On the geological position of the Castoroides ohioensis / by James Hall ; also a description of the cranium of the same, by Jeffries Wyman.

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Publication/Creation

Boston : Printed by Freeman and Bolles, 1846.

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ON THE

GEOLOGICAL POSITION

OF THE

CASTOROIDES OHIOENSIS,

BY

JAMES HALL, Esq.
ONE OF THE NEW YORK STATE GEOLOGISTS.

ALSO

A DESCRIPTION OF THE CRANIUM OF THE SAME,

BY

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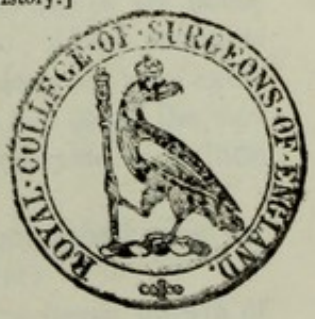
PROF. ANAT. AND PHYS. MED. DEP. HAMPDEN AND SIDNEY COLLEGE.

[Extracted from the Boston Journal of Natural History.]



BOSTON:
PRINTED BY FREEMAN AND BOLLES.
1846.

CASTOROIDES OHIOENSIS.

I. GEOLOGICAL POSITION.

The cranium was received from Rev. Benjamin Hall, D. D., President of Geneva College, and was discovered in a swamp on the farm of Gen. W. H. Adams, of Clyde. The situation in which it was found is an elevated plateau or level tract of land, a portion only of which would be denominated a swamp, though the whole surface is covered with a peaty soil which supports a heavy growth of elm, hemlock and ash, with some maple and beech. This elevated ground is the summit level, from which the waters flow in opposite directions, into Lake Ontario on the north, and into the Clyde river, and thence into the Cayuga and Seneca lake outlets on the south. The precise locality of the fossil was near the termination of a shallow ravine, or the bed of a small stream, which flows into Lake Ontario, in a northeasterly direction.

The extent of this level tract is about five or six miles, while its width, in most parts, is much less. Along nearly its entire length a canal of eight or ten feet deep has been excavated, and in this excavation, about eight feet below the surface, the skull was found, the lower jaw separated some little distance from the cranium.

A section at this place, and at numerous others near the same spot, presents the following characters:

1. Muck, or vegetable soil, supporting a heavy growth of timber, two feet or more in thickness.

2. Fine sand, with occasional thin bands of clay, often consisting of alternating layers of sand, twigs, leaves and other fragments of vegetable matter, and much blackened thereby; two to three feet thick.

3. Muck or peaty soil, composed of decayed fragments of wood, bark, leaves, &c., enclosing trunks of trees of large size, about four feet thick.

Skull of Castoroides Ohioensis.[1]

4. Fine sand, with shells of Planorbis, Valvata, Cyclas, &c., one to two or three feet thick.

5. Ancient drift, with northern bowlders and fragments of the sandstones and limestones, which occur in place a few miles farther north — depth unknown.

The thickness of 2, 3, and 4, is variable, though the bottom of No. 3 usually varies little from the depth of eight feet from the surface. A glance at the section reveals the true period of the deposit, showing conclusively that the whole is a lacustrine formation, made subsequent to the deposition of the ancient drift, (No. 5,) which is characterized by its foreign materials, while in the later deposit not a pebble of the size of a pea can be found.

The section of the bank of the Sodus canal presents the character here given, for the space of a quarter of a mile or more, in a north and south direction. To the southward the stratum No. 3, with trunks of trees, &c., gradually disappears, and the two layers of fine sand are united in one, which is still surmounted by the vegetable soil above, and rests upon the drift below. This sand is regularly stratified, the lines of division being almost perfectly horizontal, and very regular. Towards the north the sand generally gives place to clay, with the disappearance of the fossil wood, &c.

The direction of the fallen trees in No. 3 of the section, as well as of the branches and twigs in No. 2, indicate that dur-

[1] Among the fossil wood above mentioned, were plain marks of the teeth of the beaver, and but for the size of this skull I should have supposed it to be one of that race.

ing the deposition of these materials, the direction of the current was towards the north or north-east; and this is corroborated by the fact that the southern part of the deposit is wholly composed of sand, while the clay increases towards the north. From what I can learn of its elevation, it corresponds very nearly with the "ridge road" bordering Lake Ontario, which I have fully described in my Report on the Geology of New York. The portion of country now under consideration doubtless formed at that period an estuary through which a considerable body of water flowed into Lake Ontario, and upon the bed of which has been deposited the sand, fallen trees, &c., of this formation. Indeed it appears quite probable that this was a part of a great estuary, through which the waters of the Cayuga and Seneca lakes flowed into Lake Ontario; the existence of which I have shown to be probable at the time when the latter lake stood at the elevation of the "ridge road." This view has received additional proof from the excavation along the Sodus canal, which passes through the locality under consideration. From this excavation we can demonstrate that for five or six miles north of Clyde there is no barrier of solid rock rising to a height sufficient to prevent the water flowing from the outlet of Canandaigua lake, at Clyde, into Lake Ontario. Indeed the excavation already made to the surface of the drift, does actually drain the water from this outlet at Clyde, during high water in the streams, and were this channel excavated a few feet deeper, it could be made the outlet not only of the waters of Canandaigua lake, but also of the waters of Cayuga and Seneca lakes, which now pass into Lake Ontario by the Oswego river.[1]

[1] To those unacquainted with the physical features of this part of the country, it may be necessary to state that the outlet of Canandaigua lake and the waters of Mud creek, a stream which drains the deep valley west of Canandaigua lake, form the Clyde river, which unites with the outlets of Cayuga and Seneca lakes, in the Cayuga marshes. The descent of this river from Clyde eastward is so little, that a strong south wind, pressing the water northward in these two lakes, elevates the water in the river at Clyde, from which place, as we have seen, a cutting of ten feet will furnish an outlet into Lake Ontario, or into the channels of streams flowing into that lake.

I am informed by General Adams, that he has caused the whole distance along this line to Lake Ontario, to be probed, and there is no rock within twenty or thirty feet of the surface, proving the entire practicability of draining these marshes in that direction ; — a project worthy of consideration.

The condition of the surface, at the time of the existence of this animal, is a matter of much interest ; and admitting to be true what we consider as having been pretty well demonstrated, namely, that Lake Ontario was at an elevation of one hundred and fifty or two hundred feet above its present one, and having a direct communication with the smaller lakes on the south, we are able to show that extensive tracts would have been marshes and estuaries, with the more elevated ridges of drift only raised above the level of the waters, giving a vastly greater proportion of this kind of surface than at present. Thus far the bones of the mastodon and elephant have all been found at a higher elevation than the relic under consideration, and this is precisely what we should expect, with the condition of surface we have described. The animal in question doubtless found the extensive marshes, with wooded margins and intervening higher grounds, well adapted to its wants and mode of life. That its remains have been so rarely met with, may be explained from the fact, that very few extensive excavations have been made in situations likely to contain them ; while the smaller and more elevated marshes, where the bones of the mastodon have been found, are more accessible and oftener excavated. Therefore, from all we know at present, this animal may have abounded on the marshy borders of the former Lake Ontario, when the now fertile regions of Oswego, Wayne, Monroe, Orleans and Niagara counties, as well as the corresponding parts of Canada were mostly covered by water and marshes.

So far as the general features are concerned, and the relative age of the deposition, there cannot remain a doubt ; and although as yet no other bones have been found with this cranium, we feel justified in referring its period to that of the

great mastodon and other animals of our country, whose remains have been found in similar situations. The relative level of the surface of the country, at this place, varies very little from that of Rochester, where the bones of a mastodon were found some years since.[1] The bones found at Genesee, many years since, were proved to have occurred in the marl of a swamp, over which was deposited a layer of peaty matter.[2] All the other situations, where similar bones have been found, correspond to this one in general characters, with perhaps the partial exception of the tooth of a mastodon found at Niagara, in a modern alluvial, in which, however, were found fluviatile shells of existing species.

From all the facts adduced, it will not be questioned that the remains of the mastodon do occur in situations proving their existence upon the surface subsequent to the period when it has undergone any great change. Or, in other words, the surface of our globe had arrived at its present condition, essentially, at the period of the existence of the mastodon and other animals whose remains are associated with it. Now although the specimen in question was not found associated with remains of this kind, yet the deposit in which it occurs is of the same age, and the shells are of existing species. We might be willing to admit its existence without this attempt at proof, but it is still desirable to establish, beyond doubt, the fact. The only fossil bones of a similar animal before known, are the lower jaw, together with the upper incisor and the radius. These bones were found with those of the mastodon, in the bottom of a peat swamp in Ohio, at the depth of fourteen feet from the surface, resting on a bed of pebbles and gravel, and they are represented as considerably worn by attrition before their deposition. Their position being upon the surface of these drifted matters, even were that deposit the older drift, would not prove them coëval, since they are preserved in the "car-

[1] See Geological Report of the Fourth District, N. Y., 1843, p. 363. Lyell.
[2] See as above.

bonaceous mud," which was evidently a quiet deposition in the shallow basin, made long after the coarser materials at the bottom had been deposited. At the same locality, (two miles north of Nashport, between the Muskingum and Licking valleys, on Wakitomika creek,) were found also the bones of a ruminant animal, at the depth of eight feet from the surface. This was in all probability coëxistent with the animal in question and the mastodon.

The discovery of this relic has added a very interesting species to the ancient Fauna of the state of New York, of which we before possessed only the remains of the mastodon, the elephant, and possibly a deer, a jawbone and teeth of this last animal having been found in a swamp, with the bones of the mastodon, in Greenville, Greene county, New York.

Although attaching little importance to the discovery of wood gnawed by beavers in these swamps, I may notice, in connection with the present example by General Adams, the following:

"Mr. Williams, one of the assistant engineers, has informed me, that at the summit level of the Genesee Valley Canal, at New Hudson, four miles from Cuba, several deers' horns and the horn of an elk, [*Elaphus canadensis*,] were found twelve feet below the surface, in a muck deposit. In the same situation, a piece of wood gnawed by beavers was also found. These are all the remains of existing animals, but their position is the same as that in which the remains of the mastodon are found."[1]

From the few facts which have come to our notice, we are induced to believe that the geographical distribution of this animal must have been very extended; for its remains have been discovered in New York, in Ohio, and, as we have been recently informed, in the neighborhood of Natchez.

II. ANATOMICAL DESCRIPTION OF THE CRANIUM.

Among the fossil remains of extinct Mammalia heretofore

[1] Geological Report, Fourth District, New York, p. 367, note.

discovered, those of Rodents do not appear to have been abundant, nor remarkable for their size. In no instance, excepting that of the Castoroides, have they excelled or even equalled the bones of the existing Capybaras of South America, which are by far the most gigantic Rodents belonging to the actual condition of the globe. The largest fossil species referable to the order above mentioned, belong to the genera Castor,[1] *(C. Europæus,)* and Trogontherium,[2] *(T. Cuvieri,)* the first identical with the existing European species, and the second about one fifth larger.

Remains of the *Castoroides Ohioensis*, consisting of an imperfect half of a lower jaw, an incisor tooth of the upper, and a radius, were first brought to the notice of the scientific world by Mr. J. W. Foster, one of the assistants in the geological survey of the State of Ohio; they were exhumed in company with a cranium belonging to the genus *Ovis*, molar teeth and bones of Mastodons, elephants and other animals.[3]

The generic characters deduced from these remains, by Mr. Foster, are as follows: "Teeth — incisors, $\frac{1}{1}$ $\frac{1}{1}$, destitute of canines; molars, $\frac{4}{4}$ $\frac{4}{4}$; total, 20; incisors of the lower jaw, convex in front, and longitudinally striated; posterior surface angular, smooth, and slightly concave. The grinders are obliquely traversed by six ridges or folds of enamel." "The *Castoroides* was an animal closely allied to the beaver, but far surpassing it in magnitude; its life was probably aquatic, and its food consisted of vegetable substances, which it gnawed off with its powerful incisors."[4]

[1] *C. Europæus*, Owen British Fossil Mam. and Birds, p. 190; *C. des Tourbières*, Cuv. Oss. Foss. 3d edit. T. V. Pt. I. p. 55; *C. fossilis*, *Goldfuss*, Nov. Act. Nat. Curios. T. XI. Pt. II. p. 488; *Trogonth. Werneri*, Fisch., Mem. de la Soc. des Nat. de Moscow, T. II. p. 250.

[2] *Trogonth. Cuvieri*, Fisch., Mem. de la Soc. des Nat. de Moscow, T. II. p. 250; *Castor trogonth.* Cuv., Oss. Foss. T. V. Pt. I. p. 59; *T. Cuvieri*, Owen, British Foss. Mam. and Birds, p. 184.

[3] Second Report on the Geological Survey of the State of Ohio, p. 81, et seq.; Am. Journ. Science, Vol. XXXI. p. 80.

[4] From a notice of these remains in the American Journal of Science, Vol. XXXI. p. 80, it would appear that the radius was ten inches in length, two inches across

An accurate cast of the lower jaw above described,[1] was made, and now exists in many museums in the United States. On comparing this cast with the lower jaw of the cranium now under consideration, no question can exist as to their belonging to one and the same species; but on reviewing the generic characters given by Mr. Foster, as will be seen hereafter, they will be found insufficient to characterize the genus, and as regards the molar teeth, his description is not in accordance with the anatomical peculiarities of those organs.

Until the present time no description of an entire cranium has been published, and as far as can be learned, the present is the first instance of the discovery of one in a perfect condition. It is that of an adult, measures 10.5 inches in length, and 7.2 inches across the broadest part of the zygomatic arches; the transverse diameter of the occiput is 5.5 inches, and that of the narrowest part of the cranium, between the orbits, is 1.9 inch. In its general outline it resembles that of the Castors; but in its dentition it more closely resembles the Capybaras than any other Rodents, and among the Pachydermata, it presents close analogies to the elephants. To the structure of the pterygoid fossæ, analogies are found in the Ondatras.

On comparing the cerebral portion of the skull with that which lodges the nasal cavities, the former is relatively much smaller than in the Castors, Ondatras, and Capybaras. In Castoroides the longitudinal diameter of the cerebral cavity is less than two-fifths of the entire length of the skull; in the Castor the same cavity is one-half, and in the Ondatra more than half the length of the skull.

The upper surface of the cranium is much more flattened than in the Castors, and the interparietal crest extends the

the head, and one and a half inches across the carpal extremity. The upper incisor tooth found with the same remains, measured along its curve, eight inches; its two extremities, however, were mutilated. The lower incisor was much less curved than the upper, and has a length of nine inches: the lower jaw itself measured eight inches.

[1] Now in the Zanesville Athenæum.

whole length of the sagittal suture — posteriorly this crest has an elevation of nearly half an inch, where it is crossed by another, which separates the occipital from the coronal region; anteriorly it terminates in two diverging ridges, which are lost on the upper edges of the orbits. A triquetrous bone relatively much smaller than in the Castor, exists at the union of the sagittal and lambdoidal sutures.

The occiput resembles that of the Castors but is more depressed, having a transverse diameter of 5.5 inches, and a vertical one of 2.6 inches; its plane inclines forwards so as to form an angle of about 80° with the base of the skull. The foramen magnum is very regularly oval, like that of Arctomys, its transverse diameter measuring 1.2 inches, and the vertical 0.6 inch — unlike the Castors, Ondatras, and Capybaras, it is destitute of an emargination on its upper border. The occipital condyles are semiterminal, forming a gynglimoid articulation with the atlas, which allows a free vertical motion on the vertebral column, but precludes the possibility of any but a very slight one in a lateral direction. The basilar portion of the occiput has a slight ridge on the median line, and at its union with the sphenoid bone there exist two conical projections, united by a transverse ridge, and are coössified with the inner pterygoid processes, thus forming a part of one of the entrances to the posterior nares.

The tympanic portions of the temporal bones present very nearly the same conformation as in the Capybaras; at the inner extremity, however, there exists a broad plate or process having a concavity forwards, which enters into the formation of the posterior limit of the pterygoid fossa. The external auditory meatus, like that of the Castors, consists of a long tubular process, about an inch in length, and extending upwards and forwards in a curved direction; the external orifice of which scarcely exceeds that of the common beaver.

In the development and conformation of the pterygoid processes, the Castoroides differs from all the existing Rodentia.

Both processes articulate with the tympanic bone, but the development of the external plate is by far the greatest; the internal, however, has the remarkable peculiarity of being curved inwards towards the median line, so that the most prominent part of its convex surface is brought in contact with that of the corresponding process of the opposite side. In consequence of this, the entrance to the posterior nares, or the meso-pterygoid fossa, is completely obstructed in its middle portion, and instead of one large quadrangular orifice, as in other Rodentia, we have two distinct orifices; one of these, superior, of a pyri-form shape, the circumference of which is formed in part by the posterior extremities of the pterygoid processes, and in part by the anterior or basilar portion of the occipital bone; the second, inferior, is formed by the origins of the same processes and the posterior edges of the ossa palati.

The pterygoid fossa has a depth of about two inches, which added to the great breadth of the outer process and the curvature of the inner, gives an extraordinary surface for the origin of the internal pterygoid muscle. The fossa serving for the origin of the external pterygoid muscle, involves the whole of the greater wing of the os sphenoides, and is more remarkably developed than in any of the allied genera.

The triangular-shaped palatine space comprised between the two ranges of molars has a length of two inches; posteriorly it is 1.8 inch in breadth, but anteriorly is so much contracted as to leave a space of 0.3 inch only between the first molars. The posterior palatine foramina are elongated elliptical openings, having a longitudinal diameter of 0.5 inch, and directed obliquely outwards.

The ossa palati terminate anteriorly opposite the space between the first and second molars, at which point commences a ridge, at first not well defined, but afterwards becoming well marked, and extending as far forwards as the foramen incisivum; commencing in front of the first molar, on each side, is another ridge, less distinct, and terminating on the side of

the same foramen. In the Castors the central ridge extends backwards quite to the posterior edge of the palatine bones.

The incisive foramen, which in the Castors, Ondatras, Marmots, Agoutis, &c., acquires so great a size, is in the Castoroides proportionally remarkably small, scarcely allowing the passage of an ordinary probe.

The anterior edge of the first molar is situated just in the middle of the base of the skull, but in the other genera above referred to, it is always in advance of the same point. The alveolar portion of the intermaxillary, situated just below the nasal orifice, presents a deeply indented and roughened surface, serving for the attachment of the upper lip, doubtless unusually developed in order to conceal the large incisor teeth. The nasal orifice is more quadrangular, but otherwise resembles that of the Castors.

The zygomatic arches project farther from the side of the cranium, but are much more slender than in the Castors, especially behind the post orbitar process of the malar bone; the orbitar process of the frontal bone is small. The zygomatic process of the temporal is also more slender, and the groove or channel serving for the lodgment of the condyle of the lower jaw is destitute of the ridge on its outer border, which is so well marked in the Castors, Ondatras, and Capybaras. The infra orbitar foramen presents nearly the same conformation as in the Castors, but is provided externally with only a very slight projection of bone.

The right inferior maxilla alone exists, and is in a perfect condition excepting only the incisor tooth. Its length from the angle to the edge of the incisive alveolus is 7 inches, and its breadth from the top of the coronoid process vertically downwards, $3\frac{3}{4}$ inches; all the processes are remarkably developed, and indicate the existence of powerful masticatory muscles; inferiorly it is remarkably broad and almost flat, from 1.5 to 1.8 inch in breadth, and terminating posteriorly in a triangular surface, the apex of which is turned inwards; in these peculiar-

ities it contrasts with the jaws of all existing Rodents. The condyloid and the coronoid processes are more nearly on the same level than in the Castors, the neck of the former being proportionally longer, and the plane of the whole of the ascending portion of the jaw forming an angle of about 45° with the shaft of the bone, the condyle being turned inwards. Immediately beneath the triangular notch, which separates the condyloid from the coronoid process, on the outer surface, there exists a deep fossa, which is limited inferiorly by the projection formed by the walls of the cavity lodging the base of the incisor teeth. The insertion of the masseter muscle is plainly indicated by a very deep triangular impression, the apex of which is directed forwards.

On the inner face of the bone, the fossa, serving for the insertion of inner pterygoid muscle, occupies the whole of the angle of the jaw, and its surface being much increased by the development on its edge of the thin plate of bone which exists in the Castors, but is very slight. A well-marked fossa is also noticeable at the base of the coronoid process, and a well-defined oval impression 2 inches long, and $\frac{1}{2}$ inch broad, situated just below the molares, indicates the existence of a powerful mylo-hoyoid muscle. The muscular depression at the symphysis indicates a corresponding power in the digastricus and genio-hyoideus.

From the above descriptions it will be seen that in its osteology the Castoroides has greater analogies to the Castors than to any other genus of Rodents, but differing materially from it, however, in the forms of those parts which serve as origins to the muscles of mastication. It now remains to examine the structure of the teeth, and institute comparisons between them and those of the allied genera.

The incisors have been already described by Mr. Foster, in his notice of the lower jaw ; they have a triangular form, one of the faces presenting forwards, and one of the angles backwards. The enamel on the two lateral or posterior faces is

smooth and thin, while that on the anterior is much thicker and deeply grooved or fluted, the grooves corresponding with others less distinctly marked on the surface of the dentine. The alveolus lodging the incisor of the lower jaw extends as far back as the angle, and the whole tooth has a length of between 10 and 11 inches. The superior incisors have curves of lesser radii, and are much shorter, but are similarly grooved on the anterior face, and are exposed for the distance of about three inches. In none of the existing genera are the grooves of the enamel so distinctly marked.

The molares form a continuous grinding surface in both jaws, that of the upper slightly convex, 2.5 inches in length, that of the lower concave having a length of $2\frac{3}{4}$ inches, and elevated anteriorly so as to form an angle of nearly 45° with the body of the bone. The molars of both jaws diminish in size from before backwards, in which respect they differ from those of the Capybara. In the lower jaw the first molar has two deep grooves on the inner and one on the outer lateral surface; the other three have a single groove on each side, so that the grinding surface of each tooth has something like an hour-glass contraction in the middle. In the upper jaw the reverse state of things exists, the last molar having the same peculiarities as the first in the lower.

In their structure the molar teeth do not resemble those of the Castors, to which they have been compared. They are all compound, consisting, like those of the Capybara, among Rodents, and those of the Elephant among Pachyderms, of a series of laminæ of dentine, invested with enamel, and united together by means of an interposed cæmentum or crusta petrosa. In the first molar of the upper and the last of the lower jaw, four such laminæ exist, while in each of the others there are but three. The worn grinding surface presents a series of sections of these laminæ, which are more or less contorted on the inner and outer border of the tooth, giving the appearance in some parts of the union of two adjoining laminæ, but which does not actually take place in any instance.

Thus we have teeth constructed upon an entirely different plan from that of the castors, in which they are simple, the ridges on the grinding surfaces being formed merely by involutions of enamel, and not unlike that of the posterior molares of the Capybara, which consist of a series of laminæ, united by means of crusta petrosa. In the last-named animal, however, the number of laminæ is thirteen, and the interspaces are imperfectly filled with cœmentum, so that the edges of the teeth are more or less serrated; but in the Castoroides the number of laminæ does not exceed four, and the crusta petrosa fills the whole of the interspaces. In the anterior teeth of the Capybara, there is an involution of the enamel at the edge which does not exist in the Castoroides.

On reviewing the description of this cranium we find that it presents analogies to the genera Castor, Fiber and Hydrochærus. Osteologically considered, the cranium bears a stronger resemblance in its shape to that of the Castors, than either of the other genera; but in its dentition the type is wholly different, as is also the conformation of the pterygoid processes and fossæ.

Compared with the Castors, the relative capacity of the cranium is much smaller, and the occiput more depressed; the occipital condyles admit of a free and extensive motion vertically, but only a very limited one in a lateral direction; the *foramen magnum* has a depressed oval form, and is destitute of an emargination on its upper edge. It differs from all other Rodents in the size and conformation of the pterygoid processes and fossæ; especially in the incurvation of the internal processes and the consequent subdivision of the entrance to the posterior nares. It differs entirely from the Castors in the compound nature of the molar teeth, and in the flutings of the incisors; in the diminutive size of the incisive foramina, and in the conformation of the lower jaw with reference to the insertion of the muscles of mastication.

In the Hydrochærus the principal analogies are found in the compound nature of the molar teeth, from which those of

the Castoroides, however, are readily distinguished by the posterior molars of the former having an increased number of laminæ; by the complication of the anterior molars in consequence of the involution of the enamel on the inside of the teeth of the upper and outside of those of the lower jaw, and by the serrated edges caused by the existence of a small quantity only of crusta petrosa between the laminæ.

In the Fibers the pterygoid fossæ are largely developed, but the entrance to the posterior nares has the same conformation as in other Rodents.

All the fossæ and processes which serve as origins or insertions to the muscles, (and consequently the muscles themselves,) of the lower jaw, are much more remarkably developed in this animal, than in the members of any of the allied genera of Rodents: they are indices of the great force with which their powerful incisors may be used.

The well-marked depressions which indicate the insertions of the mylo-hyoid, digastric and genio-hyoid muscles are also interesting. The functions of these muscles are twofold; first, to elevate or bring forwards the os hyoides, as in the act of deglutition, the lower jaw being a fixed body; this, however, requiring but a very moderate amount of muscular force: second, to depress the lower jaw, which they can do only when the os hyoides is rendered immovable by the action of the sterno-hyoid and sterno-thyroid muscles. It is with reference to this last function, the depression of the jaw, that the muscles in question are so remarkably developed, and thus supply a powerful antagonistic force to that which moves the jaw in the opposite direction. This force would frequently be brought into play in disengaging the teeth, when firmly imbedded, as must sometimes happen, in the woody substances which they were gnawing or cutting.

The great length of the portion of the incisor teeth imbedded in the alveoli, is scarcely less remarkable than the other peculiarities of this skull. The final cause of the great length and the curved form of the incisive teeth of the Cas-

toroides as well as of the Rodents, in general, would seem to be twofold; first, to increase the surface of the attachment of the tooth, and thus afford more points of resistance to the pressure applied to its free extremity during the ordinary use; secondly, the curved form serving to transmit that pressure to the convex surface, instead of the base of the tooth; this last being always in a growing condition, is from necessity pulpy as well as highly vascular, and, therefore, incapable of sustaining any great degree of pressure.

Though a matter of great interest, it is hardly possibly to form a very correct estimate of the size of the Castoroides, almost the only data offered to us being those given by the cranium. The length of the skull of this animal is 10.5 inches, and its greatest breadth 7.2 inches. According to Professor Emmons, the skull of an old female beaver, measured, from the tip of the nose to the crucial ridge, 4.9 inches, and its greatest width 3.9 inches;[1] an adult skull in my own cabinet gives precisely the same measurements. The skull of the Castoroides is therefore a little more than double the size of that of the common beaver, (Castor fiber.) According to Dr. Richardson, the largest beavers which he had an opportunity of measuring, had a length of 2 feet, 6 inches; Dr. Godman estimates the average length at about 2 feet; assuming the proportions of the Castors and Castoroides to be the same, we should have the entire length of the latter amounting to about 5 feet.

The generic characters of the Castoroides which have been deduced from the cranium just described, and which, on comparison, will be found to differ materially from those given by Mr. Foster, are as follows.[2]

[1] Report on the Quadrupeds of Massachusetts, p. 51.

[2] Common usage among zoölogists would justify us in substituting a new name for that of Castoroides, especially since the generic characters have been very differently defined from what they were in the original description. The name Castoroides, however, having gone into general use, it would therefore seem desirable that it should be retained.

TEETH. Incisors, $\frac{1}{1}\frac{1}{1}$; Canines, $\frac{0}{0}\frac{0}{0}$; Molars, $\frac{4}{4}\frac{4}{4}$; total, 20. Molars consist of thin laminæ of dentine, surrounded by enamel, and united by crusta petrosa. The first in the upper and the last in the lower jaw, have four such laminæ, and the remaining teeth have only three each; the grinding surface is slightly concave in the lower jaw, and slightly convex in the upper, the enamel forming only a very small projection above the dentine and crusta petrosa. The internal pterygoid fossæ are largely developed, and the internal pterygoid processes are so far deflected inwards as to touch on the median line, and divide the entrance to the posterior nares transversely, thus forming a superior and an inferior orifice.

EXPLANATION OF PLATES.

PLATE I. Side view of the cranium.

a. Insertion of the masseter muscle.

b. Fossa for the insertion of the temporal muscle.

c. External auditory meatus.

d. Incisors; the portions destroyed represented in outline.

e. Infra orbitar foramen.

PLATE II. View of the cranium from above.

PLATE III. Base of the cranium.

a. Foramen incisivum.

b. Internal pterygoid fossa.

c. Inferior entrance to the posterior nares.

d. Superior entrance to the posterior nares.

e. Meatus auditorius externus.

f. Mastoid process.

g. Occipital condyles.

h. Tympanic portion of os temporis.

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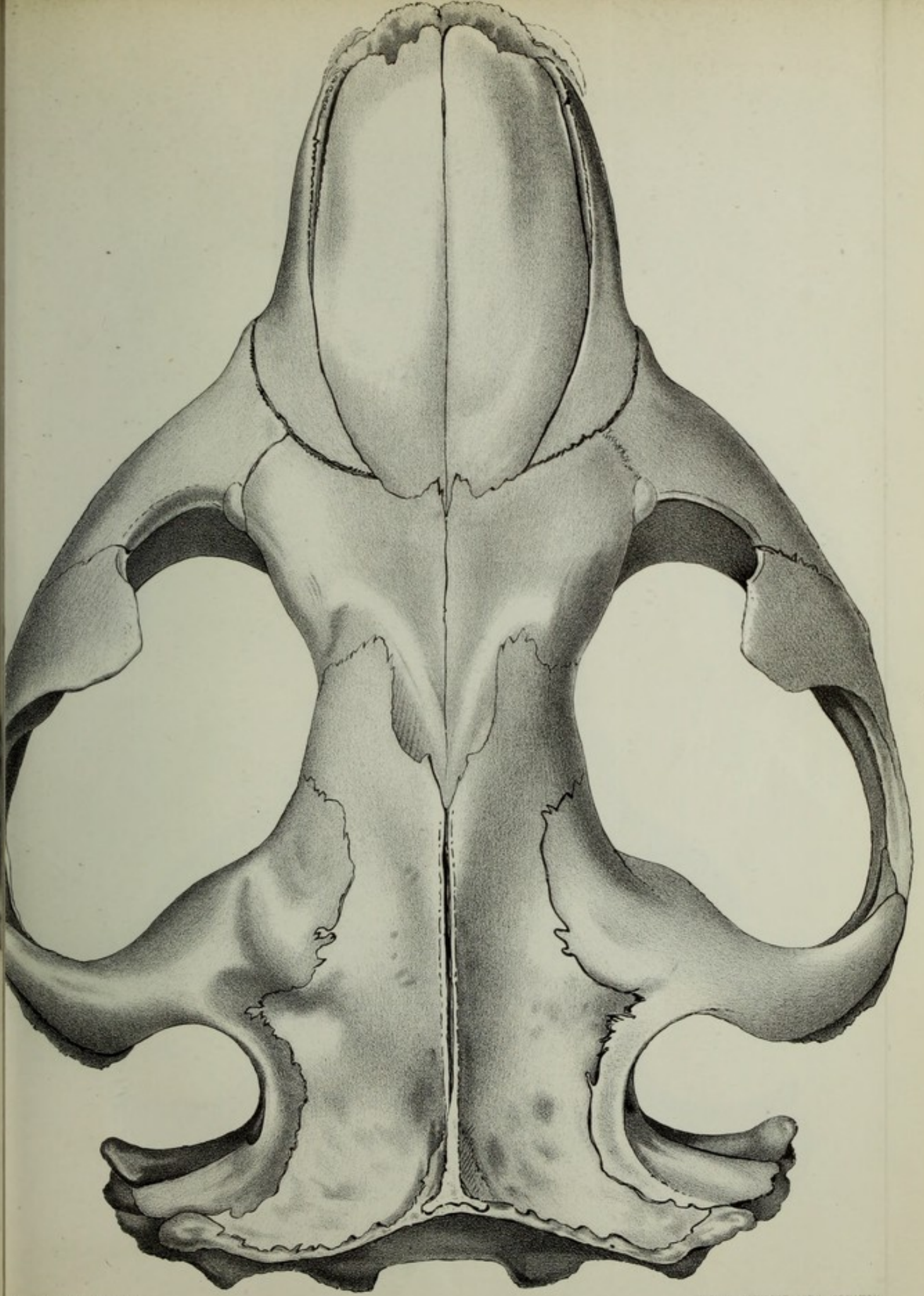
CASTOROIDES OHIOENSIS. Foster. Pl. 1.



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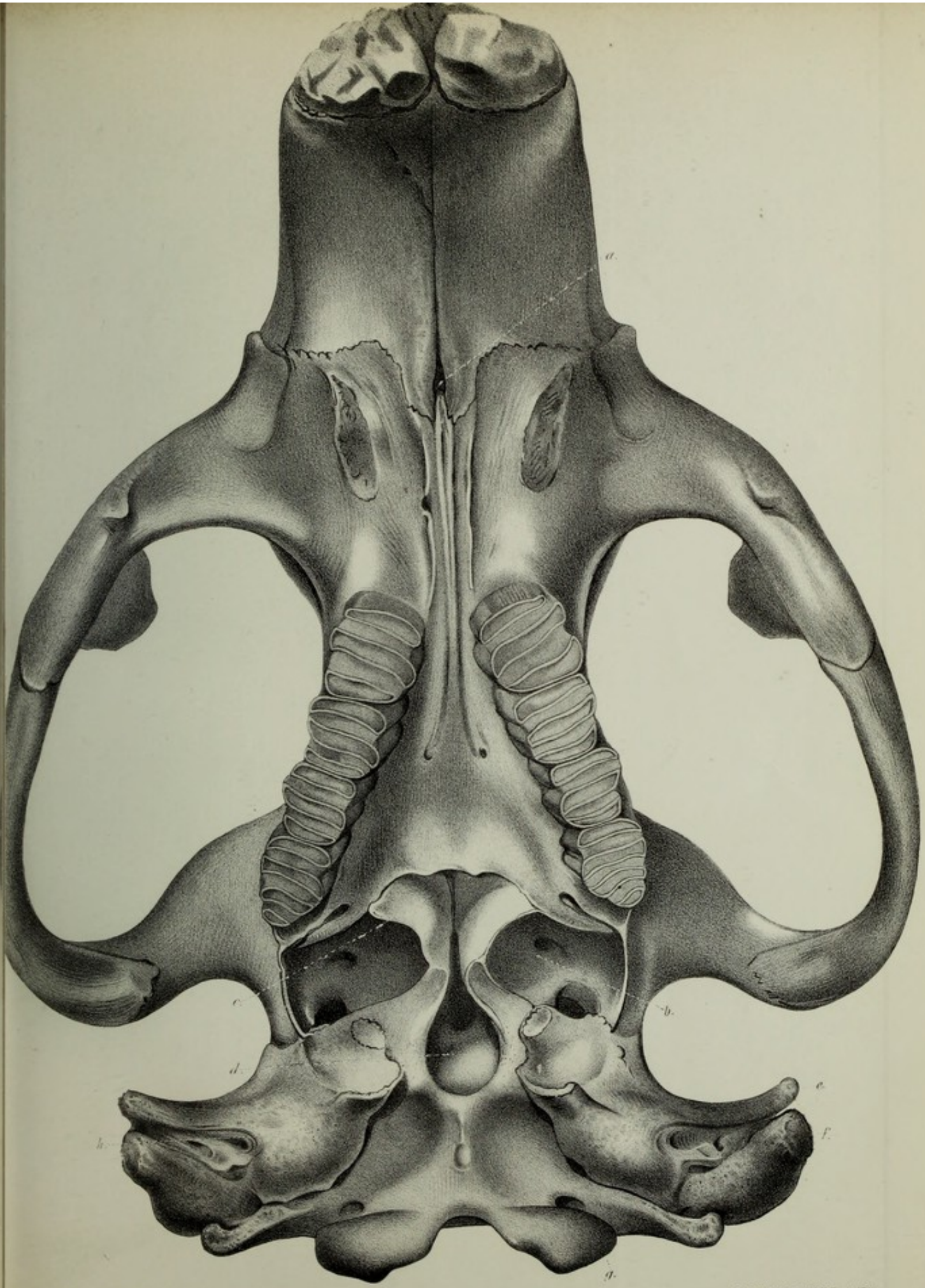
CASTOROIDES OHIOENSIS. Pl 2.



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CASTOROIDES OHIOENSIS. Pl. 3.