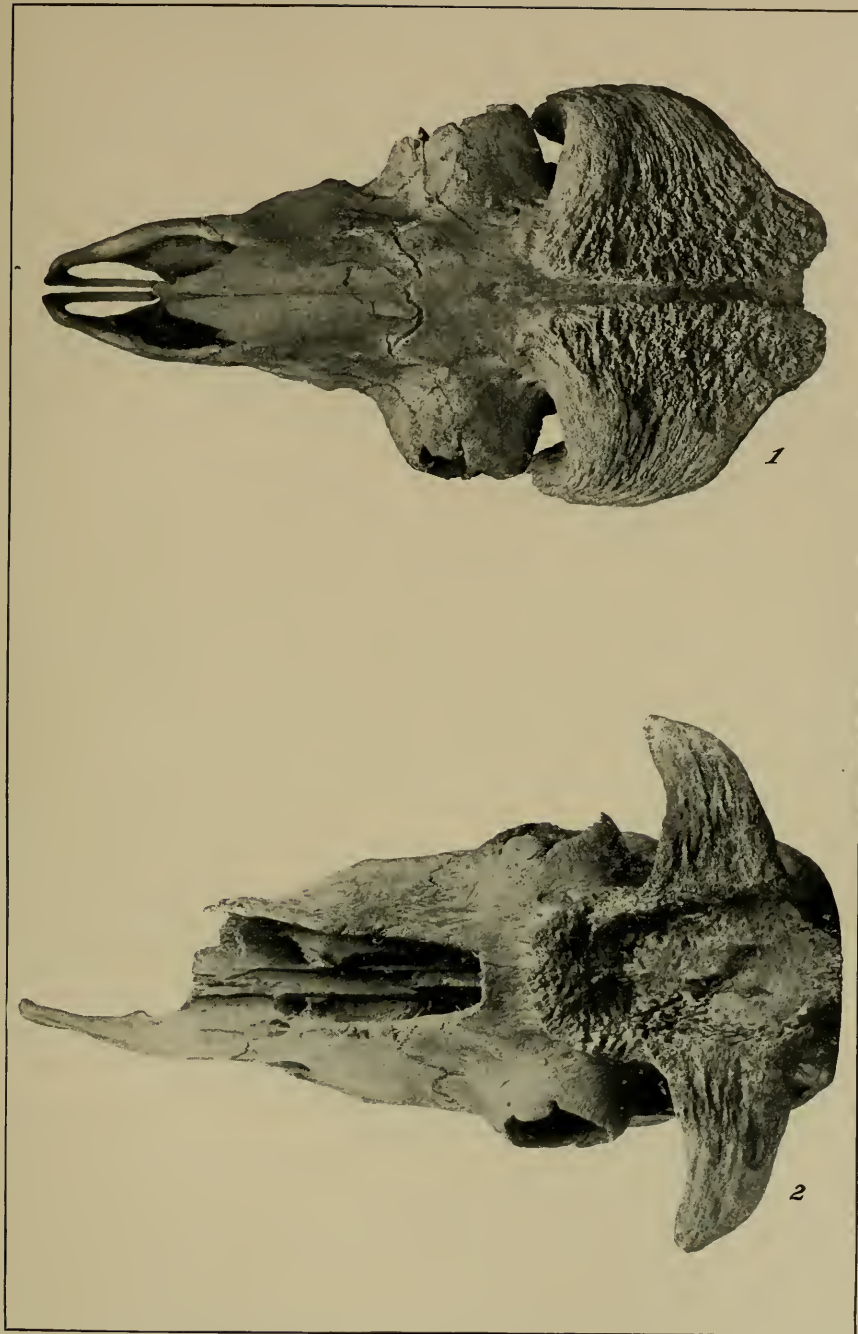
PLATE XLI

- FIG. 1. Upper surface of skull of *Scaphoceros cavifrons*. Type, from collection of Academy of Natural Sciences of Philadelphia.
- FIG. 2. Upper surface of skull of *Boötherium bombifrons*. Type, from collection of Academy of Natural Sciences of Philadelphia.

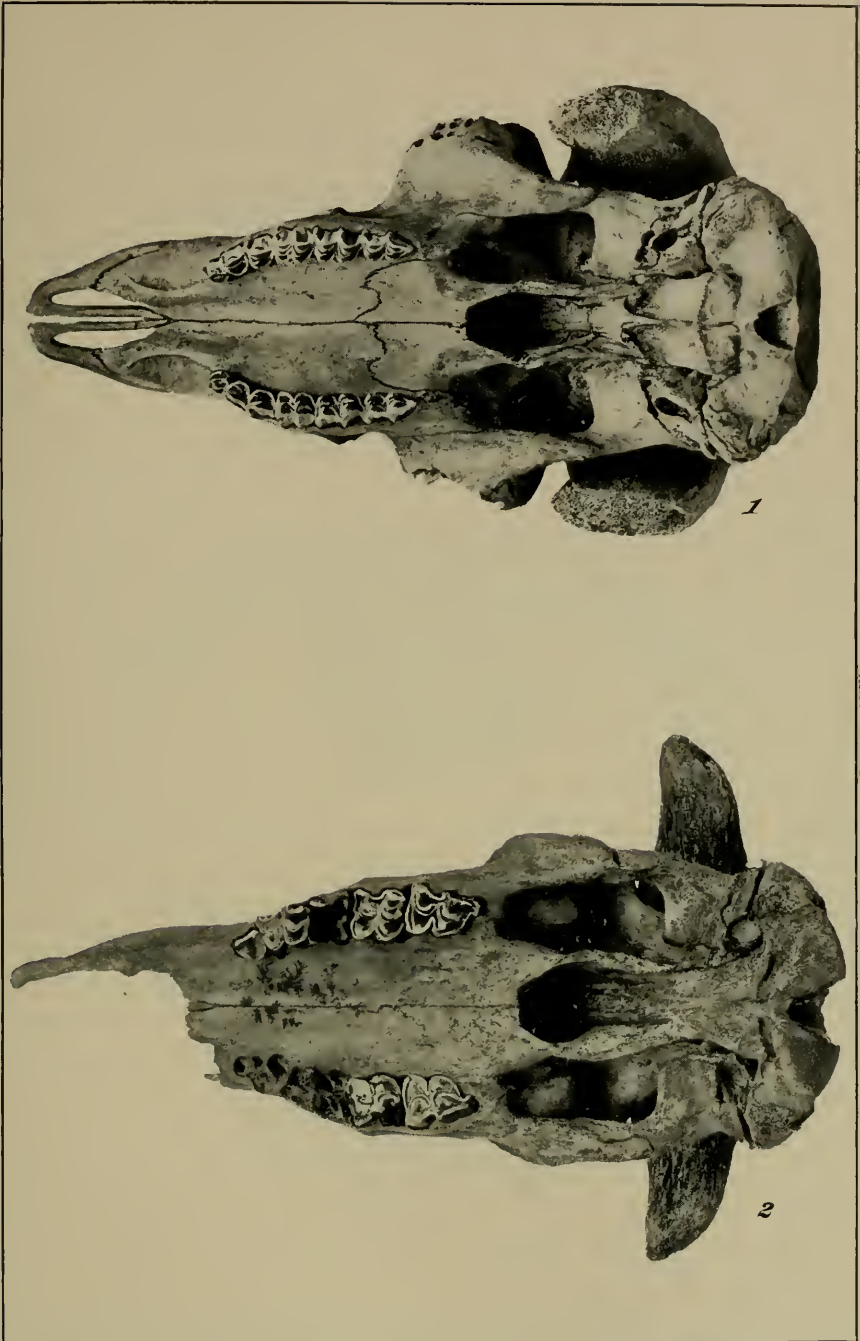
XLII

- FIG. 1. Under surface of skull of *Scaphoceros tyrrelli*. Type, from collection of Academy of Natural Sciences of Philadelphia.
- FIG. 2. Under surface of skull of *Boötherium bombifrons*. Type, from collection of Academy of Natural Sciences of Philadelphia.





SKULLS OF (1) OVIBOS MOSCHATUS AND (2) SCAPHOCEROS TYRRELLI
(About $\frac{1}{3}$ natural size.)

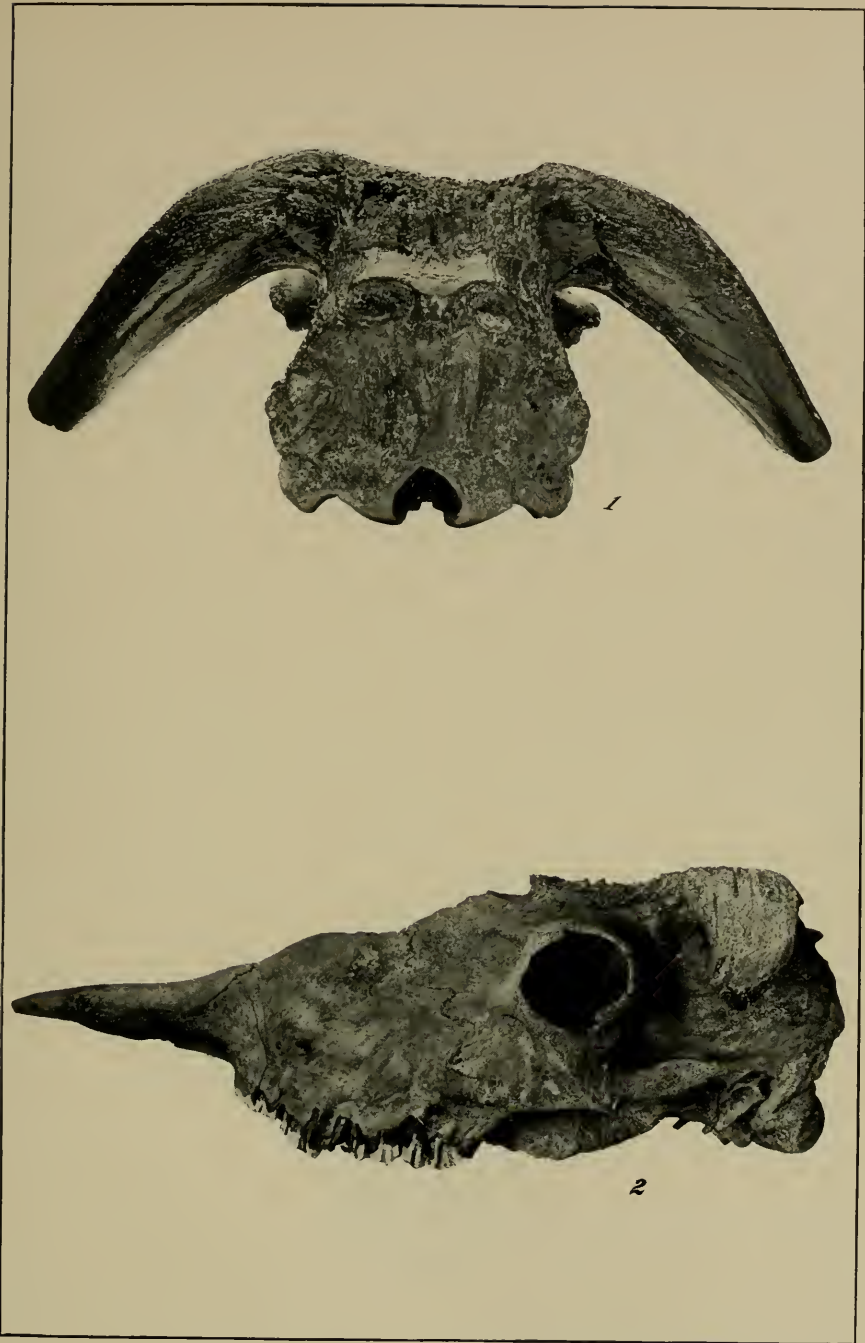


SKULLS OF (1) OVIBOS MOSCHATUS AND (2) SCAPHOCEROS TYRRELLI

(About $\frac{1}{2}$ natural size.)

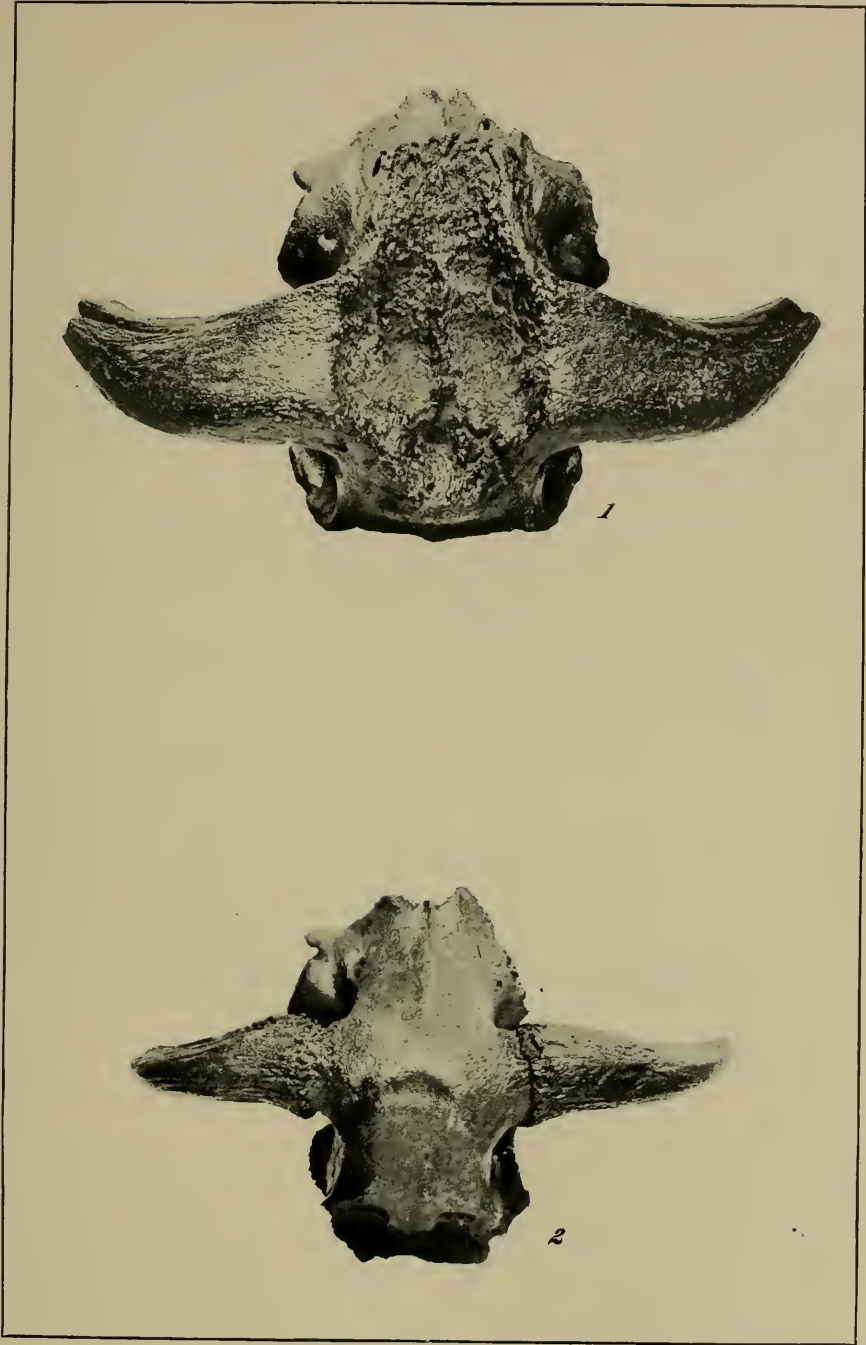


SKULLS OF (1) SCAPHOCEROS TYRRELLI, (2) BOTHERIUM BOMBIFRONS, AND (3) OVIBOS MOSCHATUS
(About $\frac{1}{3}$ natural size.)



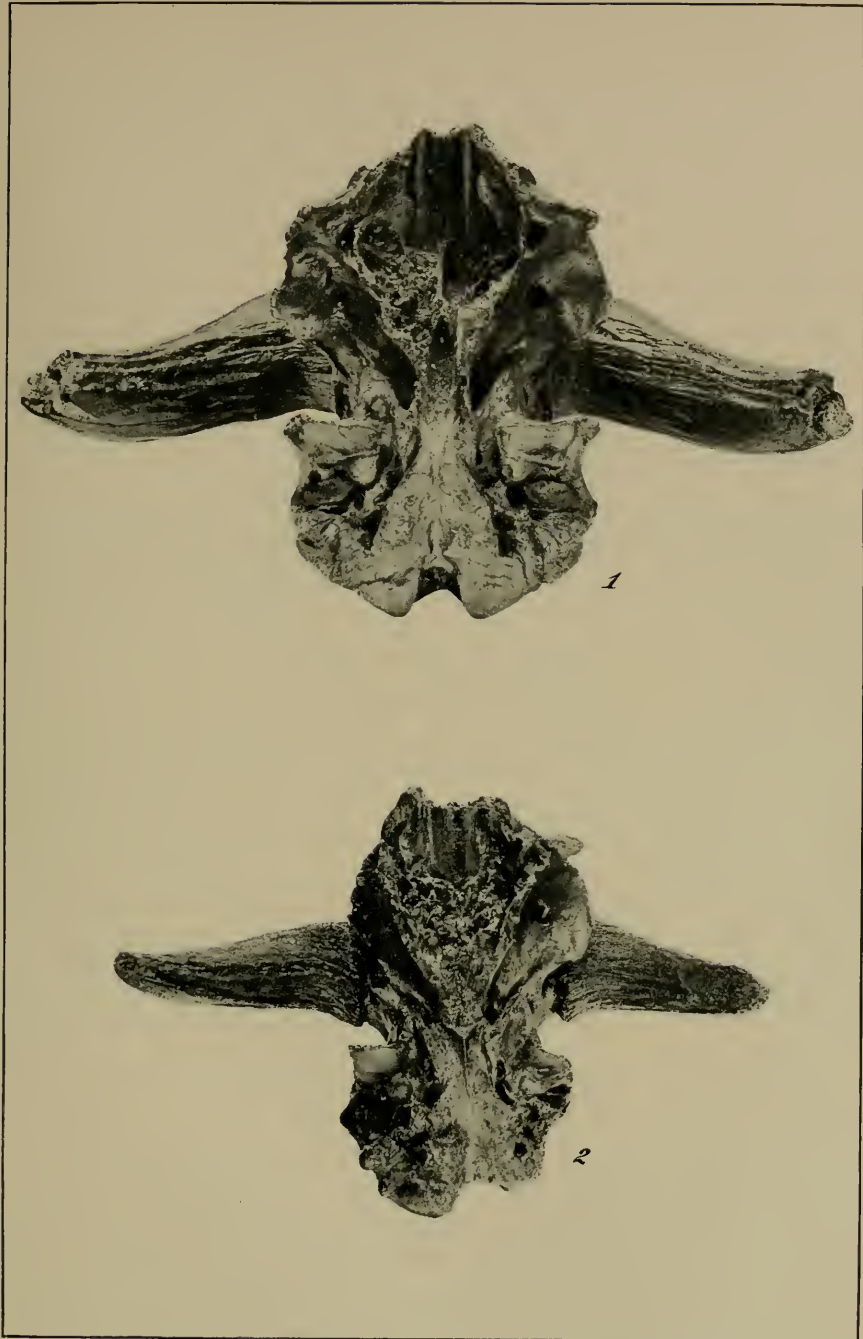
SKULLS OF (1) SCAPHOCEROS CAVIFRONS AND (2) SCAPHOCEROS TYRRELLI

(About $\frac{1}{3}$ natural size.)



SKULLS OF (1) SCAPHOCEROS CAVIFRONS AND (2) BOOTHERIUM BOMBIFRONS .

(About $\frac{1}{3}$ natural size.)



SKULLS OF (1) SCAPHOCEROS CAVIFRONS AND (2) BOOTHERIUM BOMBIFRONS

(About $\frac{1}{3}$ natural size.)

