RHINOCEROS, LINNAEUS.

THE existing species of *Rhinoceros* are confined to Africa and Asia, and the Islands of Java and Sumatra. A vast quantity of remains of extinct species have been discovered in Great Britain, the continent of Europe, Siberia, and the Himalayas, but, until the region of Nebraska had been visited, no traces of the genus had been found in America.[1]

The number of extinct species which have been proposed, frequently upon the slightest characters, is so great, that the criticism of De Blainville upon their authors appears to be quite just: "Qui semblent considérer les os comme des individus, comme des masses minérales, sans considérations biologiques ou physiologiques; en sorte que les espèces se créent chez eux, pour ainsi dire, au compas."[2]

Among the fossil remains discovered at Nebraska, are those of two species of *Rhinoceros*, certainly different from any of those found in other parts of the globe. The larger of the two species, as indicated by an almost entire skull, was nearly three-fourths the size of the *Rhinoceros indicus*, or it was about the size of the *Rhinoceros minutus*, Cuvier, which is regarded by De Blainville as a small variety of the *Rhinoceros incisivus*. The other was less than two-thirds the size of the former species, and is therefore the smallest *Rhinoceros* which has ever yet been indicated.

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[1] In the Monthly American Journal of Geology, etc., 1831, p. 10, the editor, G. W. Featherstonhaugh, has given a description of what he considered to be the fragment of a jaw, containing two incisor teeth of an animal closely allied to the *Rhinoceros*, found in Pennsylvania. Mr. Featherstonhaugh observes: "The mineral composition of this fragment gives it a very anomalous character, and is a circumstance entitled to the particular consideration of geologists. There is nothing of the nature of bone about it, except its form; the whole substance, the teeth included, being constituted of an aggregate of quartzose particles, and presenting the appearance, not of a gradual substitution by mineral infiltration to osseous matter, but of a cast of part of a jaw and teeth formed of small quartzose grit, and giving a semi-translucency to the teeth, which is wanting to the more opaque jaw."

Dr. Harlan, in his Medical and Physical Researches, refers to this specimen, page 268, and says: "For ourselves, we are disposed to wait for further discoveries of this nature, previous to admitting the present specimen as part of our fossil fauna. The specimen is no less singular or interesting to geologists, as demonstrating the very close analogy of a mere *lusus naturæ* of the mineral kingdom, if it be nothing else, to a portion of the animal skeleton." Dr. Harlan further remarks, in a note: "The original specimen was sent to London, and the geologists who there examined it, considered it of too doubtful a character to be admitted as a fossil remnant."

De Blainville, in his Osteographie, page 172, in reference to this specimen, says: "Ce n'est pas le lieu de discuter ce point au moins fort contestable; mais comme la pièce en nature fait aujourd'hui partie des collections du Muséum, nous pouvons assurer qu'elle ne resemble pas le moins du monde à un fragment de mâchoire de Rhinocéros, ni pour le corps de l'os, ni pour les dents prétendues. C'est sans doute une pièce artificielle, une grossière supercherie. Il est donc véritablement à regretter qu' on en ait hasardé et exprimé la pensée; et que tous les catalogues de paléontologie aient inscrit une espèce de Rhinocéros fossile en Amérique, sans même une expression de doute."

In addition, my friends Dr. I. Hays, and Mr. I. Lea, have informed me they had seen the specimen, and had always regarded it as a mere mineral fragment.

[2] Osteog. Gen., Rhinoceros, 212.

I was at one time disposed to consider the two species of Nebraska *Rhinoceros* as having belonged to the subgenus *Aceratherium*, Kaup, from the fact that in one of the specimens, upon which the larger species was established, the upper part of the face, as far forward as the position of the second molar tooth, presents no indication of an advancing rise to produce a prominence or boss at the end of the nose for the support of a horn. In the specimens of the smaller species, the face is too much mutilated to obtain any idea of its form, but from the resemblance of the back part of the cranium and the lower part of the face to those of the larger species, I supposed the similarity probably continued in the remainder of the face, and thus indicated the species to be of the same subgenus as the other. Upon more mature reflection, I am inclined to think both species of *Rhinoceros* of Nebraska possessed a horn upon the end of the nose, for although this portion of the face is not preserved in any specimens to determine the fact, yet the construction of the remaining portion of the face is more after the type of that of the true *Rhinoceros* than that of the *Aceratherium*. In this, according to the representation by Kaup (Fig. 2, Tab. X. of the Ossem. Foss.), the lateral notch of the anterior nares extends as far back as the commencement of the fifth molar tooth; or, as represented by De Blainville (Ost. Gen., Rhin., Pl. IX.), (who regards the *Aceratherium incisivum* as the female of the *Rhinoceros incisivus*, Cuvier, with which the name is synonymous), as far as the fourth molar tooth, thus leaving little width to the face from this point to the orbit, and a feeble support to the nasal bones from the ossa maxillaria, necessary to afford a firm basis to a nasal horn. On the contrary, in both species of Nebraska *Rhinoceros*, the lateral notch of the nares does not extend beyond the position of the first molar tooth, thus producing a great degree of relative breadth to the face, and an ample support laterally to the nasal bones, so as to enable them to sustain the horn, which probably tipped the nose. Both species of Nebraska *Rhinoceros*, at most, were unicorn, for the forehead is slightly depressed and smooth, and presents neither boss, elevated roughness, nor other indication of the existence of a frontal horn.

In the form of the upper molar teeth, the species of Nebraska *Rhinoceros* resemble the *Aceratherium incisivum* more than they do recent species of *Rhinoceros*, especially in the existence of a well-developed basal ridge on the inner side of the premolars.

In the smaller species of Nebraska *Rhinoceros*, incisor teeth existed in both jaws in the adult, as indicated in two specimens by small remaining fragments of the fangs, and it is probable that they also existed, under the same circumstances, in the larger species, although this is proved only for the upper jaw, one of the specimens of which yet preserves a portion of an incisive alveolus in the intermaxillary bone.

Rhinoceros Occidentalis, LEIDY.

(PLATES XII., XIII.)

Rhinoceros occidentalis, Leidy: Proc. Acad. Nat. Sci., 1850, v., 119; Ib. 1851, 276; Owen's Rep. of a Geol. Surv. of Wisc., etc., 552.
Aceratherium, Leidy: Proc. Acad. Nat. Sci., 1851, v., 331.

The materials which we have in possession to describe the larger species of *Rhinoceros* from Nebraska, are as follows:—

1. A skull, with the right superficial portion and end of the nose broken away, and otherwise much fractured and mutilated. It contains upon the left side all the molar teeth except the first, which fortunately exists upon the other side; but all the remainder are broken. From the collection of Dr. D. D. Owen.

2. Two fragments of lower jaws, from two other individuals; one containing the last two molars, the other the posterior three molars, except the last. From Dr. Owen's collection.

3. Nine fragments of as many upper molars, and eight small fragments of lower jaws, only two of which contain perfect teeth; apparently from three or four different individuals. From the collections of Messrs. Culbertson and Capt. Van Vliet.

The species was originally established upon several small fragments of molar teeth, procured by Mr. A. Culbertson, and its existence was afterwards confirmed by several entire molars brought home by Mr. T. A. Culbertson.

Description of the Skull.—The skull in the collection of Dr. Owen, is about three-fourths the size of that of the *Rhinoceros indicus*. Its upper part and left side, with the corresponding molar teeth, are comparatively well preserved. The specimen is an adult one, though it did not belong to an old individual, for all the molars are protruded, but in none is the enamelled triturating surface obliterated.

Lateral View.—(Pl. XII. Fig. 2.) One of the most remarkable features of the species is presented in the side view of the skull, viz.: the verticality of the inion, with the slight degree of inclination forward of the upper part of the head. Indeed, the latter is so nearly horizontal, that, in comparison with the skull of *Rhinoceros indicus*, it appears as if the two extremities of the head had been depressed, or, in other words, as if the head had been forcibly made straight. In connection with the peculiarity just described, a relatively large proportion of the temporal fossa is situated posteriorly to the root of the zygomatic process, which holds a position about the middle of the fossa, whereas in *Rhinoceros indicus* it is placed at the posterior third of the latter.

The zygomatic process extends from its root less outwardly, but rises more than in *Rhinoceros indicus*. Its upper margin slopes forward more than in the latter, and the upper surface of its root is nearly horizontal. The outer surface is vertical and convex; but anteriorly, or where the malar bone contributes to the formation of the zygoma, it is flat. The deepest part of the zygoma is just in advance of the glenoid articulation, and measures about two inches.

The meatus auditorius is vertically ovate, with the narrow part downward.

The temporal fossa has almost the same relative extent as in *Rhinoceros indicus*,

but it is longer, and less deep vertically. Superiorly, it is bounded by an acute ridge, diverging from the median line to the post-orbitar process. The parietal crest formed by the contiguity of this ridge of each side is broad and strong, and includes a median angular groove.

From the temporal surface, inclining to the middle line of the cranium, it appears more oblique than that of *Rhinoceros indicus*, but for two inches and a half above the zygomatic root it is nearly vertically convex. In advance of the root of the zygomatic process, the temporal fossa appears more deeply excavated than in the last mentioned species; and anteriorly it is better defined from the orbital cavity by a prominent pyramidal ridge, which proceeds in a curved line inward and backward from the post-orbital process to the position of the spheno-orbital foramen.

The side of the face from the post-orbital process forward is vertical. The orbit is excavated more transversely and deeply than in *Rhinoceros indicus*, and its orifice is better defined. The entrance constitutes three-fourths of a circle, and is bounded above by a very prominent supra-orbitar process, which is formed by the confluence of the antero- and post-orbitar processes. The surface of the supra-orbitar process is convex and rough, and its lower margin slightly overhangs the inferior edge of the orbit. The vertical diameter of the entrance of the orbit is two inches and a quarter; and it is defined below by a small pyramidal process at the junction of the malar bone with the zygomatic process of the temporal. The floor of the orbit is deeply concave, and terminates posteriorly by an abrupt convex margin. The lachrymal bone and foramen are too much broken to judge accurately of their form, but there appears to have been a single one of the latter, relatively of large size. The lachrymal process was small and rough. The face in advance of the orbit is much fractured in the specimen. It is relatively longer than in *Rhinoceros indicus*, and is quite vertical the entire extent. The greater portion of the infra-orbitar foramen is broken away, but sufficient remains to show its position to be about one inch and a half above the interval of the second and third molar. From a fragment of the left intermaxillary bone being preserved, it may be determined that the notch of the anterior nares was relatively short, compared with that of *Rhinoceros indicus;* and this bone is stronger, and is articulated by a finer serrated suture. It rises much more than in *Rhinoceros indicus*, its postero-superior extremity being even above the middle line of the face, or it is on a line with the inferior suture of the lachrymal bone, which is above the inferior margin of the orbit. The maxillo-intermaxillary suture is only a half an inch below the anterior portion of the naso-maxillary suture.

The intermaxillary fragment retains the bottom of the corresponding incisive alveolus, and this is just twenty-two lines from the posterior extremity of the bone in which it is situated, or is one inch and a quarter from the upper portion of the maxillo-intermaxillary suture, and presents some idea of the relative position of the incisive teeth compared with those of *Rhinoceros indicus*. So far as can be ascertained, the hiatus in advance of the molars to the intermaxillary bone has been about one inch and a half.

Superior View.—(Pl. XIII. 1.) The upper view of the head presents an extensive, depressed, trapezoidal surface. Commencing posteriorly as an angular groove, in-

cluded by the two ridges forming the parietal crest, it gradually expands forward, and, between the supra-orbitar processes, measures in its perfect state seven inches in breadth. On each side of the forehead above the anterior part of the orbits, and extending a short distance upon the nose, it is prominent and convex; but in the middle of the forehead, and upon the nasal bones, which incline slightly at their upper surface towards each other, it is transversely concave. Upon the forehead, in the specimen, are three slight exostoses.

The fronto-nasal suture is doubly crescentic with the conjoined horns directed forward. The lateral margins of the ossa nasi converge anteriorly, and are a little concave, but vertically are convex, and the naso-maxillary suture has been about three inches and a half in length.

Posterior View.—In examining the head from behind, the remarkable degree of lateral compression of the cranium in comparison with that of the *Rhinoceros indicus* is a striking feature of the species. The inion is exceedingly narrow in comparison with that of other species of *Rhinoceros*, and the occiput, in a corresponding degree, bulges out posteriorly, so that, in the median line, it projects at least an inch back of the position of the condyles.

In a corresponding degree with the narrowness of the cranium this is elongated, so that neither its capacity nor its surfaces for muscular attachment are less than in existing species of *Rhinoceros*.

In the specimen, the occipital foramen and condyles are too much broken to judge accurately of their form. The former appears to have been vertically oval, and not so much notched above as in *Rhinoceros indicus;* and it measured about one inch and a half in its long diameter, and one and a fifth in breadth. The condyles appear not to have differed in form from those of recent species of the same genus.

Inferior View.—(Pl. XII. 1.) The base of the skull is more nearly horizontal than in recent species of *Rhinoceros*.

A portion of one condyle, preserved in the specimen, indicates the position of the condyles to be more vertical than in *Rhinoceros indicus*. The angle of their articular surface is also more abrupt, is lateral, and nearly vertical. The posterior portion of the articular surface is directed backward and relatively slightly upward; the inferior portion forward and outward, or much less downward than in *Rhinoceros indicus*.

The basilar process in advance of the condyles is narrow, measuring a little over an inch only between the anterior condyloid foramina. It is elevated in the median line into a prominent acute crest, which is pyramidal posteriorly, and serves as a sort of abutment to the inferior termination of the condyles, and anteriorly it gradually decreases and vanishes at the prominent junction of the process with the post-sphenoidal body. The sides of the basilar process are concave antero-posteriorly, and form, between the condyle and the para-mastoid process, a deep concavity, at the anterior part of the bottom of which the condyloid foramen is situated.

The para-mastoid processes are broken in the specimen, and they appear to have been relatively small in comparison with those of *Rhinoceros indicus;* projecting, as they do, very little below the mastoid processes, which are much more robust in their proportions.

The foramen lacerum is relatively small compared with that of *Rhinoceros indicus*, and the foramen ovale, which is distinct from it, is situated on a line internally with the glenoid articulation.

The latter antero-posteriorly in comparison with its breadth, is relatively greater than in *Rhinoceros indicus*, and is directed more outwardly, and at its postero-external portion is more depressed.

The post-glenoidal tubercle is relatively short, thin, and broad compared with that of *Rhinoceros indicus*. It is obliquely compressed, and has one broad surface directed backward and inward; the other, forming part of the articulation, presenting outward and forward.

As in *Rhinoceros indicus*, the root externally of the pterygoid processes, is traversed by a short but large canal, into which opens a foramen representing the associated foramina rotundum and spheno-orbitale.

The passage to the posterior nares, between the pterygoid processes and vertical plates of the palate bones, has about the same relative extent as in *Rhinoceros indicus*.

The hard palate in the specimen is very much fractured, but the parts appear to have retained their natural relative position; and it is remarkable for its deep and narrow arched form. The molar teeth, in a nearly straight line upon each side, converge anteriorly, and are distant between the first premolars only nine lines, and between the anterior lobes of the seventh molars twenty-two lines. The inner sides of the molars, in advance of the posterior two, project internally beyond the alveolar margin, and gradually increase in this disposition to the first premolars, so that the passage between these latter and the hard palate forms nearly four-fifths of a cylinder.

Inferior Maxilla.—(Pl. XIII. 2–4.) Of the two fragments of the lower jaw preserved in Dr. Owen's collection, which are both of the left side of two different adult individuals, the one contains the last two molars and half of that in advance, and the other contains the third to the fifth inclusive. The depth of the lower jaw below the posterior molar is twenty-eight lines, and its thickness fourteen lines.

Superior Molars.—(Pl. XII.) The superior molars are about three-fourths the size of those of *Rhinoceros indicus*, and present a very great degree of resemblance to those of *Aceratherium incisivum*. All possess a basal cingulum, which, however, is feebly developed at the outer side of the antero-external lobe, and is entirely obsolete at the base postero-internally of the fifth and sixth molars, and for a narrow space internally upon the antero-internal lobes of the same pair of teeth. Upon the inner side of the base of the molars, from the second to the fourth inclusive, it is better developed than in the same position in *Aceratherium incisivum*.

In the seventh molar, the lobes are quite simple, neither of those within sending any sublobes into the single valley of the tooth, although they are very feebly bulging about the middle of their course.

In the corresponding lobes of the two molars in advance, the bulging of that anterior successively increases, while that posterior in the same position is constricted. This bulging of the lobes diminishes the depth of the principal valleys to a degree corresponding to its successive increase forward.

The bottom of the single, simple valley of the last molar is nearly level its whole length, and is bounded at its entrance by a prominent portion of the basal cingulum.

The principal valleys of the sixth and fifth molars are successively shallower externally, and deepen in a sloping manner toward their entrance, where they are partially closed by a prominent portion of the basal ridge, and hence, in the trituration to which the teeth are subjected, these valleys are obliterated from without inward, and leave no isolated enamel islands, or pits, as in the molars in advance, or in the corresponding teeth of *Rhinoceros indicus*.

In the sixth molar, the posterior valley is as deep externally as the principal valley, and in the fifth molar it is deeper.

In the specimen under consideration, trituration has left the principal valley of the fifth molar as a tract of enamel, which is narrow and slightly depressed externally and curves backward and inward, and expands and deepens as it approaches its termination.

In the second to the fourth molar inclusive, the inner lobes at their bases internally are confluent, and from the degree of trituration which the third and fourth molars have undergone in the specimen, the principal valleys are left as simple, oblique, trilateral pits or islets of enamel, occupying the centre of the exposed dentinal surface. In the second molar, from the less degree of confluence of the inner lobes internally, in addition to its being less worn, the principal valley still remains open.

In the fourth molar, the postero-internal lobe is not much more than half the thickness of that in advance ; but in the second and third molars, the inner lobes are nearly equal in size.

The basal cingulum of the molars, from the second to the fourth inclusive, envelops the base of the postero-internal lobes to a much greater extent than upon the antero-internal lobes, or rather these are shorter than the former, and the basal ridge descends in its course postero-internally, where it is very thick and strong, and is so prominent, that when the teeth are worn down so that the principal valleys remain only at their outer extremity as very small pits, the posterior valleys, which are very nearly as deep, would be left in the same condition.

The first molar in the specimen presents an almost equi-trilateral surface of exposed dentine, with the internal lobes of the crown curving inward and backward and dilating at their termination, and with the antero-external lobe forming its anterior rounded and prominent apex. Portions of a basal ridge connect the bases of the inner and the antero-external lobes together. The short principal valley remains as a narrow tract of enamel constricted at the middle and deepened at both extremities. The posterior valley remains as a small trilateral islet of enamel. Between the antero-external and internal lobes the basal ridge forms a broad cul-de-sac.

Inferior Molars.—(Pl. XIII. 2–6.) The teeth, preserved in the fragments of lower jaws referred to, belong all to the posterior four molars, and these do not differ in their form from those corresponding to them in recent species of *Rhinoceros*. A basal ridge with a rough margin exists in all, but is obsolete on the inner side of the

posterior three molars, and on the outer side of the posterior lobe of the same teeth, except the last. Between the bases of the lobes externally it forms a small tubercle.

Other Teeth.—No incisors are preserved in any of the specimens, but from a portion of alveolus preserved in one of the latter, already referred to, it is of course conclusive that incisors existed in the adult, at least in the upper jaw.

MEASUREMENTS OF THE HEAD AND TEETH.

	Lines.	Inches.
Length of skull from the upper margin of the occipital foramen to the inter-maxillary bone	16	9
Length of skull from same position to the first molar	15	4
Breadth of inion at the mastoid processes; estimated	5	0
Greatest breadth at the zygomata	8	0
From the tip of one post-glenoid tubercle to the other; estimated	3	6
Distance from the meatus auditorius externus to the lachrymal tubercle	8	0
Height of face from alveolar margin on a line with the anterior orbital margin	5	6
Height of face from alveolar margin on a line with the infra-orbitar foramen	4	6
Greatest breadth of forehead at the supra-orbitar processes	7	0
Length of upper molar series	7	3
Greatest breadth of seventh molar	1	7
Greatest breadth of sixth molar	1	8
Greatest breadth of fifth molar	1	7
Greatest breadth of fourth molar	1	6
Greatest breadth of third molar	1	4
Greatest breadth of second molar	1	0
Greatest breadth of first molar	0	9
Antero-posterior diameter of last lower molar	1	6
Antero-posterior diameter of the third lower molar	1	1

Rhinoceros Nebrascensis, Leidy.

(Plate XIV., XV.)

Rhinoceros Nebrascensis, Leidy: Proc. Acad. Nat. Sci., 1850, v., 121; Owen's Rep. of a Geol. Surv. of Wisc., etc., 556.

Aceratherium Nebrascensis, Leidy: Proc. Acad. Nat. Sci., 1851, v., 331.

Of the smaller *Rhinoceros* of Nebraska we possess portions of at least twelve different individuals, as follows:—

1. The anterior portion of a skull, accompanied by the lower jaw, of an adult individual. The former has the forehead, orbital entrance, and molar teeth well preserved, but the face is very much broken, and its nasal part is displaced. The lower jaw contains all the molars in perfect condition, but it has lost its rami and the symphysis. (XIV. 1–3.) From Captain Stewart Van Vliet's collection.

2. A much mutilated face, containing on both sides the molar teeth nearly perfect. It belonged to a nearly adult individual, as the teeth, which belong to the permanent series, are all in place except the last, which has about two-thirds protruded. (XIV. 13.) From the collection of Dr. Owen.

3. The skull, accompanied by a small fragment of the lower jaw, of a very old individual. The former has its upper part broken away, but the base is nearly

entire; and it contains all the molar teeth, which have their crowns worn nearly to a level with the alveolar margin. (XV. 1, 2.) From Dr. Owen's collection.

4. The crowns of four permanent premolars of the left side of the upper jaw and one of the right side. These are perfect and are not at all worn, having been concealed within the maxillary bones, from which they were removed with much labor. (XIV. 4–8.) Presented to the Academy of Natural Sciences, by Mr. Alexander Culbertson.

5. A small fragment of an upper jaw containing the first permanent true molar, slightly worn, and a portion of the fourth permanent premolar, which was still concealed within the bone. From Dr. Owen's collection.

6. A small fragment of an upper jaw, with an unworn sixth molar, and the seventh unprotruded. From Mr. Culbertson's collection.

7. A second inferior permanent molar, and two fragments of lower jaws. One of the latter contains the fifth molar unworn, and the other contains a sixth molar partially protruded. All three specimens are apparently from different individuals. From Mr. Culbertson's collection.

8. A fragment of the right side of a lower jaw, containing the last three molars. From Dr. Owen's collection.

9. A fragment of the left side of a lower jaw of a very young animal, containing the last temporary molar unworn, and the first permanent true molar protruded. (XIV. 9, 10.) From Dr. Owen's collection.

10. A fragment of the right side of the upper jaw, containing the posterior three temporary molars, which are considerably worn. (XIV. 14.) From Mr. Culbertson's collection.

Description of the Head.—The skull of *Rhinoceros Nebrascensis* is about three-fourths the size of that of *Rhinoceros occidentalis.*

Lateral View.—(Pl. XIV. 1; XV. 1.) So far as can be ascertained from the imperfect specimens, the side of the head presents most of the characters of that of *Rhinoceros occidentalis.*

The root of the zygomatic process is implanted about the middle of the bottom of the temporal fossa, and its upper surface is antero-posteriorly convex.

The temporal surface is convex and smooth, and, as in *Rhinoceros occidentalis*, apparently rose upon a prominent sagittal crest. Its occipital border curves from the base of the mastoid process upward and backward to the summit of the inion.

The squamous portion of the temporal bone is nearly vertically convex, and is an inch in height above the root of the zygomatic process.

The squamous suture at its upper part pursues a course almost horizontal for nearly three inches. At its posterior part, in the particular specimen under investigation, there are two deep, ascending, vascular grooves.

The orbit has about the same form as in *Rhinoceros occidentalis*, but in the specimens its floor is more superficial.

The optic foramen is large and vertically oval, and is placed an inch in advance of the spheno-orbital foramen.

The margin of the orbital entrance is as well defined as in *Rhinoceros occidentalis;* but the supra-orbitar process is neither quite so prominent nor so rough.

The post-orbital process, though merely the termination of the supra-orbital margin, is nevertheless well marked compared with its condition in *Rhinoceros indicus*.

As in the latter, there exists a prominent lachrymal process; but there are two lachrymal foramina, placed one above the other internal to the process.

The malar bone is robust, and in its course is directed a trifling degree more outward than in *Rhinoceros occidentalis*, and its external face presents more upward.

The alveolar portion of the face is vertical, but antero-posteriorly is convex. The position of the lachrymal bone presents an oblique slightly depressed surface.

The infra-orbital foramen is placed about an inch above the interval of the second and third molar teeth.

In all the specimens, the remainder of the face is too much broken to form any correct idea of its form.

Superior View.—(Pl. XIV. 11.) The forehead, preserved nearly entire in one specimen, is broad, and above the orbits is elevated and convex, but is depressed towards the median line. The temporal ridges converging from the post-orbitar processes are relatively not so prominent as in *Rhinoceros occidentalis;* but, as in this, they evidently conjoin to form a sagittal crest.

Posterior View.—(Pl. XIV. 12.) The inion has a more trilateral outline than in *Rhinoceros indicus*, and in the middle it is much more bulging or prominent, so that the superior angular margin of the foramen magnum projects considerably posterior to the basilar margin. Towards the summit the median portion of the surface of the inion becomes depressed, and each side is directed quite laterally in its course to the temporal margin.

The occipital condyles are more vertical in their relation to one another than in *Rhinoceros indicus;* and above each there is a well-marked depression of the surface.

The occipital foramen is subrotund, and about ten lines in diameter, and it has an angular margin above and a concave one below. It is directed backward and a little downward.

Inferior View.—(Pl. XV. 2.) In the specimen in which the base of the skull is preserved, the junction of the basilar process and sphenoidal body is completely obliterated. Near its position on each side is a superficial rough elevation for muscular attachment.

The median line of the basilar process is prominent, and each side is slightly depressed.

The sphenoidal bodies are prominently convex, and within the roots of the pterygoid processes slope on each side to form a broad shallow groove for the Eustachian tube.

Separated by the anterior scroll-like terminations of the occipital condyles, a distance of ten lines, are the anterior condyloid foramina, which are oval and three lines in diameter antero-posteriorly.

To the outside of the latter, and a little in advance, is the para-mastoid process, existing in the specimen as a broad stump, compressed antero-posteriorly.

The mastoid process forms the posterior abutment of a high arch conducting to the entrance of the tympanic cavity, or in other words the meatus auditorius, as it

exists in *Rhinoceros indicus*, is open at the bottom. The process is strong and is bent forward at its apex, which is tuberous and extends nearly as far downward as the post-glenoid tubercle, from which it is about five lines distant.

The pars petrosa is quite small. It appears at the bottom of the arch between the post-glenoid and para-mastoid processes, as a V-shaped body, bent forward at its lower part by the base of the styloid process.

The remaining portion of the latter, in the specimen, is a stout cylinder clasped antero-internally by the os petrosa.

Between the bottom of the styloid and para-mastoid processes is the stylo-mastoid foramen.

The foramen lacerum is a very large reniform vacuity, being about an inch in diameter antero-posteriorly, and about four lines transversely.

In advance of the latter a few lines is a distinct foramen ovale, and a short distance antero-internal to this is a round foramen, conducting into the homologue of the foramina rotundum and spheno-orbitale.

The latter opens at the bottom of the orbit just internal to a pointed process arising from the conjunction of three ridges; one of which comes from the margin of the foramen, the other from above the position of the optic foramen, and the third constitutes the boundary of origin between the temporal and external pterygoid surfaces.

The optic foramen is placed about an inch in advance of the spheno-orbitale.

The glenoid articulation is more concave than in *Rhinoceros indicus*, and that portion of its surface situated on the anterior part of the root of the zygomatic process presents more backward and outward.

The post-glenoid tubercle, compared with that of *Rhinoceros indicus*, is relatively short; at its outer margin being ten lines in length, and it projects only two lines below the mastoid process. What it loses in length it gains in robustness and breadth; and its outer side is rough, and the apex truncated. Posteriorly it is perforated by a vertical foramen.

The interpalatine notch extends forward as far as the posterior third of the penultimate molar tooth.

The hard palate is strongly arched, though not so much as in *Rhinoceros occidentalis*, and it also differs from that of the latter in being relatively broader, and less convergent at the alveolar margin anteriorly.

Inferior Maxilla.—(Pl. XIV. 2.) The body of the lower jaw externally is vertically convex, and anteriorly is more convergent than in *Rhinoceros indicus*. Its depth below the posterior molar tooth is about twenty lines; below the first molar, fifteen lines. The base is rounded, and is about as convex antero-posteriorly as in the last mentioned species.

In the specimen under investigation, the symphysis is broken off a few lines in advance of the molars, and it there presents a crescentic surface only ten lines broad and six deep, indicating the inferior incisor teeth to be of small size in this species. Upon each side of the broken surface, about three-fourths of an inch from the position of the first molar teeth, there remains the end of the fang of the external incisors.

The anterior mental foramen occupies a position near the base of the bone below the hinder fang of the second molar of the remaining series. In advance of it, on nearly the same line, are two other and smaller foramina of the same kind.

A portion of the ramus shows this to have been thin and deeply excavated internally, as in the Tapir. The posterior mental foramen is large, and placed about one inch behind the last molar tooth.

Dentition.—Except the first inferior molar tooth, which is shed at an early period, the entire series of permanent molar teeth in *Rhinoceros Nebrascensis* is retained to a late period of life, as is indicated by the specimen of a skull of a very old individual in the collection of Dr. Owen, in which, although the crowns are almost completely worn away, yet the whole number remains.

From minute fragments of fangs of an upper and lower incisor existing in two of the adult specimens under investigation, we are satisfied of the existence of these teeth permanently, but the number we have no means of ascertaining.

Superior Molars.—(Pl. XIV. 1, 13; XV. 3.) The upper molars bear a very great resemblance in form to those of *Aceratherium incisivum;* and they possess a basal ridge all round except at the inner side of the bases of the internal lobes of the true molars, and where it has been obliterated by pressure from the teeth in contact.

The outer surface of the true molars is broad and slightly depressed at the middle, and at the anterior fifth forms an abrupt fold, as in all other species of *Rhinoceros.*

The last molar exhibits a disposition to the development of a posterior valley, or rather a separation, as in the other molars, of the postero-internal and external lobes. The anterior valley of this tooth is almost as deep as the crown, is nearly level at bottom, and is bounded at its entrance by a mammillary eminence, which is a portion of the basal ridge. The hinder lobe is quite simple, and exhibits no tendency to encroach upon the anterior valley; but the antero-internal lobe at its middle posteriorly protrudes considerably into the latter.

The inner lobes of the true molars in advance expand gradually to their base, are impressed anteriorly, and protrude into the valleys about their middle posteriorly. The valleys are of equal depth at their outer extremities or termination, and the principal ones, except in the penultimate tooth in one specimen in which the bottom throughout is nearly uniform, deepen towards their entrance, so that in the trituration to which the teeth are subjected in mastication, as in *Rhinoceros occidentalis* and *Aceratherium incisivum*, they become obliterated from without inwardly. The entrance of the anterior or principal valleys in the fifth and sixth molars is not obstructed by the existence of a constituent portion of the basal ridge, as in *Rhinoceros occidentalis.*

A small fragment of an upper jaw, presented to the Academy of Natural Sciences by Mr. Alexander Culbertson, contained the crowns of the four premolars entirely concealed within the bone. These, having been divested of their hard envelop, are remarkable for their state of preservation and beauty, and lead me to describe them more minutely than may be considered essential. (XIV. 4–8.)

The first premolar is only three-fourths the size of the others, and it is trilateral with the inner and posterior sides, forming a continuous convexity. The posterior

three premolars increase slightly to the last one, and they are quadrate and have the inner side convex and narrowest.

The outer side (4) of these teeth forms a large quadrilateral surface with rounded angles. It is slightly convex, and is feebly waved longitudinally. At the fore part a narrow fold descends from the base and expands towards the triturating margin; but it is successively less developed forward, and in the first of the series is rudimentary. This fold increases in depth in the true molars, and is quite characteristic of the outer part of these teeth in *Rhinoceros*, as it does not exist in *Palaeotherium*, *Titanotherium*, nor *Anchitherium*.

In advance of the fold just described, the antero-external margin of the molars projects forward and slightly outward, and looks like an independent column or buttress, and is the shortest portion of the outer lobes.

The triturating margin of the latter, in the specimens of premolars under especial examination, is bilobed and acute.

The inner surface of the postero-external lobe is a little convex, and from the same surface of the antero-external lobe in the third and fourth premolars an abrupt fold projects into the principal valley of the teeth (5). This fold, when the teeth are partially worn away, gives the termination of the principal valley a bifurcated appearance; and in *Rhinoceros indicus* and *Rhinoceros tichorinus* it is the extension and confluence of the fold with the anterior part of the postero-internal lobe of the teeth which produces a division of the principal valley, represented when the teeth are considerably worn away by two enamel pits.

The internal lobes have acute summits and more or less expanding bases, and, except in the first tooth, their inner extremities for more than half their depth are confluent, so that the principal valley is a deep pit, with shelving sides and an internal notch (5, 6).

In the fourth premolar, the postero-internal lobe is a sigmoid fold projecting from the confluence of the outer lobes.

In the three premolars in advance, the postero-internal lobe consists of two portions; an inner pyramid with two broad sides directed obliquely antero-posteriorly, and a bent fold extended between the confluence of the outer lobes and the outer side of the pyramid, and separating the two characteristic valleys of the teeth. This fold does not reach the summit of the inner pyramid, nor of the outer lobes, and it looks more like a narrow partition separating the valleys than a constituent portion of the postero-internal lobes.

The antero-internal lobe of the premolars, except in the first, is directed transversely inward on a line with the characteristic fold of the outer surface of the teeth, and it expands as it approaches its termination, and antero-internally swells into a sort of conoidal buttress, gradually increasing in distinctness from the second to the last premolar. In the first premolar it appears only as a small, compressed mammillary eminence of the basal cingulum.

The latter, as in *Rhinoceros occidentalis*, is well developed upon all the premolars. In the specimens under special examination, ossification had not yet advanced to its production, externally (4), but in older specimens in this position it measures over a line in depth (1). At the postero-external margin of the teeth it very

abruptly descends half the length of the crown (6), then, proceeding inward, it envelops the base of the postero-internal lobe, and internally it ascends to the base of the antero-internal lobe, and winds anteriorly to the antero-external margin of the crown, and then makes an abrupt ascent to the base externally (7, 8).

The anterior and posterior valleys in all the premolars are deep culs-de-sac with shelving sides (5).

When the molar teeth have had one-half their crown worn away in mastication they are hardly recognizable in those which have not been subjected to trituration. Comparatively with one another, they of course suffer attrition most in the order of their succession, and this, judging from the specimen in Dr. Owen's collection, in which the seventh molar is only partially protruded, may be determined to occur in the following manner. After the temporary teeth, the fifth molar is protruded, and in the permanent series appears most worn; then succeed the first to the fourth permanent molars, then the sixth, and finally the seventh (13).

In the specimen of the skull containing all the molars, presented by Capt. S. Van Vliet to the Smithsonian Institution, these teeth are worn about one-half away, and exhibit very strikingly the transformation of form produced by attrition. (XV. 3.)

The enamelled grinding surface of the fifth molar, except a short inlet constituting the entrance of what was the principal valley, has been completely obliterated. The exposed dentinal surface is concave, and bordered by enamel, except anteriorly and posteriorly, where it also appears to have been removed, probably from the combined influence of long-continued pressure and friction from the contiguous teeth.

In the sixth molar, the exposed dentinal surface is more deeply bilobed internally than in the former; or, in other words, a longer tract of enamel remains from the anterior valley; and farther, almost the whole of the bottom of the posterior valley yet remains.

The seventh molar, from its being the last to take its position in the functional series, is worn less than any of the others. Its valley remains entire, except that it is rendered a little more shallow, from the summits of the lobes which embrace it being worn off. The exposed dentinal surface presents an irregular V-shaped figure, with the apex and extremities of its arms bifurcated.

The second to the fourth molars inclusive present nearly square dentinal surfaces bordered with enamel, bilobed internally, and possessing, each, two trilateral pits of enamel, the remains of the valleys. The central pit is the larger, and has convex sides and rounded angles; and the smaller pit is in contact with the posterior border of the teeth.

The exposed dentinal surface of the first premolar, in the specimen, upon one side of the jaw, has two small circular pits of enamel, and on the other, a single trilateral pit, which remains from the posterior valley; and in both teeth a cul-de-sac in connection with the internal border exists before and behind the rudimentary antero-internal lobe.

When the enamelled triturating surfaces of the molars are completely obliterated by mastication (1, 2), as is the case in the specimen of a skull of a very old animal in the collection of Dr. Owen, the exposed dentinal surfaces are quadrate and bilobed

The inferior last temporary molar preserved unworn, in company with the first permanent true molar protruded, in a fragment of lower jaw, exhibits a disposition to the formation of three lobes, by the ordinary anterior normal lobe being deeply notched at its anterior horn, while in advance of this a smaller transverse lobe, slightly bent forward and inward, is developed at its outer side. A continuous basal ridge surrounds the tooth, which otherwise than in the characters given corresponds with the permanent molars. (XIV. 9, 10.)

MEASUREMENTS OF THE HEAD AND TEETH.

	Inches.	Lines.
Length of skull from the upper margin of the occipital foramen to the anterior part of the first molar tooth	9	0
Breadth of inion at ends of mastoid processes	3	0
Greatest breadth at the zygomata (estimated)	5	2
Breadth at the post-glenoid tubercles	3	4
Distance from meatus auditorius to the lachrymal tubercle	4	6
Height of face from the alveolar margin on a line with the middle of the orbit	3	4
Greatest breadth of forehead at the supra-orbitar processes	3	5
Breadth of hard palate about its middle	1	7
Length of upper molar series	4	10
Length of lower molar series	4	4
Breadth of last superior molar	0	11
Breadth of fourth molar	0	11
Breadth of first molar	0	6
Antero-posterior diameter of fifth upper molar	0	11
Antero-posterior diameter of second upper molar	0	$8\frac{1}{2}$
Antero-posterior diameter of first upper molar	0	$6\frac{1}{2}$
Antero-posterior diameter of last lower molar	0	11
Antero-posterior diameter of first (of six)	0	$7\frac{1}{2}$
Breadth of fourth lower molar	0	$6\frac{1}{2}$