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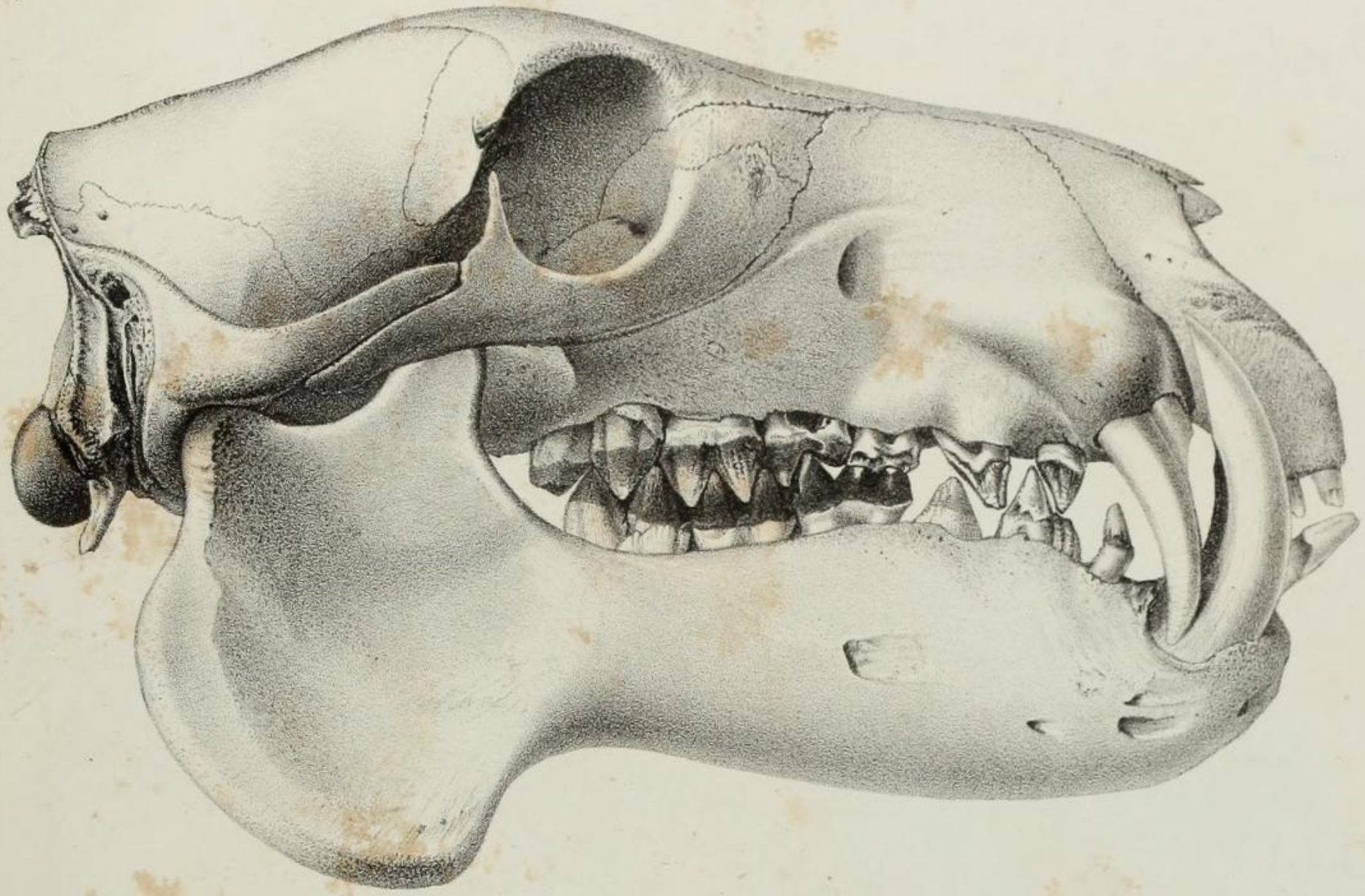

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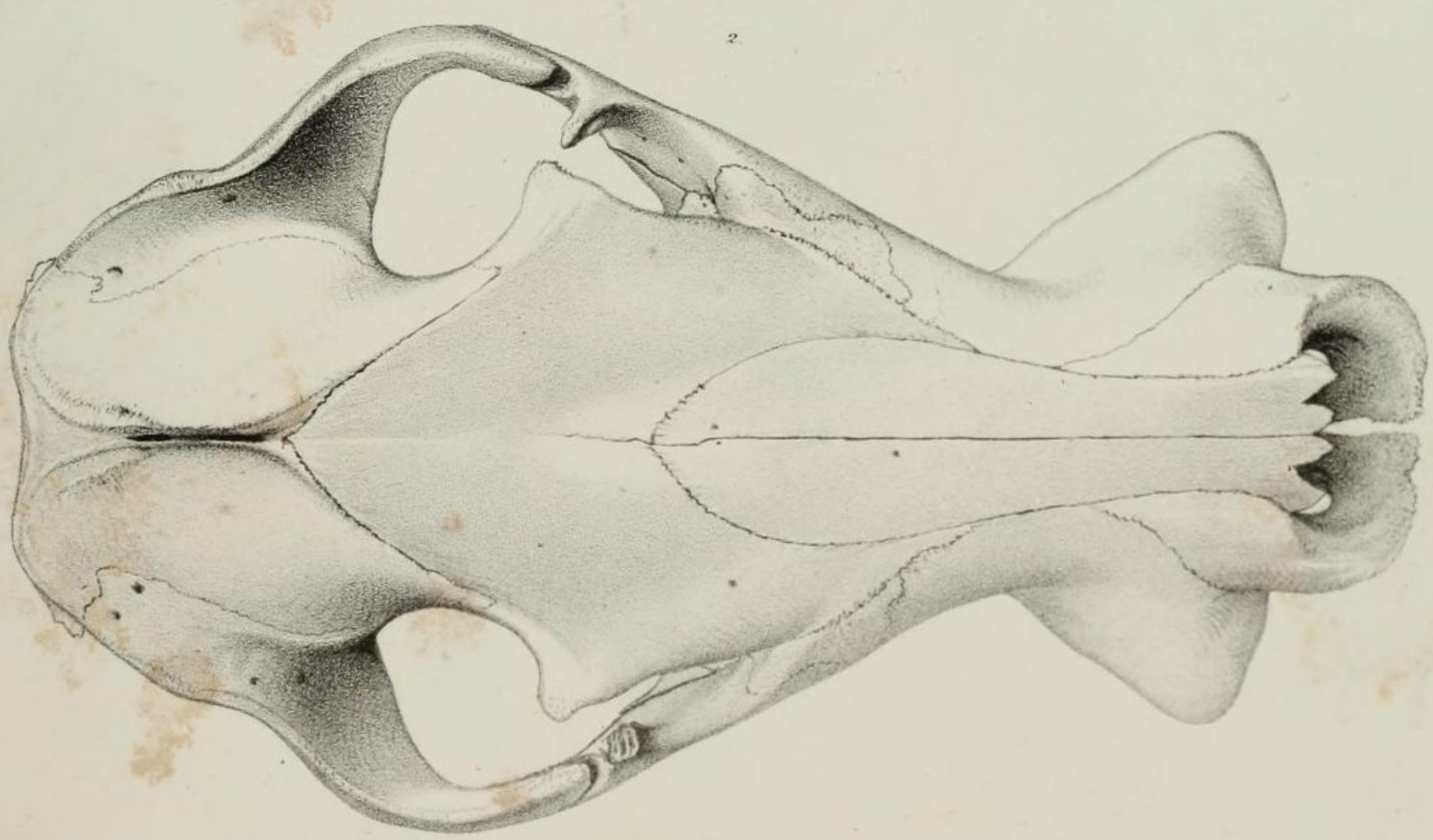

From nature by Ibbotson.

T. Sinclair Lith.

Choeropsis Liberiensis, Leidy.

ART. XXII.—*On the Osteology of the Head of Hippopotamus, and a Description of the Osteological Characters of a New Genus of Hippopotamidæ.*

By Joseph Leidy, M. D.

The opportunity afforded of studying an entire skeleton of the animal, of which two specimens of crania were described by Dr. Morton, under the name of Hippopotamus Liberiensis,* lately received from Africa, led me to an examination of the cranial specimens of the large Hippopotamus, preserved in the collection of the Academy, which has been confirmatory of the views of Desmoulins† and Duvernoy,‡ that two distinct species exist, usually confounded under the name of Hippopotamus amphibius.

But, granting that the two species alluded to are distinct, the latter name should be retained for that species earliest known, which is that of Linnæus, while the other should preserve the name given to it by Desmoulins, of Hippopotamus Capensis, as being the first applied.

The materials which we possess for studying the osteology of the Hippopotamus, are as follows:

HIPPOPOTAMUS AMPHIBIUS, *Linn.*

Hippopotamus amphibius, *p. auctorum:* Vide *Fischer*, Synopsis Mammalium, p. 424; *Schinz*, Synopsis Mam., 2, 343.

Hippopotamus Senegalensis, *Desmoulins:* N. Bull. des Sci. de la Soc. Philom., 1825; Dict. Class. d'Hist. Nat., Hippopotamus.

Hippopotamus typus, *Duvernoy:* Comptes Rendus, t. 23, p. 650.

1. *The head of a very old male?* From Guinea. Presented by twelve members of the Society to the Academy.

All the sutures of the head are entirely obliterated. In the upper jaw, on one side, are the remains of four molars, and on the other, three molars, and these are worn down nearly to the edge of the alveoli. The first permanent true molar had been shed and its alveolus nearly obliterated. In the lower jaw, also, on one side, four molars remain, and on the other, three, worn down nearly to the alveolar border. The upper lateral incisors are unhappily lost in the specimen.

* Proc. Acad. Nat. Sci., vol. 2, p. 14; Journ. Acad. Nat. Sci., vol. 1, 1849, p. 231.

† N. Bull. des Sci. de la Soc. Philom., 1825. Dict. Class. d'Hist. Nat.: Hippopotame.

‡ Comptes Rendus, Oct., 1846.

2. *The head of a young female?* From the River Gambia. Presented by Dr. S. M. E. Goheen to the Academy.

In both jaws the first premolar is lost, but the alveolus remains. The second permanent premolar, in the upper jaw, is partially protruded, and entirely so in the lower jaw. The third is partially protruded in the latter, but the second temporary premolar had not been shed above. The temporary true molar remained in both jaws, but is lost on one side. The anterior two permanent true molars are fully protruded, but the last was but partially developed. The right intermaxillary bone is lost.

Comparison of these heads of Hippopotamus amphibius, considered to be male and female.—The upper part of the inion is much narrower, and forms a deeper notch in the female than the male. The sagittal crest of the latter is three inches in length from the inion to its bifurcation, and is formed by the conjunction of the temporal ridges. In the female it is differently constituted, and this part of the cranium, in the specimen under consideration, would not be much altered from any increase of age, for the lambdoidal suture is obliterated. The summit of the occiput rises into a prominent tuberosity, an inch in advance of the inion, which then abruptly declines into a thin ridge, and after an inch more of length, bifurcates and diverges upon the supra-orbitar processes. The temporal ridge proper is three-fourths of an inch to the outside of the parietal ridge, is slight, and curves from the lateral occipital crest forwards, to the bifurcation of the ridge last mentioned.

The zygomæ converge more rapidly forward in the male, and the orbits are smaller, and present not so much upwards. The forehead is also slightly more concave in the male, and the face considerably more so just in advance of the orbits.

HIPPOPOTAMUS CAPENSIS, *Desmoulins.*

Hippopotamus amphibius, *p. auctorum:* vide *Fischer*, Synopsis Mammalium, p. 424; *Schinz*, Syn. Mam. 2, 343.

Hippopotamus Capensis, *Desmoulins:* N. Bull. des Sci. de la Soc. Philom., 1825; Dict. Cl. d'Hist. Nat., Hippopotamus.

Hippopotamus australis, *Duvernoy:* Comptes Rendus, t. 23, p. 650.

1. *The head of an adult male.* From the Cape of Good Hope. Deposited in the Academy of Natural Sciences by Dr. Morton.

The sutures of the face remain open, and the intermaxillaries have not co-ossified with the maxillaries.

All the permanent molars have fully protruded. The first premolar in both jaws has been shed, and the alveolus filled up. The first true molars in both jaws have had their enameled triturating surface obliterated. A hiatus of about an inch in extent exists between the second and third premolars, in the upper and lower jaws.

Upon the right side of the lower jaw, the third premolar apparently had been broken out long before the eruption of the fourth, so that this, which ordinarily in Hippopotamus, in the upper and lower jaws, always appears stunted in growth, for want of space, is as well developed as any of the other premolars, and better than the corresponding tooth of the opposite side.

2. *The skull of an adult female.* From the Cape of Good Hope. Deposited in the Academy by Dr. Morton.

Several of the sutures of the face are partially ossified, and the intermaxillaries have become inseparable from the maxillaries.

The molars are considerably worn down, and, with the exception of the last, have had their enameled grinding surfaces obliterated. The first true molar has been entirely deprived of its enamel. The first premolar has been shed, and the alveolus obliterated. The succeeding six molars form an unbroken row.

3. *A lower jaw, probably of a male.* From the Cape of Good Hope? Donor?

The permanent molars are all fully protruded, and none have their enameled grinding surface obliterated. The first premolar has been shed, and the succeeding six form an unbroken row.

4. *Head of a young male.* Locality? Presented by Dr. P. B. Goddard to the Academy.

The temporary premolars were about being shed, and the corresponding permanent teeth were protruding. The temporary true molar retains its position in both jaws, but is much worn. The first permanent true molar is fully protruded, and the summits of its lobes are worn into the characteristic trefoil appearance. The second had not yet protruded, and the third was only partially developed. The first premolar has been already lost, and the alveolus only partially remains, except on one side of the lower jaw, where it is entirely filled up. The intermaxillaries are detached from the specimen, and lost.

The inferior incisors still retain part of their enamel armature, at the distal extremity.

5. *An inferior mid incisor and canine.* Presented by Capt. Geisinger, U. S. N.

The incisor is cylindrical, slightly curved, sixteen inches long, and seven inches in circumference. The canine measures twenty-six inches along its convexity.

6. *Two upper and two lower canines.* Presented by Mr. Jacob Gilliams.

These are apparently from several individuals of adult size.

Comparison of the male and female head, of Hippopotamus Capensis.—The difference in general size of the head, in the two sexes of Hippopotamus Capensis is not much, the excess being, of course, in favor of the male. The length of the latter is

several inches greater, and the breadth, at the posterior part of the zygomatic arch, and at the canine alveoli is also greater, but is less at the anterior part of the arch, just mentioned, and at the infra-orbitar foramen. From the relative sizes stated, the zygomatic arch is of course more parallel in the female, or more convergent to the face, in the male. In the latter a sagittal crest exists, which is three and a half inches long, from the notch at the inion to its bifurcation forwards, in which direction it is descending. In the female there is no parietal crest formed by the conjunction of the temporal ridges, but a broad obtuse ridge presents itself at the summit of the occiput, which trifurcates an inch and a half in advance of the inion; the lateral portions constituting the bounding temporal ridges; the middle, a slight rough ridge, an inch and a half long. The middle parietal ridge also in the female, does not descend to the forehead, but is nearly on a level with it.

The orbits are very much more elevated in the male than the female, and consequently the transverse concavity of the forehead is much deeper in the former than in the latter, while its breadth remains nearly the same in both.

The orbital entrance, and the malar surface below, are directed more upward in the female, and the concavity of the face, just in advance of the former, is less than in the male.

The ossa nasi are shorter, but considerably broader in the female, and the boss of the canine alveoli is very much shorter, and the concavity of the face, internal to it, correspondingly shallow.

The orifice of the nose is broader, but a little lower, in the female than the male.

We have no means of comparing the lower jaw of the male with that of the female.

The superior incisors and canines are smaller and less exserted in the latter than the former. Their exact form is probably not only variable in the different sexes, but also, to a slight extent, in different individuals, as indicated by the lateral incisors in the two adult specimens of the lower jaw of the male; being very much more compressed laterally in that preserved with the skull, than in the other.

In the male the superior mid incisors are very slightly bent in their course, are cylindroid, a little compressed antero-posteriorly, six and a half inches long by four inches in circumference, and are protected by a band of enamel, ten lines wide, upon their outer side. The exserted portion is two and a half inches long, projects downward and forwards. Its abraded surface is oblique, presents inwards, and is two and a half inches long by one inch broad.

In the female the protruding portion of the upper mid incisors is three-fourths of an inch long by three and a quarter inches in circumference, is directed downwards and

slightly forwards, is quadrilateral, and has the external side convex and invested by a band of enamel, nine lines wide, and the other three sides longitudinally depressed. At the postero-internal angle of the right mid incisor only, a band of enamel exists three-fourths of a line wide. The triturating surface is quadrate, about one inch in diameter, directed downwards, and a little obliquely towards that of the other side.

The lateral incisors of the male are strongly curved, cylindroid, seven inches in length, of which two and three-fourths are exserted, by four in circumference. They are totally devoid of enamel, project from the jaw downwards, outwards, and towards the distal end slightly backward, and are abraded upon each side for one and three-quarter inches.

In the female the lateral incisors above, project from the jaw downwards and slightly inwards for one and a quarter inches; are two inches seven lines in circumference, and quadrilateral, with two broad flattened sides directed postero-external and antero-internal, and two narrow convex sides, the antero-external of which is invested by a band of enamel two and a half lines wide. Abrasion has given the protruded portion of the tooth a conical appearance, with a blunt apex.

The exserted portion of the superior canines of the male measure two and a half inches externally and five inches two lines in circumference, at the border of their alveolus. The posterior groove is broad and three and a quarter lines deep. The anterior abraded surface presents two planes, one external and superior to the notch, the other about one-sixth the size of the preceding, and internal to the notch. The long diameter of the former plane is oblique, and measures two and a half inches.

In the female the protruded portion of the upper canines externally is two inches in length, and is four and a half inches in circumference at its base. The posterior notch is much shallower than in the male, being a line only in depth. The anterior abraded surface is constituted by one simple vertical reniform plane, with the long diameter oblique, and measuring two and a half inches.

Comparison between Hippopotamus amphibius and Hippopotamus Capensis.—Hippopotamus amphibius is a little smaller than Hippopotamus Capensis. The lower jaw is less spreading posteriorly, less deep at the angle, and very much narrower posteriorly.

The parietal ridge of the male is shorter but thicker, and the orbits are much smaller, more nearly circular, and less oblique in the same sex.

The upper canines are more exserted, and those inferior, very much smaller.

The most remarkable difference exists in the arrangement of the enamel of the superior canines. In Hippopotamus Capensis, in both sexes, old and young, the outer side of the posterior groove of the upper canine presents a space uncovered by enamel, in the adult three lines wide; or, the enamel investment of the tooth consists of two unequal bands, one covering the outer semi-circumference, the

other about a half inch wide, placed to the inside of the posterior groove. In Hippopotamus amphibius, old and young, the enamel forms a continuous investment of every part excepting the anterior third of the circumference of the tooth.

The anterior abraded surface of the upper canine, in the male Hippopotamus amphibius, has its long diameter nearly perpendicular, and the inner plane of the surface is not more than one-tenth of the whole.

The enamel is thicker on the canine of the young, than upon that of the old head of this species.

The incisors above and below are smaller than in the male **H.** Capensis.

In the male **H.** amphibius the upper mid incisors, which are nearly three inches in circumference, have the enamel band relatively broad, being eleven lines.

In the young specimen, supposed to be of the female, the mid incisor is a little over three inches in circumference, and is four and a half inches long, and has two distinct bands of enamel, one antero-external eight lines wide, the other postero-internal and five lines wide. The lateral incisor is about three and three-quarter inches long, by two and a half in diameter, and possesses an antero-external band of enamel two and a half lines wide.

Comparative Table of Measurements of the Head of Hippopotamus Capensis, and H. amphibius.

	H. Capensis.		*H. amphibius.*	
	Male. *Inches.*	Female. *Inches.*	Male? *Inches.*	Young Female?
Length from occipital condyles to anterior extremity of intermaxillaries	27	26	22½	22½
Length from the notch of the inion superiorly to end of nasal bones	23	22	19	18
Length from anterior margin of orbit to anterior extremity of intermaxillaries	17	15¾	14	13½
Length of hard palate	18¾	16½	15	14½
Greatest breadth, at posterior part of zygomæ	17¼	15¼	15	15
" " anterior " "	11	13	9½	11
Breadth of forehead, between supra-orbital margins	10½	10⅛	10	9
Depth of transverse concavity of forehead,	2	1	1	¾
Length of nasal bones	16½	15	13	11
Breadth " " posteriorly	4¾	5½	—	4
" " " anteriorly	1¾	2¼	—	1½
" at infra-orbitar foramina	4½	5	3¾	4½
" canine alveoli	13	11¾	11½	10½
Semi-circumference of face, on line with infra-orbitar foramina, from alveolar margin to middle nasal suture	8	7½	6¼	6¼
Greatest breadth of inion	11¾	10¾	10¾	10½
Heighth of inion from occipital foramen	6¼	5¼	5	5¼
" of face on a line with infra-orbitar foramina	6½	6½	5½	6
Vertical diameter of orbit	3	3	2¼	3
Transverse " "	2½	2½	2	2½
	Two specimens.			
Length of lower jaw from most posterior part to canine alveoli	21 20	—	19	18
Distance from angle to edge of canine alveoli anteriorly	15 13½	—	13½	13
Expanse of lower jaw posteriorly	20 19½	—	17	15
Distance from angle to angle	16½ 16½	—	15¼	13
Breadth at base below third premolars	9½ 11	—	8	—
" canine alveoli	15 15½	—	12	11½
" between coronoid processes	7½ 8	—	8	6¾

Table continued.

	H. Capensis.		*H. amphibius.*	
	Male. *Inches.*	Female.† *Inches.*	Male? *Inches.*	Young Female?
Depth from condyle to angle	13 13	—	11	11
" " coronoid process to angle	14 13	—	12	12
Transverse diameter of condyles	3½ 3½	—	3¼	3
Breadth of interspace of the molar teeth	3½ 3	—	3	—
Length of series of six upper molars	10½	9	8¼	—
" " " lower "	11 10	—	9¼	—
" exserted portion of superior canine	2½	2	3¼	2½
" " " inferior "	9½ 13	—	5½	—
" " " superior mid incisors	2¼	¾	1¾	—
" " " " lateral incisors	2¾	1	—	—
" " " inferior mid incisors	8 9	—	4	—
" " " " lateral incisors	2½ 3¼	—	2½	—
Distance between mid incisors above	3¼	3¼	3¼	—
" " " " below	1 ¾	—	¾	—
" " canines and incisors above	1¾	1½	3	—
" " " " below	4 5½	—	1¾	—

The animal referred to at the beginning of this memoir as having been described by Dr. Morton,* from two skulls, under the name of Hippopotamus Liberiensis, from St. Paul's river, Liberia, Africa, upon examination I find to possess so many characters which do not belong to the two species of Hippopotamus designated in the previous pages, that I have been induced to consider it as belonging to a distinct genus of Hippopotamidæ, for which the name Chœropsis† has been already proposed in the Proceedings of the Academy.

CHŒROPSIS LIBERIENSIS, *Leidy.*

Hippopotamus minor, *Morton*, Proc. Acad. Nat. Sc. vol. 2, p. 14; *Duvernoy*, Comptes Rendus, t. 23, p. 650.

Hippopotamus Liberiensis, *Morton*, Journ. Acad. Nat. Sci., n. s., vol. i., p. 232.

Chœrodes‡ Liberiensis, *Leidy*, Proc. Acad. Nat. Sci., vi., 52.

The materials in possession of the Academy of Natural Sciences of Philadelphia, of this remarkable animal, are as follows:

1. An imperfect skin of a nearly adult animal, from St. Paul's river, Africa. Presented by Dr. T. B. Wilson.

The specimen, when received, was so much decayed from its having been wet, that the taxidermist could not stuff it. The skin is black and hairless; the ears are twenty lines long, furnished with hairs on the inner surface. The snout is provided with short bristles. The tail is 3½ inches long, compressed, and furnished with bristles from one to two inches long.

2. The entire skeleton belonging to the same individual as No. 1. When first

* Pr. Acad. Nat Sci., ii. 14; Journ. Acad. Nat. Sci., n. s., i. 232.

† Pr. Acad. Nat. Sci., vi., No. III.

‡ Previously adopted for a genus of insects.

received, the bones were still held together by their natural attachments, and in this condition the following measurements were taken:

Length from nose to end of tail, in a straight line	5 ft. 8 in.
Length of spine, following curvatures from the inion	4 " 8 "
From ankle to hip joint, in a straight line	1 " 7 "
From scapula to wrist	2 " 0 "

The sutures of the head are all open except the occipito-parietal.

The deciduous molars have not been shed, nor has the last true molar commenced to protrude.

The epiphyses of the vertebral bodies are separable, also the head of the os humeri, extremity of the olecranon, distal extremity of the ulna and radius, trochanters and condyles of the os femoris, and head of the tibia. In all other positions the skeleton is perfectly ossified.

3. The skull of an old individual, probably a female. From St. Paul's river, Africa. Belonging to Dr. Morton's collection.

The canines, incisors and anterior two premolars are lost from the specimen, but their alveoli remain. The first permanent true molar has its enameled triturating surface obliterated, and all the cranial sutures have disappeared.

4. The head of a nearly adult individual, probably male. From the same locality and belonging to the same collection as the preceding.

The deciduous molars had just been shed, and the last true molar had not fully protruded, as is the case also with the fourth upper premolar. The sutures have been nearly obliterated, excepting those surrounding the ossa nasi.

5. An inferior canine tooth. From St. Paul's river, Africa. Presented by Dr. Goheen.

The head of Chœropsis Liberiensis is about one-fourth the bulk of that of Hippopotamus Capensis. In the former, its longitudinal outline above is convex, rising from the occipital region along the sagittal crest to the forehead, and then gradually sloping downwards to the end of the nose. In Hippopotamus the same outline descends or is level from the occipital summit to the forehead, then gently rises upon the bones of the nose, and very gradually slopes downwards to the end of the latter.

In viewing the outline of the skull from above, it is observable on each side in Chœropsis, that an oblique line nearly straight converges from the bend forward of the zygomatic process, to the vicinity of the infra-orbitar foramen, and then immediately diverges in a straight line upon the canine alveoli. In Hippopotamus, the corresponding line posteriorly is more irregular or undulant in its course, and its anterior portion longer relatively, and curvilinear.

In both animals the relative breadth between the zygomæ is the same, but ante-

riorly between the canine teeth it is relatively less in Chœropsis than in Hippopotamus.

The temporal fossæ are alike in both genera.

In a comparison of the side view of the skull, we are struck with the relative shortness of the face and the advanced position of the orbit in Chœropsis, being placed immediately posterior to the middle; while in Hippopotamus it is situated at the middle of the posterior two-thirds of the head. In Hippopotamus the orbits also are elevated to so remarkable a degree that a considerable portion of the vertical extent of their entrance is above the level of the forehead: but in Chœropsis, so far as elevation is concerned, they occupy the more ordinary position of ungulata, as in the Hog. They are rendered very prominent laterally in Hippopotamus, from the elevation and projection outwards of the anterior extremity of the ossa malarum, and the prolongation outwardly, upwards and forwards, of the orbitar portions of the os frontis. In Chœropsis, they do not project laterally, but have very much the same relative position in this respect as in the Hog, but are removed rather farther from one another by the greater breadth of the forehead.

The face, anterior to the position of the orbits, is relatively shorter in Chœropsis than in Hippopotamus.

In the anatomical details of the upper part of the skull, the differences are so great between Chœropsis and Hippopotamus, that any one finding a fragment constituted by this part of the former, from his previous knowledge of the latter alone, would not suspect it even of being closely allied to the genus Hippopotamus.*

A very conspicuous difference is observed in the transversely slightly convex forehead of Chœropsis, and the deep concavity of that of Hippopotamus produced by the extraordinary elevation of the orbits.

In the adult of Chœropsis, the forehead is more plane transversely than in the younger animal, or is even a little depressed in the middle line.

The form and proportions of the os frontis are also quite different in the two genera. In Chœropsis it is absolutely as long, but relatively less broad than in Hippopotamus. In the former it extends into an angular process on each side of the ossa nasi in advance of the ossa lachrymalia, to join the ossa maxillaria; in the latter it terminates anteriorly in two divergent supra-orbitar processes, enclosing in front a broad concave notch receiving the sutural connexions of the ossa nasi and lachrymalia. In Chœropsis the facial portion of the latter bones is relatively very small, is

* De Blainville says in his Osteographie, p. 69 of the Mem. sur les Hippopotames, "je viens d'apprendre tout à l'heure (8 Septembre dernier,) de M. R. Owen, à son dernier voyage à Paris, que le docteur Morton avait l'année dernière décrit et figuré, comme espèce nouvelle, sous le nom de *H. minor*, un Hippopotame de petite taille, probablement du Gabon en Afrique. Il paraît cependant, d'après ce que m'en a apris M. R. Owen, qui en a vu le crâne, que les différences spécifiques porteraient essentiellement sur la différence de taille, et du reste seraient peu importantes."

oblong quadrilateral, and presents a plane or very slightly convex surface, presenting outwards and forwards, and continuous with the oblique plane of the malar surface. Superiorly it articulates with the outer margin of the angular process of the os frontis, anteriorly with the os maxillare, inferiorly with the os malæ, and posteriorly constitutes part of the margin of the orbit. It is completely separated from the ossa nasi by the angular process of the os frontis. In Hippopotamus the corresponding portion of the lachrymal bones forms a large, square, transversely concave plate, presenting upwards, and sloping downwards and outwards, from which proceeds a very narrow portion outwardly to the margin of the orbit, continuous with the orbital portion of the same bones. Its inner or superior margin articulates with the corresponding os nasi; its posterior margin with the orbital process of the os frontis and lateral process of the os nasi, anteriorly with the os maxillare, and inferiorly with the os malæ, and a very small portion contributes to the margin of the orbit. It separates entirely the os frontis from the os maxillare.

In Chœropsis the anterior suture of the lachrymal and malar bones forms one continuous oblique line: but in Hippopotamus the suture of the latter bone is considerably in advance of that of the former. The ossa nasi are relatively much shorter in Chœropsis than in Hippopotamus. In the former they gradually widen from the points of the ossa intermaxillaria to their posterior fourth, when they converge in a slightly curved line to their pointed commencement. Their posterior fourth fills up the notch between the angular processes of the os frontis. In Hippopotamus the ossa nasi are slightly constricted between the ossa lachrymalia, and posterior to these expand laterally into a triangular curved process projecting between the ossa lachrymalia and the os frontis. Their posterior margin articulating with the latter is a broad convexity occupying the middle half of the width of the forehead.

In Chœropsis the external malar surface presents a uniform oblique plane inclining from the lachrymal surface downwards and backwards below the orbit, and does not advance upon the face beyond the anterior line of the lachrymal bone. In Hippopotamus the anterior extremity of the malar bone is more prominent outwardly than in Chœropsis, and that portion of its supero-external face anterior to the orbit, is bent inwards from its oblique plane below the latter on a line with the anterior orbital margin. This anterior portion of the malar surface forms part of the same concavity of the face, to which the lachrymal bone contributes. In Chœropsis the masseteric surface of the malar bone is relatively narrow and directed downwards; in Hippopotamus it is broad and presents outwards and downwards. The ossa maxillaria in Chœropsis are relatively shorter, but less narrow at their middle than in Hippopotamus. The ridge proceeding forward from the malar articulation is very much shorter and less prominent in the latter than the former. Postero-superiorly the ossa maxillaria in Chœropsis present a continuation of the same

inclined plane of the ossa lachrymalia and malarum. In Hippopotamus the corresponding portion of surface presents a continuation of th econcave conditiono f the lachrymal and malar bones. Below the latter the maxillary bones are relatively less deep in Chœropsis than in Hippopotamus. In both genera the infra-orbitar foramina occupy the same relative position. The canine alveoli in Chœropsis project relatively less outwardly than in Hippopotamus, and the boss or protuberance so conspicuous upon them in the latter, is less distinct, smaller and more external, so that the deep transverse concavity existing above the alveoli in Hippopotamus, hardly exists at all in Chœropsis.

The antero-internal portion of the ossa intermaxillaria is less everted in Chœropsis than in Hippopotamus, and these bones, in the former, possess but a relatively small protuberance antero-externally.

The inion, the relative position of the auditory meatus, and the existence of a partial or complete post-orbital arch, are the same in both genera of Hippopotamidæ.

Upon an examination of the basal aspect of the skull, we observe an important difference in the direction of the glenoid articular surface. In Hippopotamus it slopes from the post-glenoid tubercle forwards and outwards, and for the external half of its extent presents downwards and backwards; while in Chœropsis it is nearly horizontal, presenting downwards and a very little forwards, except the portion on the post-glenoid tubercle, which presents forwards and outwards.

In this view, also, of the skull, may be particularly noticed the less degree of divergence of the canine alveoli from the face in Chœropsis than in Hippopotamus. In the former the inner margin of the orifices of these alveoli is immediately to the outside of the line of the molars, whereas in the latter it is removed several inches to the outside.

In consequence of the reduction of the relative length of the face of Chœropsis, the molar teeth, with the exception of a hiatus of about from 1 to 3 lines between the first and second premolars, form on each side an unbroken row. The canine, at its inner margin, is only 4 lines from the first premolar, and the lateral incisor is in a nearly straight line forward from the molars, and about three-fourths of an inch antero-internal to the canine.

The rami of the lower jaw are relatively not so much divergent in Chœropsis as in Hippopotamus, nor are they so concave externally. The angles in the former are relatively nearly equally distant as in the latter, and project outward and downward but not forward as they do in Hippopotamus.

The condyles are nearly horizontal convexities in Chœropsis, and present slightly backward, except their inner end, which turns down and looks inwards. In Hippopotamus, on the contrary, the condyloid surfaces incline inwards and forwards. The coronoid process in Chœropsis rises more rapidly and vertically from behind than in Hippopotamus. The inferior canine alveoli relatively project little forward

and very little outward in the former, contrasted with the latter. In Chœropsis the inner side of the orifices of the canine alveoli is on a straight line forward from the outside of the molar alveoli, while in Hippopotamus it is at least several inches distant from the same line.

Dentition.—The formula of the permanent dentition of Chœropsis Liberiensis is,

$$\text{i.}\ \frac{2-2}{1-1} \qquad \text{c.}\ \frac{1-1}{1-1} \qquad \text{p. m.}\ \frac{4-4}{4-4} \qquad \text{m.}\ \frac{3-3}{3-3} = 38.$$

De Blainville, in the memoir "sur les Hippopotames," in his magnificent Osteographie, p. 28, in regard to the incisor dentition, says, "dans le jeune age le nombre des incisives doive être et sont réelement $\frac{3}{3}$; mais le grand écartement des os incisives et des dentes qu' ils portent par suite du développement de la première paire d'incisives inférieures, aussi bien que de celui des canines, a sans doute entrainé la perte de la première incisive supérieure, et déterminé l'oblitération de la troisiéme d'en bas." And a few pages further (p. 32) he observes, "Dans la très jeune âge, il est certain qu' il y a trois paires d' incisives en haut comme en bas, et que ces incisives sont beaucoup plus subegales, dont une paire excessivement petite n' est pas remplacée, la première supérieurement, la troisème inférieurement." And, in a note, he adds, "je n' ai réellement vu que celle d 'en bas, formant une petite callote convexe en dedans et en dehors de la seconde; mais je suppose, par analogie, que la première d'en haut etait gingevale et n'est pas restée dans la préparation."

In an adult specimen of a skull of Chœropsis, described by Dr. Morton, and in a second specimen of a head, in connection with the entire skeleton lately received from Africa by the Academy, in addition to the two upper pairs of functionally developed incisors, in front of those lateral, there exists an elongate conical cavity, of about half an inch in length, communicating with the alveoli of the latter, and containing an ossified rudimentary incisor, of the same size and form of its cavity, worn away at the lower part, where it comes in contact with the contiguous functional incisor. In a specimen of an old adult of Chœropsis, the rudimentary incisors have disappeared, and their cavities are obliterated.

Thus has been established, without doubt, that the normal incisive formula of the Hippopotamidæ is: $\frac{3-3}{3-3}$ as in the ordinary pachydermata. Functionally developed in the extinct Hexaprotodon, they are reduced to $\frac{2-2}{2-2}$ in the Hippopotamus (Tetraprotodon of Falconer and Cautley,) and in Chœropsis undergo the excessive reduction of $\frac{2-2}{1-1}$

Dr. Falconer, in a letter to Dr. Morton,* makes use of the following singular language: "Hippopotamus comprises two subgenera, Hexaprotodon, with six incisors above and below; and Tetraprotodon, the species with reduced incisors, viz., four above and below. Your species," referring to the Chœropsis Liberiensis, "although it has but two in the lower jaw, belongs to the latter subgenus. The excessive reduction is probably only an individual case of variety, but if proved to be constant, the position of the species in the genus will not be altered."

It would indeed appear singular if the functional development of the normal number of incisors should be thought sufficiently worthy to consider Hippopotamus Sivalensis a distinct subgenus from the existing Hippopotamus, and a reduction from the number as existing in the latter, should not alone entitle Chœropsis to the same distinction. But, in addition to the reduced number of incisors in the latter, the important differences, which have been already designated, between the head of Chœropsis and that of Hippopotamus, in addition to others which will be pointed out, more especially in the constitution of the upper incisors, quite as remarkable as the minimum number below, induce me to believe, that if the genus Hexaprotodon be adopted as distinct from Hippopotamus, Chœropsis must be admitted without hesitation.

The two inferior incisors of Chœropsis are nearly straight, being bent in their length slightly downwards, and project obliquely forward and upward, as in Hippopotamus, their size corresponding to those lateral of the latter. As in this, when young, their protruded portion is capped with enamel, which being worn off leaves them as two rods of dentine, of persistent growth.

In neither of the specimens, of the lower jaw of Chœropsis which we possess, have I observed any rudiments of the deficient incisors, but it is not improbable they may be concealed within the jaw.

In the upper jaw of Chœropsis the incisors all curve in the same direction forwards and downwards; the protruding portion being directed vertically downward. In the young animal, enamel envelopes the protruding portion of these teeth, but no bands continue down their whole length, so that in the adult they are persistently growing rods of dentine, entirely devoid of enamel, as in the lower incisors in this genus and Hippopotamus, and as is also the case with the supero-lateral incisor of the male specimen of a head, which has been indicated, of Hippopotamus Capensis.

The upper incisors of Chœropsis are of course opposed to the lesser number below. The abraded surface of the superior mid incisors is a horizontal, oval convexity; that of the lateral incisor, an oblique, oval disk, directed inwardly. The distal extremity of the inferior incisors presents an upper, horizontal surface, oblique in its relation to the length of the tooth, and divided into two irregular abraded concavities, separated

* Journ. Acad. Nat. Sci., of Philada., new series, vol. 1, p. 236.

by a ridge; one antero-internal near the end of the tooth, produced by the contact of the upper mid incisors, the other postero-external to the former, produced by the upper lateral incisors.

The exserted portion of the upper canines projects much less obliquely outwards in Chœropsis than in Hippopotamus, and the posterior groove is not only much nearer the middle of the tooth, but it is very much deeper. Its outer side, near the bottom, for one line wide, is uncovered by enamel, approaching, in this respect, more the Hippopotamus Capensis than the Hippopotamus amphibius. The outer and inner sides of the upper canines of Chœropsis are also a little depressed longitudinally, more on the former than the latter, so that the anterior vertically abraded surface presents a somewhat trilobate character, instead of the reniform appearance exhibited by Hippopotamus.

The inferior canines are situated at their alveoli, much more internally than in the latter genus, but their exserted portion diverges relatively more obliquely outward. They are uniformly convex externally and antero-internally. Their enamel is relatively less ridged than in Hippopotamus.

The true molars above and below in Chœropsis are very like those of Hippopotamus, but their lobes are less constricted laterally, so that the trefoil appearance of their summits when abraded is not of so striking a character as in the latter, presenting rather the form of triangles with concave sides and rounded angles. The posterior lobes of the middle true molar, and all those of the last, are exceedingly slightly constricted laterally. The lobes of the molars are also less obtuse on the outer and inner sides of the teeth, so that the entering angles or interspaces are also relatively wider. The basal ridge is also more horizontal in Chœropsis, or, in other words, does not rise upon the lobes anteriorly and posteriorly in a crescentic manner, as is the usual disposition in Hippopotamus.

The superior fourth premolar presents no variation of importance in the two genera. In the third and second premolars of Chœropsis the basal ridge is nearly obsolete, while in Hippopotamus it is well developed, especially in the former tooth. In Chœropsis these two teeth also possess a posterior conical tubercle, or short accessory lobe, rising out of the base, and becoming confluent with the principal lobe.

The first premolar is retained even to old age in Chœropsis, is small, curved in its course, and has a simple conical crown.

In the lower jaw the fourth premolar has a slight basal ridge externally, and a posterior tubercle, more or less confluent with the principal lobe of the crown.

The third and second premolars are quite simple, compressed conoidal, without a basal ridge, and are relatively longer than in Hippopotamus.

The first premolar is smaller than the corresponding one above, is curved, and has a simple conoidal crown.

The remainder of the skeleton of Chœropsis corresponds so closely in its anatomical details with Hippopotamus, so far as can be ascertained from comparisons with the excellent figures in the Osteography of De Blainville, that a few remarks only are necessary to complete the description of the animal.

The number of vertebræ and ribs are the same in Chœropsis as in Hippopotamus, there being forty-seven of the former, and fifteen pairs of the latter.

In the skeleton of Chœropsis there are four lumbar vertebræ, of which the last, from its transverse processes, sends backwards an apophysis to join the corresponding portions of the sacrum.

There are also in the specimen, five sacral vertebræ, of which the first two pieces only join the ilia, and the second and third, and fourth and fifth are ossified together.

Of the three skulls of Chœropsis which have been designated, though of different ages: one being an old female, the second an adult male, and the third a young, but nearly adult male, the measurements are nearly alike.

Admeasurements of the Head.

	Nearly adult ♂		Old ♀	
	In.	*Lines.*	*In.*	*L.*
Length from inion to end of ossa nasi,	11	6		
" occipital condyles to incisive alveoli,	12	6	12	9
" of ossa nasi,	5	9		
" forehead in middle line,	3		3	
Distance from anterior margin of orbit to incisive alveoli,	6	9	7	
Heighth of inion from inferior margin of occipital foramen,	4		4	
Greatest breadth of inion,	5	9	5	9
Greatest breadth of head at zygomæ,	7	9	8	
" " forehead at post-orbitar processes,	5	3	5	6
Greatest breadth at infra-orbitar foramina,	3		3	
" " canine alveoli	5	6	6	
Breadth of ossa nasi at middle,	1	6		
Vertical diameter of orbit,	2	2	2	2
Transverse " "	1	2	1	9
Length of hard palate,	8		8	6
Breadth of do. between first true molars,	1	4	1	4
Greatest length of lower jaw,	9	6		
Heighth at first true molar,	2	3		
" from angle to coronoid process,	5	6		
" " condyle,	4	6		
Breadth at angles,	7	6		
" at canine alveoli,	4	6		
" between first true molars,	1	9		

Admeasurements of the dentition from the specimen of an adult male skull.

	Inches.	*Lines.*
Length of upper molar series,	6	3
" lower " "	6	6
" upper true molar series,	3	3
" lower " " "	3	3
" exserted portion of upper canines externally,	1	9
" " " lower " anteriorly,	3	7
" " " upper mid incisors,		6
" " " " lateral incisors,		7
" " " lower incisors,	1	5

Admeasurements of the Skeleton excepting the Head.

	Feet.	*Inches.*
Length of spinal column following its curvatures along the summits of the spinous processes,	4	6
Length of neck,		7
" back,	1	10
Breadth of atlas,		$5\frac{1}{2}$
Length of first dorsal spinous process,		$4\frac{1}{2}$
" third " " "		5
" first rib,		6
" seventh rib,	1	3
" last "		11
" transverse process of third lumbar vertebra,		$4\frac{1}{2}$
" sacrum and tail,	1	$5\frac{1}{2}$
" sternum to end of ensiform cartilage,		$11\frac{1}{2}$
" scapula,		$9\frac{1}{4}$
Breadth of " at base,		$5\frac{1}{2}$
Length of os humeri,		10
Circumference of os humeri at middle,		4
Length of ulna,		$9\frac{3}{4}$
" radius,		$6\frac{3}{4}$
" first toe,		$5\frac{1}{4}$
" second toe,		7
" third "		$6\frac{1}{2}$
" fourth "		5
" first metacarpal bone,		$2\frac{1}{2}$
" second " "		$3\frac{1}{2}$
" third,		$3\frac{1}{8}$
" fourth,		$2\frac{1}{4}$
Breadth of carpus,		3
Length of anterior extremity from head of os humeri to end of second toe, following its flexures,	1	$11\frac{1}{2}$
Length of innominatum,	1	$1\frac{1}{2}$
Breadth of ilium,		$6\frac{1}{2}$
Distance between the anterior inferior spinous processes of the latter,	1	
Length of os femoris,		11

	Feet.	*Inches.*
Circumference at middle,		$3\frac{3}{4}$
Length of tibia,		$8\frac{1}{4}$
" fibula,		7
" patella,		2
" foot from heel to end of third toe,		$10\frac{3}{4}$
" inner toe,		4
" second "		6
" third "		$6\frac{1}{4}$
" fourth "		$4\frac{1}{2}$
" os calcis,		4
" first metatarsal bone,		2
" second and third metatarsal bone,		$3\frac{1}{8}$
" fourth " "		2
" posterior extremity following flexures,	2	4
Heighth of the skeleton at the middle,	2	7

REFERENCES TO PLATE XXI.

Head of Chœropsis Liberiensis, reduced one-half.

Fig. 1. View of the right side.

The upper jaw contains from before backwards, the two right incisors, the canine, the premolar, which has no successor, the temporary molars, and the anterior two permanent true molars. In the lower jaw are the right incisor, the canine, the premolar without a successor, the first permanent premolar with its apex just protruded internally to and in advance of the next tooth, which is the first temporary premolar, then follows the second permanent premolar just protruding, the temporary true molar, and the anterior two permanent true molars.

The teeth of the left side, so far as they might be seen in this view of the head, have been purposely left out, so as not to obscure those represented.

Fig. 2. Upper view of the skull.