PART 9. PRICE 1s.

RESEARCHES

ON

FOSSIL BONES,

IN WHICH ARE ESTABLISHED

THE CHARACTERS OF

VARIOUS ANIMALS

WHOSE SPECIES HAVE BEEN DESTROYED

BY THE REVOLUTIONS OF

The Globe;

BY

BARON CUVIER,

Great Officer of the Legion of Honour, Counsellor of State, and Member of the Royal Council of Public Instruction, One of the Forty of the French Academy, Perpetual Secretary to the Academy of Sciences, Member of the Academies and Royal Societies of London, Berlin, Petersburgh, Stockholm, Edinburgh, Copenhagen, Gottingen, Turin, Bavaria, Modena, The Netherlands, Calcutta, and of the Linnæan Society of London, &c. &c. &c. &c.

FOURTH EDITION,

Revised and Completed

BY ADDITIONAL NOTES,

AND A

SUPPLEMENT LEFT BY THE AUTHOR.

Triomphante des eaux, du trépas, et du temps,
La terre a cru revoir ses premiers habitans.

DELILLE.

IN FOUR VOLUMES.

LONDON:

G. HENDERSON, 2, OLD BAILEY, LUDGATE-HILL.

AND SOLD BY ALL BOOKSELLERS.

1835.

J. HENDERSON,] [WHITE-FRIARS.

Fig. 1

Fig. 2

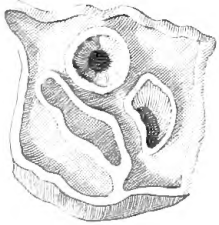


Fig. 3

Fig. 12

Fig. 4.

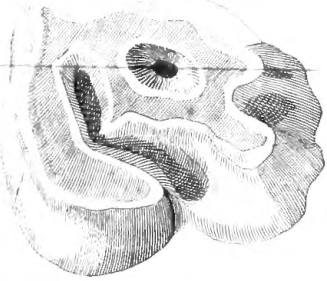


Fig. 5

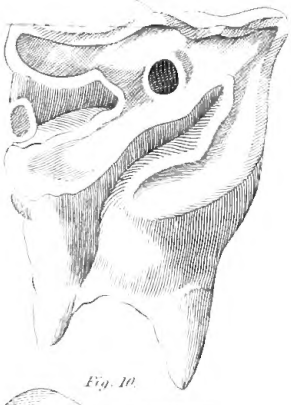


Fig. 7

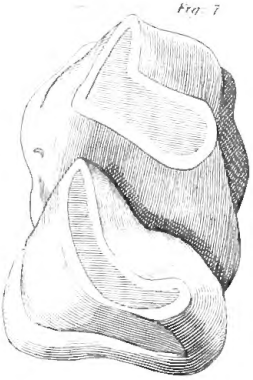


Fig. 6

Fig. 10

Fig. 8.

Fig. 9

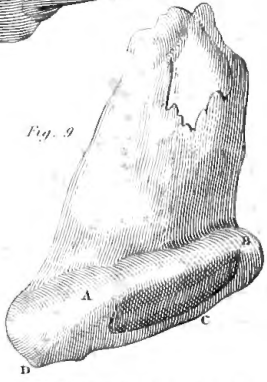
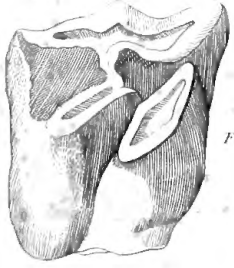


Fig. 11



RHINOCEROS. PL. VI.

London, G. Henderson, 2, Old Bailey.

Fig. 1.

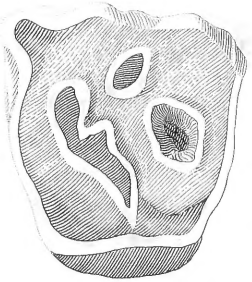


Fig. 2.

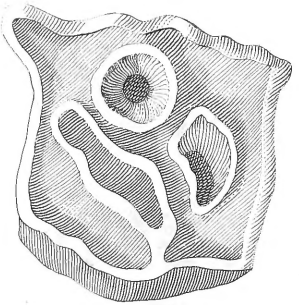


Fig. 3.

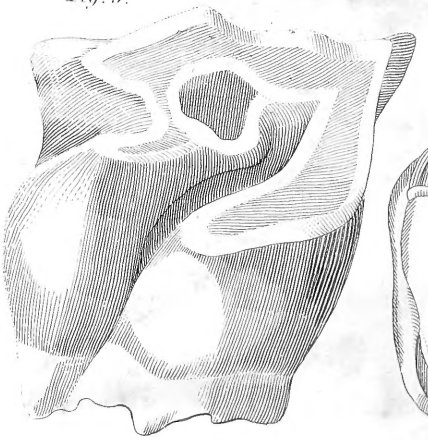


Fig. 12.

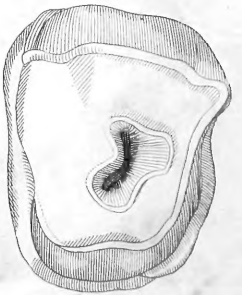


Fig. 4.

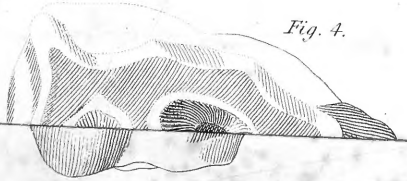
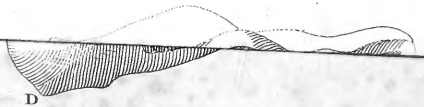


Fig. 5.



D

RHINOCEROS. PL. VI.

London, G. Henderson, 2, Old Bailey.

Fig. 1. 1/2

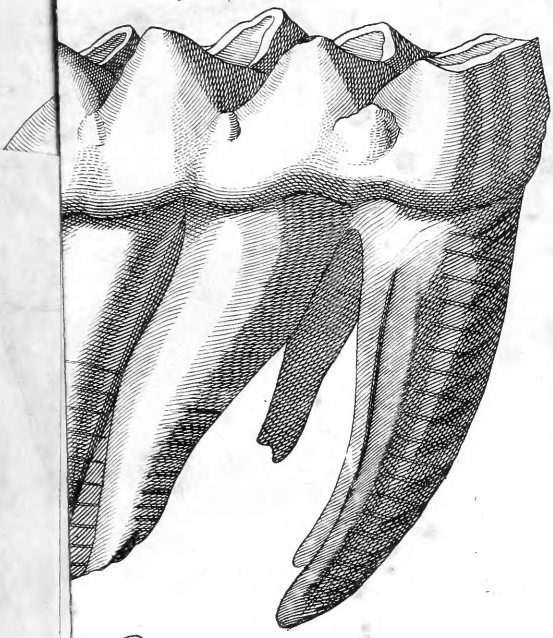


Fig. 4. 1/2

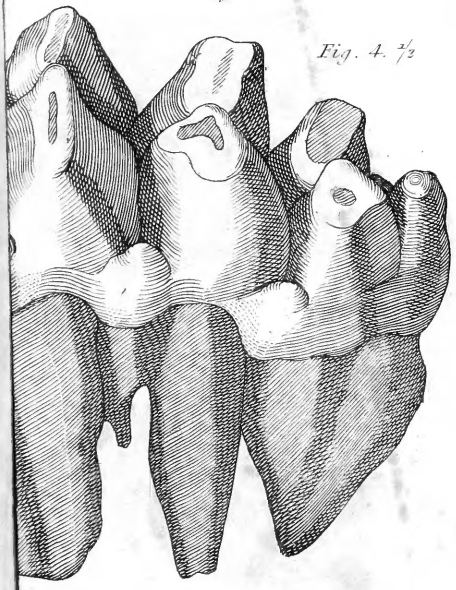


Fig. 2. 1/2

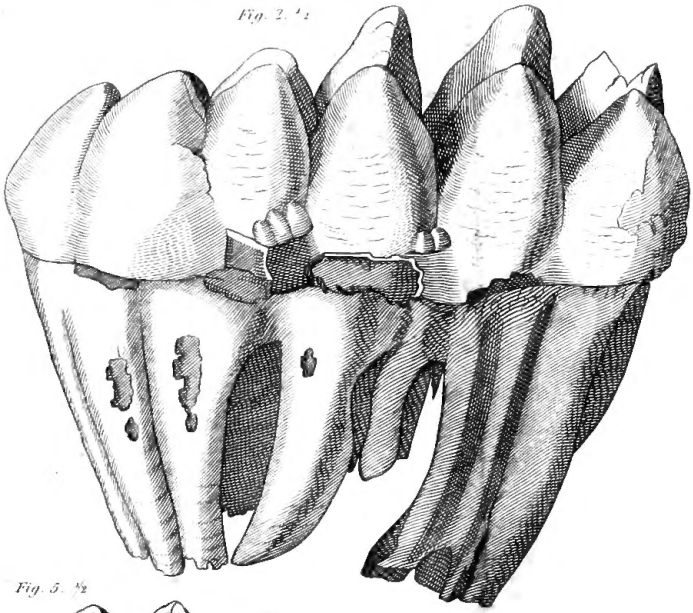


Fig. 4. 1/2

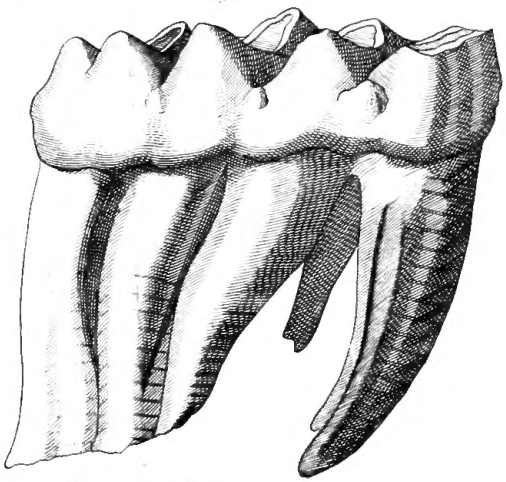


Fig. 5. 1/2

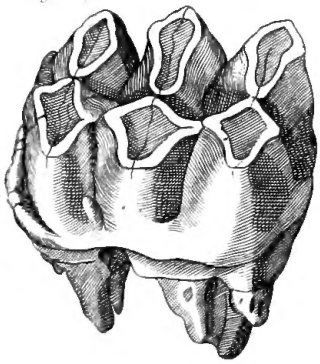


Fig. 3. 1/2

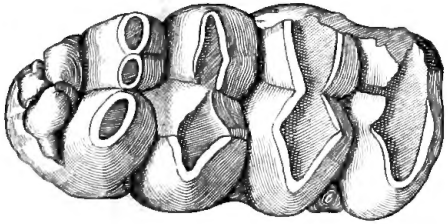
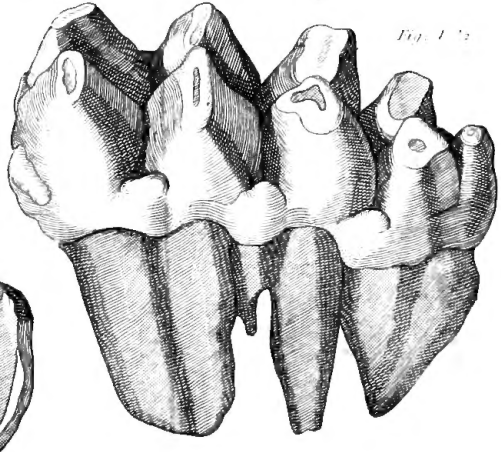


Fig. 1. 1/2



THE GREAT MASTODON. PL. I.

London: Henderson 2 Old Bailey

2nd. The tusks of the elephant are enveloped with a substance which differs from ivory in its texture; its fibres converge towards the centre, and though the substance is not so hard as common enamel, it is nevertheless a species of it.

"The band of the circumference," says Daubenton, "is sometimes composed of straight transverse fibres, which would terminate in the centre if prolonged."—(Natural History, vol. xi, 4to.)

This, however, is an observation which any one may make upon the tusks, when their surface has not been impaired. My tusk of the *mastodon* resembles those of the *elephant* in this particular.

3dly. Perhaps the softness of the interior of the tusks found by Mr. Peale may be owing to some accidental cause which may have decomposed them more or less, although the bones discovered at the same time had scarcely undergone any alteration. M. Morichini, professor of chemistry at Rome, ascertained, some years since, that fossil ivory is liable to decomposition by changing (by what agency has not been discovered) its phosphate of chalk into fluid of chalk.

Our complete tusk of the mastodon has not any fluoric acid, as MM. Vauquelin and Laugier, who have analysed it, have ascertained. Perhaps the tusks of Mr. Peale have some.

The curves of these tusks vary as much as do those of the *elephant*. That which is represented by M. Michaëlis is almost straight; my own, which I give in plate 22, fig. 3, is gently arched. A very large one, found with the head of the skeleton of Philadelphia, is curved almost to a semicircle. As it was much mutilated, they were under the necessity of substituting a model in wood in its place. Following the line of the circumference, it measures 3,17 in length. That sent by Mr. Jefferson is 2,35, or more than seven feet in length, and 0,194 in diameter at the base.

The alveoli of the skeleton of Mr. Peale are eight inches English, or 0,202 in depth; the points of the tusks which fit into them are not quite in the same place as the base, and form the commencement of a worm screw. It would appear that their direction on emerging from the sockets is a little more oblique in front than in the elephant. At first they were placed, as they appear in the elephant, with the point upwards. In this position the distance between their bases was 6″, or 0,15, and 8′ 9″ or 2,65 between their points*.

M. Rembrandt Peale afterwards determined upon placing them in an inverted position—that is, with the convexity in front, and the points downwards and backwards. He gives the following motives for this change†:—

1st. The depression of the occipital condyle, and the very decided curve of the tusks, elevated the points of the latter to too great a height above the ground, and above the head of the animal itself. It could never have lowered them sufficiently to make use of them for any purpose whatsoever.

---

* Extract of a letter dated Philadelphia, March 23, 1802, a copy of which has been kindly forwarded to me by Mr. Everard Home.

† Historical Disquisition, page 52.

2nd. The tusks found in one of those places above mentioned are worn at their points; so that, supposing this extremity to have been upwards, we must conclude that the animal was in the habit of rubbing it, without any apparent reason, against rugged and vertical rocks. Perhaps these reasons may not appear conclusive to every body.

The fossil elephant, or real Russian mammoth, frequently had its tusks as decidedly curved as those of the mastodon, and yet their points were upwards. We are as much at a loss to conceive of what possible use they could be, in the position assigned them by Mr. Peale, as in that which is pointed out for them by analogy.

The rosemarus *(trichecus rosmarus)* has, it is true, its tusks directed downwards; but then it is a short limbed animal, formed for the most part to swim in the water; and in that element such tusks might prove serviceable. But the mastodon, with its immense length of limb, must unquestionably have inhabited the land. It might easily have worn the front or convexity of its tusks by rubbing them against trees, rocks, or in any other way.

Finally, the babiroussa, whose tusks rise vertically above its head, and then bend their points in a spiral form backwards and below, has much less the appearance of being able to make use of its tusks than the mastodon. Hence, until such time as the skull of a mastodon shall have been discovered, with its tusks implanted in their sockets, nothing, in my opinion, can justify their being placed otherwise than as they are observed in the elephant.

5. *Had the Mastodon a Trunk?*

It has been shown that the mastodon had an immense head; the thick and compact jaw teeth augmented its weight: this was further increased by long heavy tusks, which removed the centre of gravity still farther from its supporting point. These causes necessarily required the neck of the elephant to be short; that of the mastodon must have been short likewise. As its legs are very long, as we shall presently see, it could not have reached the ground without the assistance of a trunk; in fact, if there were no other obstruction, its tusks must have prevented it. If, like the seal, the sea cow, and the cetacea, it had been an inhabitant of the waters, these reasons would not be conclusive. But this cannot have been the case, as its feet are not made for swimming; they are much too long, and the toes are too slightly developed. It is therefore placed beyond all doubt that the mastodon had a trunk, and that in this, as well as in so many other particulars, it resembled the elephant.

6. *The Bones of the Trunk.*

It is impossible at present to verify the conclusion drawn from the preceding reasoning by an appeal to facts, as the soft parts must necessarily have disappeared in almost every case; but we can at least substantiate that part of the premises relating to the neck. The vertebræ are very slight, forming a neck which is very far from permitting the mouth to descend to a level with the fore feet. We are enabled to

judge of this by a drawing from the skeleton (plate 23). The first vertebræ, which I only know by one of the figures of M. Michaëlis, appeared to me to bear a strong resemblance to that of the elephant.

Mr. Peale says, that the spinal apophyses of the three last vertebræ of the neck are shorter than those of the elephant. The second, third, and fourth dorsals have very long apophyses; they then decrease rapidly to the twelfth, after which they become very short*. In the elephant they are more uniform, which would indicate greater strength in the muscles of the spine and in the cervical ligament. There are seven cervical, nineteen dorsal, and three lumbar vertebræ. The elephant has an additional vertebræ and pair of ribs; but perhaps those of the mastodon were lost. The ribs are formed differently from those of the elephant, being slight towards the cartilage, and thick and strong towards the back. This difference is more peculiarly remarkable in the first; the six first pair are very strong compared to the others, which also become very short in proportion; which joined to the depression of the pelvis, indicates that the belly was less capacious than that of the *elephant*†.

7. *The large Bones of the anterior Extremity.*

1st. *The Shoulder-blade* appears to have been much narrower than that of the African elephant, and yet to have had its recurring apophysis placed as high as in the Indian elephant, as may be seen by comparing that of the skeleton of our plate 23 with the figs. 6 and 7 of our plate 14, upon elephants. In other respects this shoulder blade has all the characteristics of those of the elephant, particularly that of the recurring apophysis, which belongs exclusively to this species, and to some *ronguers*. That of the skeleton of Mr. Peale measures 0,935 in length. A large fragment, at present in the cabinet of M. Camper, demonstrates that the interior of the spine is cavernous. The articulating facette is 0,22 long, and 0,14 wide. The total length of the fragment is 0,75. The acromion is wanting; but Mr. Peale represents it as very long and very pointed‡.

2ndly. *The Humerus.* Mr. Peale remarks, that in general the long bones of the anterior extremity are much thicker in proportion than those of the posterior extremity, and that the difference between them in this particular is more decided than in the elephant. In fact, the humerus of the skeleton (plate 23), and two others of the cabinet of M. Camper, one of which I (give plate 24, figs. 8 and 9), have their inferior crest set much higher than in the elephant, although their general form is nearly similar. The largest is 0,84 long, its breadth at the base is 0,235. Its crest rises to 0,42, that is to one half its length; while that of the elephant does not reach beyond two-fifths. The humerus of the skeleton of Mr. Peale measures 0,86.

3rd. *The Fore-arm.* Mr. Peale contents himself with observing, that the extreme width of the two bones renders the oblique direction of the radius, in front of the cubitus, more decided in this than in any other

* Historical Disquisition, page 54. † Ib. p. 56. ‡ Ib. p. 7.

animal. At the period of the publication of my first edition, I had come to the conclusion that their disposition is in every material circumstance similar to that of the elephant.

Mr. Jefferson having since sent me a very complete radius, I have given a drawing of it (plate 24, figs. 5, 6, 7), and I have compared it attentively with that of the elephant. Its general form is pretty much the same; its superior facette is less contracted on the outside; its edges are more decided; it is more angular; its inferior part begins to grow thick sooner, and is grosser in proportion towards the base. This radius of Mr. Jefferson is 0,670 long; the width of its superior extremity is 0,130; that of the inferior, taken at the articulated facette, is 0,132; and a little higher up, at the thickest part, 0,160.

The radius of the skeleton of Mr. Peale is 2′ 5″ 6‴ English, or 0,745 in length. It bears to the humerus a proportion of a little more than 6 to 7. In the elephant this proportion is as 6 to 8. Thus the fore arm of the mastodon is longer, and its arm shorter in proportion, than are those of the *elephant*.

The difference of relative proportion between the humerus and the shoulder blade is still greater. In the elephant it is as 8 is to $6\frac{1}{2}$; that is to say, the humerus is one-fifth longer. In the mastodon, on the contrary, it is a little more than as 8 is to 9. Thus the humerus is in the latter animal shorter by a ninth.

There is not the slightest room for doubting of the exactness of these relative proportions, since the bones of the extremities having been found together by Mr. Peale, it amounts to an almost positive certainty that they belonged to the same animal.

8. *The large Bones of the posterior Extremities.*

The *Pelvis* is much more depressed, in proportion to its width, than in the elephant; its aperture is also much narrower. This is observed by Mr. Peale, and it may be seen by comparing the pelvis of the skeleton, plate 23, with that of my plate 7 upon elephants, and the front section of the same pelvis, plate 24, fig. 10, with fig. 3 of the plate 13 upon elephants. This form of the pelvis must necessarily have rendered the abdomen smaller and consequently less capacious than that of the elephant—a circumstance which, taken in conjunction with the structure of the teeth, has led us to look upon the *mastodon* as not being so exclusively herbivorous.

Mr. Peale tells us, that the width of the pelvis of his skeleton is 5′ 8″ English; but I am afraid there must be some typographical error here, or else that he meant the circumference.

2ndly. The *Femur* was described before any of the other parts. Daubenton made a drawing of that in our Museum, in the Memoirs of the Academy for 1762. In fact, its enormous mass strikes us with astonishment at the first glance. Its immense width serves at once to distinguish it from that of the fossil elephant. It is, moreover, flatter from front to rear in its lower extremity, because the canal corresponding with the rotula is there shorter. It is 1,088 long, and 0,44 wide at the top between the head and the great trochanter; 0,29 at the bottom, and 0,18 in the middle. Its antero-posterior diameter is 0,15

above, 0,104 in the centre, and 0,21 at the base. The diameter of its head is 0,18.—(See plate 22, figs. 5, 6, 7.)

The femur of the skeleton of Mr. Peale is 3′ 7″ English, or 1,085 long. This corresponds almost exactly with our own.

3rdly. *The Tibia.* That of the skeleton of Mr. Peale is 2′ English, or 0,607, which makes the relative proportion between that and the femur to be as 6 is to 10.

Mr. Peale is of opinion that this proportion is less than in the elephant; but I have not found it so. The femora of our two Indian skeletons measure 0,92, and the tibiæ 0,56, giving in both cases the proportion of 6 to 10 almost precisely. Nevertheless, if, as is very probable, the abdomen of the mastodon be not so large as that of the elephant, its knee must appear more disengaged from the belly.

I give (plate 24, figs. 1, 2, 3, 4) the tibia presented to our Museum by Mr. Jefferson. Compared with that of the elephant, it is much thicker in proportion to its length. The anterior upper crest is much fuller and more obtuse; it is not cut with so deep a fossa opposite to the two femoral articulations. The latter are more irregular; that is, the external one is narrower in proportion from back to front. The posterior surface above is more hollowed; the malleolus is more salient towards the base; the pulley of the tendon of the fibular muscle is more hollowed, comprehending the internal. This tibia is 0,595 long; its upper head is 0,238 broad, and the inferior 0,181.

The late M. Adrien Camper had a tibia in his Museum 0,71 long, 0,25 broad at the top, and 0,21 at the bottom, indicating an animal much larger, but of proportions similar to the preceding one. Of the fibula I can say nothing.

9. *Of the Figure in general.*

On adding together the lengths of the humerus and the radius, and those of the femur and the tibia, we find the height of the front extremity to be 1,60, and that of the rear 1,69.

The elephant, eight feet high, has the same lengths, or rather gives the same sums—1,40 and 1,48. Thus the relative proportion of the extremities is pretty much the same in the two species, although those of their component parts are not so.

The height of the extremities, taken by themselves, would give nine feet or three metres for the greatest height of the mastodon. But as the shoulder blade of the latter is almost one-third longer, we may allow a little more for the height of its withers. Mr. Peale has given his skeleton eleven feet English, or 10′ 1″ to the height. I am of opinion that he has elevated it a little too much, by placing the shoulder blades too low, and not spreading the articulations sufficiently. This is also the opinion of Mr. Everard Home, who saw this skeleton. Granting, however, that it really does measure ten feet in height, it would only equal the height of the most common elephants at present existing in India, and would be very far from realising those gigantic proportions which people have fancifully attributed to the mastodon. And as the large bones, deposited in the British and French Museums, and in that of M. Camper, do not exceed in size those which Mr. Peale has formed into a

skeleton, we cannot thence infer that the latter have belonged to an animal of the middle size.

Calculating by the largest teeth which have been found isolated, a calculation oftentimes liable to exaggeration, we shall find that they belonged to animals of eleven feet three or four inches at the utmost: and the tibia in the cabinet of M. Camper, to which I have already adverted, would indicate one eleven feet eight inches. Thus, as we stated at the commencement of the chapter, there is no piece extant which may serve to prove that the mastodon ever attained, far less surpassed, twelve feet.

The skeleton of Mr. Peale measures 15′ English, or 4,55 from the chin to the croup, as he expressed it. I fancy he means to say, from the end of the snout to the posterior edge of the ischium.

This dimension of the elephant is not more considerable than his height: an elephant ten feet high would not measure quite eleven feet in length, or 3,57; so that the mastodon was much longer in proportion to its height than the elephant. A very fair idea of this may be formed by comparing my plate 23 with my plate 7, upon elephants.

10. *The Feet.*

According to Mr. Peale (Hist. Disq. page 57), the hind feet are strikingly smaller than the fore feet. In the fore feet, according to the same authority, the second phalanges terminate by grooves, which seems to indicate that the third phalanges, or unguals, were capable of more action than the same parts of the elephant, and bore a greater resemblance to those of the hippopotamus.

Thanks to the generosity of Mr. Jefferson, we are now enabled to form more exact comparisons on this subject. In general, these bones resemble those of the elephant, as must necessarily be the case in two animals so much akin to each other. Neither the scaphoid of the carpus, or the trapezium, or the trapezoides, or the pisiforme, have been met with.

The semilunar (pl. 25, fig. 2) is much more depressed than in the elephant, that is to say, it is much broader and less high. It is also shorter from front to rear; in other respects its shapes and surfaces are almost the same. The same depression likewise exists in the cuneiforme, but in a less degree.

The cuneiforme (fig. 3) is as the proportion of the semilunar, that is to say, longer and less high than that of the elephant. We have only had an opportunity of seeing this bone slightly mutilated, so that we have been unable to compare the shapes of its surfaces.

As for the *os magnum* (fig. 4), it must have occupied less space transversely, in proportion, for its proportional dimensions are almost the same as those of the elephant. The bones of the metacarpus which I have seen, are all shorter and thicker in proportion than those of the elephant. This shape is more especially marked in that of the index (pl. 25, fig. 6), which, without being longer than that of an elephant eight feet high, is doubly as broad: besides, the articulating surface of the trapezoid is convex, and broader than that of the elephant; the articulation of the trapezium is longer, and that which corresponds with the metacarpa of the medius is less vertical.

The metacarpian of the annular (pl. 25, fig. 7), though of equal length, is broader by a third than in the elephant. The surface, which corresponds with the cuneiforme, is divided into two planes by a salient edge.

This difference has become the more perceptible, as I have seen in juxtaposition with this metacarpal of the annular of a mastodon, another of a fossil elephant, found in the same place, and almost similar in every respect to that of the Indian elephant.

The astragalus sent by Mr. Jefferson (pl. 25, fig. 8), is more compressed than that of the elephant; its tibial surface is more rectangular, somewhat narrower in proportion: that part of it which approaches to the scaphoid is much shorter. In all these particulars, it bears so strong a resemblance to the fossil elephant of Tuscany, (pl. 7, fig. 2, F), that I should feel inclined to doubt of its belonging to a mastodon, if a calcaneum, sent at the same time, and evidently corresponding with the astragalus, did not offer more strongly defined, and, at the same time, analogous differences.

This calcaneum (pl. 25, fig. 9) is thicker and shorter: the part descending towards the cuboid is much shorter; its fibular surface rises much higher along the internal surface of the astragalus. The latter approaches the external, and touches it towards the top. The surface joining the scaphoid, placed beneath the internal edges of the internal astragalion is narrower and almost round.

The scaphoids of the tarsus (fig. 10) is thinner in proportion to its breadth: like all the other bones, it is more compressed. I have not seen either the cuboid or the cuneiforme of the tarsus in a sufficient state of preservation to enable me to describe them.

The bones of the metatarsus are even thicker and shorter in proportion to those of the elephant, than are the bones of the metacarpus.

The second (pl. 25, fig. 11), besides its thickness, is still further distinguished from that of the elephant, by the articulation of the first bone, and coincides with the whole length of that corresponding with the first cuneiforme.

The third bone (pl. 25, fig. 12), is less thick in proportion to its length; its surfaces differ but slightly from those of the elephant. The only difference is, that the two laterals are larger, particularly that which corresponds with the fourth.

The fourth bone (pl. 25, fig. 13), has its lateral surface larger; besides, there is a well-defined edge between the parts of its cuboidian surface. It appears to touch the fifth very slightly.

The same relative thickness obtains in the phalanges.

11. *General Resumé.*

The result of this description is—that the great mastodon bore a strong resemblance to the elephant, both in its tusks and its whole osteology, except the jaw-teeth; that, in all probability, it had a trunk; that its height did not surpass that of the elephant; but that it was a little longer, with limbs a little thicker, and a more contracted belly; that, spite of all these resemblances, the peculiar

structure of its grinders are sufficient to point it out as a distinct species from the elephant; that it fed on the same substances as the hippopotamus and the wild boar, giving the preference to the roots and other coarse parts of vegetables; that this sort of nutriment must have attracted it towards boggy and marshy lands; that, nevertheless, it was not formed to swim or live in the water, like the hippopotamus, but that it was a real terrestrial animal; that its bones are more abundant in North America than elsewhere; that it may be, that they belong exclusively to that country; that they are in a better state of preservation, and fresher than any of the fossil bones known to us; and that, nevertheless, there is not the slightest proof, the slightest authentic testimony, sufficient to convince us that there does exist either in America or elsewhere, a single animal of this species: for the different announcements which we have seen from time to time, touching the living mastodons, which may have been seen in the woods or the high lands of that vast continent, have never been confirmed, and must be accounted as mere fables.

Addition.

On the great Mastodon, and its existence on the ancient Continent.

In spite of the testimony of M. Pallas, and of the tooth given to Buffon, by M. Vergennes, stated to have come from Little Tartary, I still entertained doubts of the great mastodon's remains, though so abundant in America, having been found in Europe.

But this uncertainty has been dissipated since the period that the Abbé Borson, Professor of Mineralogy at Turin, has sent me a plaster cast of a tooth found in the neighbourhood of Asti, in the same place where so many teeth of the narrow toothed mastodon had been discovered. Its crown is 0,18 long, and 0,09 broad.

We may there observe four transverse crests, each divided into two hillocks; the second of which, though a little worn, presents the commencement of a lozenge. Nevertheless, these crests appeared to me to be a little more oblique than in those of America. Could this too have been another species? *

SECTION II.

ON A MASTODON LESS THAN THAT OF OHIO, TO WHICH I HAVE GIVEN THE NAME OF THE NARROW TOOTHED MASTODON.

We have seen in the preceding section, that the first engraving of a great molar of Ohio is that published by Guettard in 1752; but these teeth, and the animal to which they belonged, did not acquire

---

* Some new teeth discovered more recently in Piedmont, Switzerland, and very lately in France, in the department of the Haute-Saone, would seem to confirm this suspicion of Cuvier, that the new specimen sent by M. Borson belongs to a new species, and would leave still undecided the question of the existence of the great mastodon on the old continent.

their great celebrity in Europe until the years 1760 and 1770, when they were made known by the Memoirs of Collinson and of William Hunter.

Notices of some of those which I am about to mention, were in existence long prior to that period; but naturalists had passed them by unregarded, for want of objects of comparison; and when the teeth of the Ohio had become known, they confounded the others with them, so that it has been reserved for me to point out the specific differences of those mentioned before my time, and to make known, for the first time, many of which the world were wholly ignorant.

To begin with 1656, we find a figure, which may be easily recognized in the "Museo" of Moscardi, page 122: it is announced to be the tooth of a giant. A second was published by Grew in 1681, (Mus. Soc. Reg. pl. xix, fig. 1), under the title of "The petrified Tooth of a Marine Animal." Camper alludes to this figure (Nov. Act. Petrop. ii, p. 259) as if it were belonging to the species of the Ohio.

In 1715, Réaumur, describing the turquoise mines of Simorre, and demonstrating that these turquoises were nothing more than the bones and teeth of different species, petrified and impregnated with some metallic oxide, had an engraving taken of a tooth similar to that of Grew, being likewise under the impression that it might have belonged to some marine animal. (Mem. Acad. Sciences, 1715, p. 174).

In 1755, Dargenville represented one entire, which he too was of opinion was the production of a fish unknown. (Oryctology, pl. xviii, fig. 8). Knorr gave another of them in his "Monuments," plate viii; and Walsh, in his Commentary upon those plates, contented himself with a reference to Dargenville. Neither of these authors specifies the origin of his piece.

In the meantime, some specimens of the teeth of Simorre had been brought home, and deposited in the King's Museum. Daubenton described them, but without figures (Nat. Hist. xii, No. 1109, 1110, and 1111, and added to them No. 1112), the piece represented by Réaumur, under the title of Petrified Teeth, bearing a resemblance to those of the hippopotamus; while to those of the Ohio with six denticuli, the only ones of that immense species then known to him, he gave the name of "fossil teeth of the hippopotamus."

From that period he distinguished the one from the other, to a certain point; but they were soon utterly confounded.

In 1767, Joseph Baldasson described and represented in the Memoirs of the Academy of Sienna, vol. iii, p. 243, two large portions of the lower jaw, found at Mount Follonico, near Monte-Pulciano, and pronounced the teeth to be precisely similar to those of Guettard, which belonged to the large species.

One of these teeth, a very large one, was found at Trévoux, in 1784, by M. de Lollière, in a hillock of sand. It was noticed in 1785, by M. de Morveau, in the 6th vol. of the Academy of Dijon, page 102, as if it had belonged to the species of Ohio.

Camper likewise speaks of it under this name (Nov. Act. Petrop. ii), as does Merk in his third Letter, p. 28.

This same year, 1785, Ildéphonse Kennedy described three portions of these teeth, and gave drawings of them in the new Philosophical

Memoirs of the Academy of Bavaria, vol. iv, page 1; he likewise takes them for the same species as those of Ohio. They were found on the 6th of April, 1762, near Reichenberg, in Lower Bavaria, in a sand pit, thirty feet beneath the surface, from which some peasants were raising materials for the repair of the high roads. To this specimen the author joins the anterior portion of the jaw of a rhinoceros exhumed at the same time.

In 1786, after all the labours of Daubenton, of Camper, and so many others, Guettard, who had himself published the figure of a tooth of Ohio, thirty-four years previously, having again occasion to give the figure of the tooth of the animal found at Montabusard, near Orleans, still continued to doubt whether he was to attribute it to an hippopotamus, or one of the cetacea.

Hence, we have every reason for saying that naturalists have not bestowed on those teeth that attention which they deserved; and it was not without feelings of surprise that I learned, in the course of my correspondence, that they were so very common in different parts of Europe and of America.

In fact, besides those of Tuscany, Simorre, Bavaria, and Trévoux, which were previously described, I have seen some from Sort, near Dax, in the museum of the late M. de Borde. Mr. G. A. Deluc has sent me one from the neighbourhood of Arti in Piedmont. M. Fabroni has sent me casts of those of the Val d'Arno, deposited in the museum at Florence. M. Faujas has given me drawings of three, one of which was found at Rochetta di Tanaro, near Asti, another at the foot of the Alps, and the third near Padua. All those brought from Peru by Dombey and Humboldt, as well as those found by the latter at the Giant's Camp, near Santa Fé de Bogota, in Terra Firma, are also similar.

Since the publication of my first edition, I have been handed one from the deparment of l'Isère. M. Chouteau has sent me the fragments of some from Avaray, near Beaugency, found with some morsels of palætheriums, of ruminants, and of trionyx.

M. Biot has sent me a very large one, still adhering to a portion of its jaw. It came from Santa Fé de Bogota, and probably from the Giant's Camp likewise. I saw at Florence the casts of two very handsome and very large germs, with six pair of denticuli.

The originals were found at Palaia, between San-Miniato and Leghorn, and are in the museum of the late M. Baldovinetti, provost of the Chapter of Leghorn. The Cabinet of the Academy of Turin, of the Institute of Bologna, of the University of Pisa, and of the Roman College, have presented me with specimens more or less considerable. M. George Santé, professor at Pisa, has given some teeth found at Sienna, which I have deposited in the King's Museum. I also brought some with me from Rome, which were found near Monte-Verde.

But a short time since, M. Sœmmerring announced to me in a letter, dated the 5th of April 1819, that some had been discovered at Darmstadt, at Alzey, not far from Worms, and near the lake of Zurich in Switzerland, casts and fragments of which had been sent to him from those several places.

The same learned man, in the Appendix of his Memoir, read to the

Academy of Bavaria, on the teeth found by Kennedy, tells us, that there is a jaw bone of this animal in the Museum of the University of Erlang. The usual story was, of course, in circulation, that it had been exhumed in 1645, near Krembs, not far from the Danube, and that it must have belonged to a giant twelve feet in height. Hence it is evident that this must be a part of the supposed giant found near Krembs in 1645, mentioned by divers authors.

The late Abbé Amoretti, in a letter to M. de la Torre, archbishop of Turin, inserted in the Memoirs of the Italian Institute, on the tooth of Rochetta di Tanaro, announces his having seen a tooth at Vienna, in the house of the Baron Joseph de Brudern. It was found on the estate of that gentleman in Hungary. In the Imperial Museum he noticed half of a lower jaw which had come from Moravia.

André Stütz speaks of teeth of the same species as this jaw being found in Lower Austria, to the south of Vienna, near Brünn, at Entzersdorf and at Modling*.

In the 24th volume of the Memoirs of the Academy of Turin, page 167, and plates 1 and 2, the Abbé Borson has described and represented two portions of a jaw, containing one tooth each, which were found near Asti more than sixty years since, as also two germs found at Castelunova-Calcea, in the same province.

In addition to this, I have had the drawings and originals of several others, the origin of which I could not discover; but which, taken in conjunction with those already mentioned, furnish decisive proofs that the animals to which they belonged must have left a very great quantity of spoils.

Like those of the great mastodon, these teeth are all furnished with conical denticuli more or less numerous, which are worn down by mastication; and, as we shall see hereafter that the shapes of some of the bones found with these teeth also resemble those of the great mastodon, and that there is reason to believe that they were accompanied by tusks, we may thence conclude, with a very great show of probability, that the animals of which they formed part were also of the species of the mastodon.

But again, these teeth may be distinguished from all those of the *great mastodon* of Ohio, by some specific characters. The principal and most general is, that the sides of their crowns are furrowed more or less deeply, and sometimes they terminate in many denticuli; sometimes they are accompanied by other and smaller cones upon their sides, or in their intervening spaces; the result of which is, that mastication produces at first upon this crown many small circles, and then a trefoil shaped figure, but never lozenges.

These trefoil figures have frequently caused these teeth to be taken for the teeth of the hippopotamus. We have already seen that Daubenton found some resemblance between them; and on the subject of this hippopotamus we shall have occasion to mention similar opinions entertained by Peter Camper and M. Faujas; but it is easy to guard against the recurrence of this error. Independently of the sizes, the teeth of the hippopotamus never have more than four trefoil figures,

* Oryctography of Lower Austria. Vienna, 1807, page 74.

while those of which I speak have most commonly from six to ten. The anteriors alone may give rise to some doubt; but we shall see in its proper place that they are as easily distinguishable.

It is more difficult to assign the specific characters of these diverse teeth, with reference to each other, for they do not bear a perfect resemblance. There is in the first place the difference of position in the jaw, which may be judged of by the number of denticuli; then comes the difference of age, which may be determined by the degree of detrition. Let us examine and compare them successively, according to those relations.

I begin by a tooth of Simorre (plate 26, fig. 4). It is the same described by Daubenton, in his Natural History, Vol. xii, No. 1109.

It is 0,116 long, and 0,06 broad, and yet is very much worn. Of its six pairs of denticuli, the two anterior are confounded in a disc of four lobes (*a b*); one of the middle (*c*) is already trefoil shaped, leaving a small round isolated disc; the other (*d*) is elliptic and double lobed; the last (*e f*) only show four discs, one of which begins to become lobed. We may see that had it been a little more worn, this tooth would have had three discs of four lobes. Behind is a fang of two blunted and furrowed denticuli, one of which (*g*) is higher than the other.

This crown is less worn, and consequently higher on the side of the unlobed discs (*a d e*), which we shall soon see form the external side. Two thick roots, both broken, take a backward direction. The posterior (*i*) is by far the thicker; in fine, there is in front (marked *k*) a flatness, giving rise to the supposition that this tooth had been preceded by another.

I have found the same tooth still implanted in the palate. In the cabinet of M. de Borda, at Dax, it has the same protuberances, the same figures, and the same proportions (plate 28, fig. 2); it is merely a little smaller and less worn; the two anterior discs were not confounded.

The fact is, that it was preceded by a tooth with two pairs of denticuli (*a b*); and we may observe behind (at *e*), that it must have been followed by another.

I have a third time found the same tooth among those which Dombey brought home from Peru (plate 26, fig. 7), fixed in a portion of the palate, and perfectly similar to that of Simorre in the outlines and proportions, but a little more worn.

The two centre discs are at present confounded in a quadrilobed disc, and the two posteriors are not far from being so. There is no appearance of a small tooth in front; its socket has disappeared, and the body of the existing tooth begins to exhibit symptoms of decay. More backward, towards *b*, may be seen the remains of the socket of a tooth which was next in succession.

The tooth of Peru is precisely the same in length as that of Simorre, although it falls short of it a little in front, and it does not exceed it in breadth by more than 0,005. Thus, in spite of the distance of the places, it is impossible not to recognize these two teeth as belonging to the same species. Hence, setting aside the shape of the tooth, these teeth go the length of proving that there were two others in the upper jaw of the animal, one in front, with only four denticuli, and one behind. They, moreover, prove that these teeth displaced each other

from back to front, as in the elephant and the mastodon, and that the anteriors disappeared at a certain period.

I have further reason to believe that the anterior tooth was susceptible of being replaced from top to bottom, as is the case in the hippopotamus, whose replacing teeth descend also. My reason for thinking so is, that this little tooth of Dax is not worn as yet, and yet it must have come after the great one, which is worn.

This tooth of Dax further helps us to recognize a tooth of Simorre of our Museum (plate 26, fig. 2). It is half worn, and presents the figure of four lobes in front, and two round discs behind.

A similar tooth (plate 28, fig. 14), but that it is not worn, and only presents four cones, is in the cabinet of M. Hammer, who is unacquainted with its origin. The circumstance of its having a small fang, might lead us to suppose that it belonged to the opposite jaw, consequently to the inferior; for the tooth of Dax belonging to the upper has no fang, neither has that of Simorre. Moreover, this may be a sucking tooth.

The identity of the species of the teeth of Simorre, and of those brought home by Dombey, being once sufficiently established, we may proceed still farther.

Among the specimens of Dombey is a large fragment of a lower jaw (plate 28, fig. 4), at a fourth of its natural size. The fore part terminates in a species of beak like that of the elephant and the mastodon. Thus our actual species had not, like the two latter, either incisors or canine teeth in the lower jaw.

This piece contains two teeth: the posterior, 0,175 long, and 0,075 broad, had five pairs of denticuli, the posterior of which were the shorter; the two first are now amalgamated in quadrilobed figures, the two succeeding are almost in the same predicament, the two last and the fang are untouched. Such then is the posterior lower molar tooth of this animal.

In this particular it is the external side which is the most worn, consequently the internal is the most prominent, and this must be so to enable the lower teeth to correspond with the upper, where the contrary is the case.

It is the external denticuli which form trefoil figures, and above, it is the internal: this too is the result of a general law which obtains in herbivorous animals; when both sides of a tooth do not resemble each other, they are placed contrariwise in the two jaws. Thus, ruminants have the convexity of the crescents of their upper teeth inside, and those of the lower outside.

It is easy to see by the convexity of this long tooth being behind, that it was not followed by another. That in front is so much worn and mutilated, that its figure is no longer distinguishable: but I very soon hit upon the means of remedying this deficiency.

We have got in the Museum, a tooth of Simorre of six denticuli (Daub. XII. No. MCX), differing from the former in its not having a fang. (See plate 28, fig. 3).

It was natural to look upon it as the corresponding tooth of the former, in the lower jaw; this appeared the more natural, as the last lower teeth of the hippopotamus also differ from the corresponding

upper teeth, by the want of a fang. The lower jaw of Baldassari reduces this to an absolute certainty, for we have there this tooth of six denticuli in its place, and without a fang.

The posterior-superior is now the only tooth remaining to complete our knowledge of the jaw-teeth of this animal.

It is not very difficult to perceive that it is the tooth of Trévoux (plate 26, fig. 5). It is nothing more than a germ, still unimpaired and without roots. It is 0,185 long, 0,08 broad, and 0,06 high, from the neck to the top of one of the denticuli. Five deep furrows divide it into six rows of prominences, each of which, except the last, is subdivided into two. The partial prominences on one side have in front a protuberance, which must necessarily have given them a trefoil shape had the tooth been half worn. Those of the opposite side would have remained elliptic. Hence the latter are the interior. The last prominence or fang is a large uneven papilla, surrounded by others of a smaller size.

There is then a fang or an uneven collection of prominences in this, which are not on the posterior-inferior tooth. And this is an additional circumstance analagous to what obtains in the hippopotamus, and a relation with the superior middle tooth.

All these teeth, when compared one by one with the corresponding teeth of the great mastodon of Ohio, present us with a very strong characteristic, of which I shall avail myself for denominating this species : it is this, that they are much more narrow in proportion than they are long.

Having once ascertained these characteristics, I have had no difficulty in recognizing isolated teeth or their fragments belonging to this species, when they have presented themselves to my view.

Figure 7, of plate 29, is a posterior-superior, preserved with its congenerie in the cabinet of the late M. Baldovinetti, of Leghorn. Though very similar to that of Trévoux (plate 26, fig. 5), its protuberances are a little smoother, and its fang is more prolonged : it is 0,248 long, and 0,096 broad in its centre (marked *d*).

Figure 3, of plate 26, is the anterior half of a superior-posterior from the cabinet of M. Drée, the denticuli of which are only just beginning to be impaired. The roots are not developed.

Figure 7, plate 28, is one nearly similar, in which the fang alone is a little more worn.

Figure 10, plate 27, is one from the collection of M. Hammer, more advanced in detrition, and with more strongly developed roots.

Figures 1 and 2, plate 29, is in a similar stage. It was found at Rochetta di Tanaro near Asti, and belongs to M. d'Incisa of Milan. M. Faujas has given me a drawing of it : it is as white as wax.

Figure 6, plate 26, was brought from Peru by Dombey. Detrition is here very forward in front, while it has not commenced behind, a circumstance for which I feel at a loss to account.

Figure 13, plate 27, was found in the Val d'Arno, and presented by M. Fabbroni. It is the posterior part of one which has not been worn.

Figure 8, plate 27, was found in the Val d'Arno. It is the posterior part of a lower back tooth, not much worn.

Figure 3, plate 29, is the same part but more worn, preserved in

the cabinet of Padua. I am also indebted to M. Faujas for this drawing. It is a bright red colour, and its enamel is very glittering.

Figure 1, plate 26, is the germ of a posterior lower tooth of Simorre, broken in front. (Daubenton, No. MCXI).

Fig. 6, plate 27, is the same part, not at all worn: it was brought by M. de Humboldt from the Giant's Camp; and fig. 4 is a less considerable part, which had begun to be worn.

Figure 1, plate 28, comes from Simorre, it is the first range of a posterior upper tooth, which has not come out or been worn.

Some pieces have been too much mutilated to allow of our determining them with accuracy. Such for instance is the drawing of a tooth from the valley of the Arno, broken at both ends (plate 27, fig. 9); the tooth with a longitudinal fracture, found in the neighbourhood of Asti, by M. G. A. Deluc, (plate 27, fig. 7); that of the cabinet of the Count d'Aris at Padua, found in the Alps, and fractured behind (plate 29, fig. 4); that of the cabinet of the University of Pisa (plate 29, fig. 6), fractured towards the back and the internal edge, but remarkable for more numerous wreaths than any of the others. Nevertheless, all these teeth proceed from the same species, although we may be unable to assign them their place.

A most interesting piece, and one which serves to prove to what a degree detrition operates in wearing down the teeth of this animal, is the portion of the jaw, represented (plate 28. fig. 5). It has been placed in the King's Museum, and it is believed to have been found in France. The great posterior molar alone is there remaining. Its crown presents no other appearance than a uniform disc of ivory. Even the socket of the anterior molar has disappeared.

Having thus recounted in their proper places all the jaw-teeth of this secondary species of mastodon, it remains for me to point out and to describe the other bones belonging to it, of which unfortunately, we have very few.

Of the skull we have only two slight portions of the palate, to which I already had occasion to allude, and which, as they are fractured on every side, do not present us with any character.

The plate preserved in the British Museum, and represented by Camper (Nov. Act. Petrop ii, plate 8), belongs to this species, and not to that of Ohio, as that learned anatomist was led to think. A drawing on the natural scale, given me by M. Wiedeman, shows us in the posterior molar, all the shapes of our narrow teeth, which were rendered indistinguishable in the engraving.

Hence, we learn by this specimen that the upper grinders of the narrow-toothed mastodon diverge towards the front like those of the great mastodon of Ohio.

It is more than probable from analogy, that the species of which I am speaking had tusks similar to those of the species of Ohio; and we have a further confirmation of this in the assurance of Daubenton (Nat. Hist. xi, No. 1011), that he observed some ivory among the specimens sent from the turquoise mines of Simorre. This ivory was, no doubt, the produce of the same animals, as were the jaw-teeth which yield the turquoises.

I myself have found two plates of ivory among the fragments sent

to me from Avaray by M. Chonteau. But, in order to have a positive proof, it would be requisite that a tusk, or at least its socket, should be found with a portion of the jaw bone still adhering to it; and this has not occurred.

The lower jaw is most certainly that of an animal with long tusks. That of Peru (plate 28, fig. 4), judging by such portions of it as I have in my possession, is very similar to that of Ohio: it is merely a little higher in proportion; its inferior edge is less rectilinear, and its external surface is more knobbed. The holes of the chin are likewise more advanced. Its length from the extremity of the great jaw-tooth to the anterior angle is 0,35. The same measurement gives 0,40 in that of Ohio; it is precisely the proportion subsisting between their great teeth, being 0,20 and 0,175 in length. But the proportion of their breadth is very different, being 0,115 and 0,075. Hence, the denomination of narrow-toothed mastodon is amply justified by the fact.

The height of the jaw of Peru is 0,12; of that of Ohio 0,18. Their thickness towards the centre of the great tooth is 0,14 and 0,15. Thus, the former is not so high, but is more knobbed in proportion.

Compared to that of the elephant, the jaw of the narrow-toothed mastodon has its anterior projection longer and narrower towards its centre; it is not truncated so vertically; its chin holes are one behind the other, and not one below the other, as in the elephant.

The lower jaw of Baldassari (Mem. of Sienne, vol. iii, plates 6 and 7) supplies those parts towards the back, which are wanting in that of Dombey. It shows us that the narrow-toothed mastodon had those parts more rounded than the great mastodon, and that, in this particular, it bore a greater resemblance to the elephant.

All these characters are discernable in the jaw attributed to an elephant, kept in the Museum at Florence, and represented by M. Nesti (An. Mus. Flor., vol. i, plate 1, figs. 1 and 2), and they induce me to refer it to the species at present under discussion. Consequently, I feel myself authorised to conclude, that the narrow-toothed mastodon had the projection of the lower jaw dilated in front, and truncated as we may observe it in this jaw at Florence.

Of the great bones of the extremities, we have nothing more than a tibia, brought from the Giant's Camp by M. de Humboldt. Its angles are all very much mutilated, which renders its characters very indeterminate. It is represented at a fourth of its size, plate 28, figs. 8, 9, 10, 11.

Although a little thicker in proportion than that of Ohio, its general formation is not very different. It is 0,40 long, and 0,15 broad at the upper extremity. We may also observe, that it is short in proportion to the teeth, for the latter, as well as the jaws, are only one-eighth less, while the tibia is more than a third. The narrow-toothed mastodon must then have been much lower upon its limbs, so that its trunk would be shorter, &c.; but I am forgetting that a single bone will not justify me in indulging in conjectures.

M. Canali tells us of his being in possession of a tibia found near the Tiber, which he believes to have belonged to the mastodon, but he neither gives us a drawing or any precise description of it*.

* In his correspondence with M. Spadoni.

In the Museum of the Academy of the Fisiocritici at Sienna, I observed and took a drawing of the fragment of a pelvis found with the jaw described by M. Baldassari, but its characters were not sufficiently marked to make it worth my while to make a drawing of the jaw.

Of the fragments of M. Chonteau, a bone of the metacarpus alone is perfectly distinguishable. It bears a strong resemblance, in minature, to that of an elephant.

It would appear that the *narrow-toothed mastodon* is more frequently to be found accompanied by marine bodies than the *great species of Ohio*. Réaumur, indeed, does not mention shells in his description of the turquoise mines of Simorre; he merely states that the teeth and bones are found on a whitish earth, covered and incrusted with a fine grey, and sometimes a blueish sand, mixed with small stones, and that on this there is another bed resembling river sand.

The great teeth are accompanied by others smaller, the proportions of which are too inaccurately sketched to allow us to form an exact estimate of the species to which they may belong. Some of them, however, appeared to me to be the anterior teeth, with four denticuli of the same animal, and the others those of the great fossil tapir.

I cannot account for Réaumur's placing Simorre in Lower Languedoc, in which he has been imitated by all those who have written after him. This little town, at present included in the department of Gers, formed part of the county of Estarrac, in Gascony. It is situated on the river Gimont. According to Réaumur, teeth of a similar description are found lower down at Gimont, as well as at Auch, on the river Gers. I know it to be a fact, that in this latter place the teeth of the gigantic tapir were discovered.

The specimen of M. de Borda is not affected by a similar uncertainty. It was found at Sort, not far from Dax, in the department Des Landes, in a bed most positively formed of marine substances, with the jaws of a species of dolphin, of which I shall speak hereafter, glossopetiæ, and some jaws, which I recognised as proceeding from diodons and tetrodons, when I observed them in the museum of the owner.

Baldassari does not mention what substances were found in company with the jaw described by him. He confines himself to stating that it was discovered by the sliding down of a little hillock, and that the neighbouring country abounds in marine productions; nay more, that the large vertebræ of the cetaceæ are found on the ridge of Mount Follonico. The tooth of Trévoux was found by M. Lollière, in the interior of a hillock of sand: no mention is made of any other fossils which might have been found there likewise.

With regard to the bones of South America, the old Spanish writers have made them the subjects of numerous marvellous legends. From them they have derived their ideas of the race of giants, who in the early ages inhabited Peru, whose exploits may be seen in the Spanish Gigantology of Torrubia, or in a work of more surpassing excellence, the History of Pedro Creça, copied by Garcillasso, book ix. chap. 9.

Moreover, we meet with notices of these bones of imaginary giants in the works of divers travellers. Lengentil affirms that he saw the

remains of them on his route to Peru, and even that his guides pointed out to him traces of the thunder by which they were destroyed*.

Some of the teeth thus attributed to giants, are still preserved at Lima, either in the Museum begun in 1792, or in the custody of curious individuals†.

It is most probably from a similar tradition, that one of the places where these bones are found in the greatest abundance, lying near Santà-Fe de Bogota, has received the name of the *Giants' Camp*. M. de Humboldt says, there was an immense collection of them there. Those which he brought home from it are penetrated with marine salt.

We find more frequent allusions to the giants' bones of Mexico than to the former; but as I have not seen any teeth coming from South America belonging to the species at present under discussion, I am inclined to think that those Mexican bones must belong to the large species of Ohio, or to the fossil elephant; for I know that both are found in that country.

A peculiarity connected with the bones of South America, is the extraordinary height at which they are sometimes found. The Giants' Camp is one thousand three hundred toises above the level of the sea.

They are likewise found in the low places. In a letter to Joseph de Jussieu, of which I shall again have occasion to speak, we read, that as the inhabitants of St. Helena, near Guayaquil, were employed in digging some wells, they discovered some immense bones, no doubt belonging to this species.

Dombey has not signified the place of discovery of the specimens brought home by him; he merely states that they were impregnated with lumps of native silver. I have not been able to discover any traces of it, but the bones were in several places incrusted with a hard ferruginous sand, and as the spangles of the silver of Peru are frequently found in the sand, it is possible that some might have been attached to these specimens.

Don George Juan ‡ tells us that veins of silver are found in the skeletons of the Indians who perished of old in the mines. Perhaps there is some connexion in those two facts.

It is to be regretted that the pretended turquoises yielded by the teeth exhumed at Simorre, have not acquired a sufficient value in the market to induce a continuation of the works: had that been the case, most probably we should now be in possession of a much greater number of the component parts of the animal to which they belong; but besides that the greater part of them were deficient in consistency, and split when submitted to the action of the fire, those which resisted that action rarely assumed a perfectly uniform or brilliant colour.

ADDITIONS TO THIS SECTION.

Addition to page 350.

M. Rousseau, a farmer at Angerville, in Beauce, has sent me the drawing of a large jaw tooth of the narrow-toothed mastodon, found

* Voyage Round the World, by Legentil, 1728.

† Literary Journal of Gœttingue, Feb. 27, 180 6.

‡ Travels in Peru, 4to. p. 527.

at Chevilly, near Orleans, embedded in a layer of calcareous marl. It is a lower jaw tooth without any roots, and with its denticuli quite perfect. It is 0,14 long, and 0,066 broad.

Another Addition.

The neighbourhood of Avaray, in the department of the Loire and Cher, appears to abound in bones of the rhinoceros, the gigantic tapir, and the mastodon.

Mr. Lockhart, member of the Royal Society of Sciences at Orleans, read a paper to that body, on the 5th of January, 1821, on the depôt discovered by M. Chouteau, which I have already had occasion to notice, and which I shall speak of hereafter, in the second sections of chapters iv. and x.

"These bones," says Mr. Lockhart, "lie outside the valley of the Loire, between the high road and the village of Avaray, in a bed of sand immediately reposing on the layer of fresh water calcareous substance, which constitutes the plain of Beauce. This sand presents great variety in its composition; it is formed of small calcareous fragments, and of quartz differing in size and colour. It contains particles of brown clay, yielding a fetid odour, and blackened fragments of carbonated chalk and silex.

"Its entire mass is hard, greyish, and sometimes coloured yellow by oxide of iron. We may observe in it large brown spots, which are owing to the slow decomposition, and to the carbonate of the organic substances. It is a metre in thickness, and it appears to form a peculiar bason, stretching to the south of the quarry (of fresh water gravel), where its outline may be observed. Its position is rather elevated, being on the slope of a hill 20 metres above the surface of the valley of the Loire."

This observer having had the kindness to send me the bones which he collected, I recognized among them divers fragments of those of the mastodon, viz.:—

1. Many fragments of jaw teeth, perfectly characterised as belonging to that species.

2ndly. A left calcaneum very much mutilated, but yielding, notwithstanding, the general character of the family of the *proboscidians*, while the specific characters were at the same time very distinct.

The inferior internal apophysis is broken, and has disappeared altogether, with its astragalian facette. The internal edge of the cuboidian surface is also fractured, but the largest part of it is still remaining. The posterior tuberosity has been very fairly preserved, as also the articulation of the fibula, and a part of the internal astragalian facette.

Compared with the calcaneums of the elephant and of the great mastodon, its posterior tuberosity is much longer and less swollen at the end: the facette towards the fibula rises as in the great mastodon, as high as the external astragalian, along which it is placed. The cuboidian facette is higher and narrower than in the elephant; the tuberosity beneath the inferior edges of this facette is not so large, so that this calcaneum, mutilated as it is, would in itself be sufficient to indicate a particular species of *proboscidians*.

Its greatest length, from the extremity of its posterior tuberosity to the upper edge of the cuboidian facette, is 0,19.

Its greatest height, from the summit of the facette joining the fibula, to the inferior tuberosity, is 0,11.

This height corresponds almost exactly with that of an elephant eight feet in height.

3rd. A large bone of the carpus, mutilated but distinguishable. It is similar to the corresponding part of the elephant, but it is narrower in proportion. Its lower lateral facette for the index, is also a little larger in front. It is 0,06 in height, 0,07 broad, and 0,08 in anterio-posterior diameter. Some rather large fragments of ivory were found in the same bed—a circumstance tending to prove that the narrow-toothed mastodon had tusks.

But a more decided proof of this is afforded by a discovery made in the department des Hautes Pyrenees, at Sariac, in the canton of Castelnau, in the valley of the Gers; and in a marl pit, 24 feet deep, situated at a quarter of a mile from the river.

M. Lourtau, a young physician of that country, has sent me the most interesting specimens found in that quarter; they consist of three entire grinders, two fragments of grinders, and several sections of tusks, large and small.

The two first jaw teeth have the usual four pair of lobed denticuli, and a little fang. The two points of the anterior pair are much worn, and present us with irregular trefoil figures.

One of those of the second pair is also somewhat worn, the remainder are entire. The crown of these teeth is 0,14 long, and 0,075 broad in front. The enamel is precisely similar in every respect to that of the tooth of Simorre. It is of a blueish white in many places, shaded with a reddish hue.

The third is attached to a section of ivory, quite altered and incrusted with a sort of stalactite crust, 0,27 in length. It is pointed and compressed; its section is 0,7 in its greatest diameter, and 0,5 in its smallest, but it joins other sections, with which it forms a tusk at least 0,86 in length, with a diameter at the base of 0,13. There are other fragments also corresponding with each other, and forming a tusk of more than a metre in length, with a diameter of 0,13 at the base. The two last specimens unite and form a section 0,52 long, with the same diameter as the others. These three portions of tusks appear to have been almost straight. The ivory is very much altered; the incrustation which has formed upon it, and which has even penetrated into the interstices of its plates, is of a greenish grey, intermixed with numerous hard sharp plates.

But the most important fragment is a section somewhat arched, 0,14 long, and though broken at both ends, its thickness is not sensibly diminished. It must have formed part of a long tusk, which must undoubtedly have projected from the mouth, and yet it is enveloped in a coat of real and very hard enamel, not at all so tender as the crusts of the tusks of the elephant.

The outline of this fragment of a tusk is a very regular oval, measuring 0,065 in its greatest diameter, and 0,05 in its smallest.

The process of decomposition has divided its layers into concentric

rings, similar to those observable in fossil ivory, but the figures have been subsequently filled by a ferruginous or spathic crystallization. I have not been able to discover those lines, disposed like lozenges, which characterize so distinctly the ivory of the elephant.

Notwithstanding the correspondence existing between this tusk and that of the hippopotamus, its hollow is not the same; however, it is plain that the narrow-toothed mastodon bore a resemblance to this animal in this particular, as well as in the division of the protuberances of its jaw-teeth into trefoil shapes.

Fresh discoveries have recently been made of the spoils of this animal in Tuscany.

The Chevalier Fossombroni, minister to his Highness the Grand Duke, as profound a philosopher as he is a virtuous and enlightened statesman, has sent me a drawing representing a considerable portion of the jaw, with a tooth of eight denticuli, perfectly distinguishable.

This specimen was discovered by some peasants at Bettolli near the summit of a small acclivity springing from the centre of the valley of Chiana, a country where the name of M. Fossambroni will be immortal. It was two feet deep in a bed of sand stone, supposed to be marine, which was interspersed with shells of a very adhesive quality. The enamel of the tooth is of a grey colour and very hard. It will be observed, that Bettolli is very near Mount Follonico, where Baldassari found the jaw which he described in 1767, in the Memoirs of the Academy of Sienna.

Between those two places lies Asina-Lunga, where in 1815 Dr. Giuli found two jaws of the same species, which he too has presented to the Academy of Sienna. Hence, we cannot entertain the slightest doubt of these animals having been numerous in the Valley of Chiana, at the period when the districts at present forming the territory of Tuscany were inhabited by hippopotami, the rhinoceros, and the elephant of the old world.

It would be most desirable that excavations conducted with intelligence might bring to light, from the bosom of the earth, the remaining bones of so remarkable a species, which must undoubtedly exist not far from the jaws. We might then be enabled to reproduce this animal entire, as we have done with the hippopotamus of the Valley of the Arno, and the rhinoceros of Parma. This would be a new service rendered to science by Tuscany—that science which is at present so deeply indebted to her.

Another Addition.

The researches daily made in Tuscany are a more than sufficient proof how very classical that country is, in the history of fossil animals.

A discovery has just been made there of the almost complete skeleton of a narrow-toothed mastodon. Professor Nesti of Florence is at present engaged in preparing a description of it. This will form a most important document in this line of research, and I shall lose no time in laying its contents before my readers, as soon as it shall have appeared. The bones of this mastodon are likewise found in Poland.

M. Bojanus, a celebrated anatomist and professor at Wilna, has just

sent me the drawing of a jaw tooth with four pair of denticuli and a fang, in a state of perfect preservation. It was found at Tulezyn, a city of the ancient palatinate of Braklaw, at present comprehended in the government of Podolia, situated on one of the tributaries of the Bog. It bears a singular resemblance, in shape and colour, to that of Lombardy, which I have given in plate 29, fig. 2.

Additional Article on the Narrow-toothed Mastodon, and on the Bones of the Mammiferous Animals of the Lignites.

In addition to those already recounted, I have received many teeth of this species, or drawings of teeth, from France, Italy, Germany, and England. M. Ranzani has sent me the model of a large one found on the ridge of the Apennines, fronting Bologna. A short time since, a very superb one was discovered near Montpellier. To the kindness of M. Veran I am indebted for a fine drawing of this specimen. It has twelve knobs or hills, all divided, and its length reaches 0,237. But the finest piece of this kind which has fallen under my observation, is the half of a lower jaw, which is only defective in a small portion of its coronoid apophysis. A coloured model of it has been sent to the King's Museum by the Count de Breuner, supervisor of the mines of Austria. It was found on the estate of that gentleman, at Steltenhof, in the circuit of lower Manhatzberg, in lower Austria, and about three leagues to the north-west of Krembs, where we have seen, in a former part of the present volume, that in 1645 some bones of this description, supposed to be those of giants, were found. This half jaw, according to the account which the Count de Breuner has done me the honour to address to me, was found on the summit of a hill, at an elevation of four hundred feet above the Danube. It was lying in a ferruginous, agglutinated sand, which reposed upon a coarse calcareous layer, and which is covered by the moveable earth, in which the bones of elephants, and sometimes of the rhinoceros, are found. Thus the bones of the mastodon are found at a greater depth, and almost invariably broken. Those of the elephant and the rhinoceros are nearer the surface and more entire. M. de Breuner has moreover made the extraordinary discovery of no less than five skeletons in the same spot.

This mastodon's jaw, of which I am speaking, is very similar to that of the great mastodon; its angle is less rounded than that of the elephant, its inferior edge is more rectilinear, and its beak is more projecting. It has a first tooth of eight denticuli, and a fang, rather worn, as well as a second of eight denticuli, but still perfect. Taken together, they occupy a space of 0,32 in length: the height of the condyloid apophysis, above the inferior edge, is 0,45, that of the coronoid, 0,40; the breadth of the ascending branch beneath the two apophyses, is 0,3; the height of the dental branch, between the two teeth, is 0,19, and in front of the anterior, 0,24. From this point, the oblique line descending to the extremity of the beak is 0,24.

M. Boué, so well known by his geological descriptions of Scotland and Germany, as well as by his numerous lucubrations, has assured me that he saw some of those bones of the mastodon in the Imperial Museum of Vienna, in a dross which he considered analogous to chalk. They were found in Leithagebirge, a chain of mountains which sepa-

rates lower Austria to the north of the Danube, from the adjoining districts of Hungary. These drawings which have been sent to me by M. Boué, affords incontestable proofs that the bones do in fact proceed from this species; but perhaps it might be necessary to examine more accurately the place in which they were found, before ascribing to them so remote an antiquity.

M. Boué, however, seeks to ground his opinion on some bones of ruminants, which he has sent me, surrounded by a substance very similar to our coarse gravel; and he further adduces in support of his opinion, the lignites of Switzerland, so rich in the bones of the mammiferi, of which I am about to treat. In fact, I have not the slightest doubt of these lignites containing the bones of many great quadrupeds, and especially of the narrow-toothed mastodon, to which our observations are more peculiarly directed, as M. Meissner has announced in the Museum of Natural History of Berne, and in the Indicateur of the Helvetic Society of Natural History, where he has described and represented very easily distinguishable portions of the teeth of mastodons, from the lignites of Kœpfnach, on the western bank of the lake of Zurich.

The Count Vitalliano Borromeo, of Milan, has had the extreme kindness to submit to my inspection four specimens extracted from the lignites of Horgen, a little above Kœpfnach. Among them is a small molar of two denticuli, and two fragments of a tusk, perfectly recognizable by their interior texture, similar to that of ivory, and their enamel longitudinally channelled, like that of the fragment of Sariac, which I have already mentioned.

I have this moment before my eyes a drawing made by M. Schintz, professor at Zurich, of three great jaw teeth, two of which are still adhering to the jaw, and which evidently belong to the mastodon. These two have been extracted from the lignites of Kœpfnach. A broken tusk was found with them, which must have been two feet and a half in length. Its enamel is channelled, like that of the pieces which I have just described. The mastodon is not the only species whose remains are contained in these lignites.

Another drawing by M. Schintz, represents the upper portion of the jaw of a rhinoceros, probably of the species with partitioned nostrils, containing three teeth, two of which are still entire. This specimen comes from Elgg, near Winterthur, on the frontier of the canton of Zurich, and that of Thurgovie.

To the friendship of M. Brongniart I am indebted for the jaw of a beaver, with very well characterised molars. It comes from the same place, viz. Horgen, and is still enclosed in the lignites.

These facts are probably of the same order as those bearing upon the bones of the Lophiodon of the black lands in the neighbourhood of Laon, of which I shall treat in the second section of the tenth chapter. They prove one of two things, either a more remote period for the existence of the mastodon, than that which the result of my researches has led me to attribute to it, or the existence of distinctions in the strata of lignites, more numerous than those which have as yet been recognized by geologists.

It is not very long since lignites and pitcoal were confounded to-

gether; and how much more easy is it to confound the lignites of several ages. At all events, it must be admitted that this scrutiny is worthy of the examination of geologists.

Owing to the generous attentions of M. de Humboldt, the museum has lately been enriched by several fragments of the bones of this mastodon, exhumed near Santa-Fé de Bogota, in Columbia, at a place called Cano del Fiscal. Among the number is a humerus almost complete, and a calcaneum quite entire. The humerus is shorter in proportion than that of the great mastodon. It is 21 inches, or 0,568 long, and seven, or 0,189 broad at its base: thus confirming an idea suggested to me by a tibia of the same canton, viz. that the narrow-toothed mastodon was shorter limbed than those species to which it approximates.

SECTION III.

ON SOME TEETH BELONGING TO THE MASTODON SPECIES, WHICH APPEAR TO INDICATE SPECIES DIFFERING FROM THOSE ALREADY ENUMERATED.

To the kindness of M. Humboldt I am indebted for some teeth from South America, whose tuberosities are divided like those of the *narrow-toothed* mastodon; but which have the same square proportions of those of six denticuli of the Ohio, and which might be taken for them, were it not for the trefoil figures, which cannot be confounded with the lozenges of the mastodon of Ohio. There are two sizes of them. The largest have the same dimensions as the corresponding teeth of the Ohio.

M. de Humboldt has brought home one, which he found near the volcano of Imbaburra, in the kingdom of Quito, 1200 toises high. It is very much decomposed, and is still covered with volcanic ashes. Its enamel is of a reddish tint. It is 0,12 long, and 0,085 broad. (See plate 27, fig. 1).

The same accomplished traveller found another specimen of the same kind at the convent of Chiquitos, near Santa-Cruza de la Sierra, at the 18th degree of southern latitude, almost the centre of South America. This fragment is very much mutilated: one of its thickest roots is more than six inches in length. The osseous substance is of a reddish tint, and the enamel is blackish at its surface. To the same species I attribute a tooth found in this same province of Chiquitos, a drawing of which has been sent me by M. Alonzo, of Barcelona (plate 27, fig. 12). As it is not entire in its fore part, I cannot designate its place; but from its fang I am inclined to think that it is either the middle or posterior upper.

That district lying on the other side of the Cordillieres, appears to be very productive of those spoils. The late Joseph de Jussieu, writing from Lima in 1761, states that in the valley of Tarija, in the twenty-third degree of southern latitude, at a distance of 150 leagues from the sea, and at 200 leagues from Potosi, they met with bones and petrified teeth in abundance on both sides of the river; that he himself

was actually possessed of two molars of prodigious size. He does not tell us at what precise height these bones were found, but he most positively affirms that they were not accompanied by shells.

The smaller square teeth are one third less in size. They have likewise been discovered by M. de Humboldt. I am indebted to him for one, which he has brought home from the Conception du Chili, in the thirty-seventh degree of southern latitude; it is very much worn, but in a state of almost perfect preservation. It is of a blackish hue, 0,08 in length, and 0,06 in breadth. (See plate 27, fig. 5).

Europe has moreover furnished me with two teeth, which I have looked upon as being much too small to be referred to any of the preceding species.

The first was sent from Saxony a long time since, by Hugo, a professor of Gottingen, to Bernard de Jussieu; and M. Antoine Laurent de Jussieu has had the kindness to communicate it to me. I have given it (plate 27, fig. 11), at half its natural size. Though perfectly similar to that of plate 26, fig. 4, it is less by one-third precisely.

If we could suppose it to belong to the same species, we must also suppose that its place was more in front of the jaw, as we find an instance of two almost entirely similar in the jaw of the great mastodon (plate 21, fig. 4). But this instance is not quite conclusive, as the latter teeth are of precisely the same size.

I am not aware of the situation in which that tooth was found.

The second comes from Montebusard, near Orleans. It has been sent to me by M. Defay, who discovered it in a quarry of fresh water gravel, intermixed with round and flat shells, in which were also found quantities of the bones of palœotheriums of divers sizes. I give a figure of it at half its natural size (plate 28, fig. 6). It is the same which was engraved in the Memoirs of Guettard, vol. vi, tenth Memoir, plate 7, fig. 4. Its knobs, simply notched, are not so exactly divided into two points as those of the preceding, which might afford an additional reason for suspecting the existence of another species. The undivided knobs indicate a relation with those of the great tapir, of which I shall hereafter have occasion to speak. Nevertheless, I do not think that this tooth is the actual production of that species, as the knobs of the latter are more widely separated, and its numerous and diminutive notches can never be mistaken for papillæ.

Thus, independently of the great mastodon of Ohio, and of the narrow-toothed mastodon, two species perfectly well known and defined at the present day, I find indications of four mastodons appearing to form separate species. The two which come from America may be denominated the mastodon of the Cordillieres, and the Humboldian mastodon, when their characters shall have been more completely defined and confirmed. To the first of the European species I would give the name of the small mastodon, and to the second, whose knobs are not completely divided into papillæ, that of Tapirian mastodon.

Additional Note on the Mastodons.

Since the period when Cuvier proclaimed his opinion that the mastodon was not provided with incisors in its lower jaw, some pieces have been discovered, which go far to destroy the generality of this proposition. In America some lower jaws have been found, evidently belonging to young individuals, and furnished with small incisors: other specimens belonging to adults are also provided with them, while some other jaws, likewise belonging to adults, do not present me with any traces of them. Some naturalists have been of opinion that these young jaws were those of the great mastodon, which loses its incisors at a certain period of its growth; in that case, the only opinion that can be deduced from those specimens of the adults, in which those teeth are found, is that the epoch of their falling cannot be the same in all individuals of the species. Others, on the contrary, lean towards the opinion, that the jaws of every age, in which incisors are found, belong to a different species of great mastodon. Some anatomical characters, derived from the shape of the jaws, would seem to justify this opinion.

As for the narrow-toothed mastodon, nothing has as yet come to light contradictory of the position of Cuvier, with regard to the absence of incisors in the lower jaw. But M. Kaup, keeper of the Museum of Darmstadt, has found in the sand of the valley of the Rhine a new species, which might perhaps be more deserving of the name of the narrow-toothed mastodon, than that of Cuvier; so decided is the disproportion between the length and breadth of its molars. It is moreover furnished with long and thick permanent incisors in the lower jaw.

To this we are further bound to add, that during the last three years, some Englishmen have discovered on the banks of the Iraouaddy, in the East Indies, no fewer than two new species of mastodon.—Laur.

CHAPTER III.

ON THE BONES OF THE HIPPOPOTAMUS.

In treating of the hippopotamus, I shall pursue the same course I adopted in the case of the elephant: I shall first describe the osteology of the species already known, describe the countries it inhabits, examine into the supposition of the existence of many species, and I shall then proceed to make a comparison between the bones of the same species found in the fossil state.

Such shall be the scope of the present chapter, which I shall divide into two sections, like that which treats of the bones of elephants.

SECTION I.

ON THE LIVING HIPPOPOTAMUS.

Article I.

Observations made upon the Hippopotamus.

The history and organization of the hippopotamus has been, and is at present to a certain extent, less known than that of any other of the great quadrupeds.

Although we may believe with Rochart, that it is the Behemoth of Job, the passage relating to it in that book is too vague to serve to characteriste it.

The description of the hippopotamus, given by Aristotle in his History of Animals, book ii, chap. 7, is so far removed from the animal at present known by that name, that we are at a loss for the means of explaining such an assemblage of blunders. It is true that that great naturalist points out Egypt as its country, but he goes on to give it *the figure of the ass, the mane and neighing of the horse, and the cloven foot of the ox* (διχηλὸν δ' ἔστι ὥσπερ βοῦς.) *Its snout is snubbed, its lips slightly divided, its teeth somewhat projecting, and its tail similar to that of the wild boar; the skin of its back is so thick that javelins are formed of it.*

We are the more astonished at this ridiculous description, when on ascending to the sources of this information, we find that it is almost entirely borrowed from Herodotus, who is generally most exact in his description of whatever he had himself observed. He has even one error more than Aristotle, for he says, "*the tail of the hippopotamus is likewise similar to that of the horse;*" but to compensate for this,

he has gone nearer to the truth when he attributes to this animal a height surpassing that of the largest oxen. (Herodotus Euterp. p. 71).

From these two descriptions one might feel tempted to believe that the name of the hippopotamus was then applied to a species different from that which it is at present used to designate, if Diodorus Siculus did not evidently bring us back to the latter. After ascribing to the hippopotamus its real figure, he goes on to say, "It is seven feet long, and approaches in bulk to the elephant. It has on each side three projecting teeth, larger than the tusks of the wild boar:" however, he *leaves it the cloven foot of the ox, and the tail of the horse.* (Diod. Sic., lib. i.)

Pliny, who must have seen the description of Diodorus, has contented himself with copying that of Aristotle, with the exception of the height, which he leaves undetermined, and the use of the skin, which he says "is only fit for making helmets and bucklers, so impenetrable that they are not even injured." (Book viii, chap. 25.) To all this he annexes another error—viz. *that the hippopotamus is covered with hair like the seal.* (Book ix, chap. 12.)

And yet, independently of the authority of Diodorus Siculus, he had the opportunity of collecting better information on the subject, since he states in express terms, that "an hippopotamus was shown at Rome by Scaurus, when he was edile." (Book viii, chap. 26.) And we know from Dion, that *Augustus exhibited another in his triumph over Cleopatra.* (Dion, book li, p. 655, edition of Reimari.)

Several other hippopotami were exposed after the death of Pliny. Antoninus exhibited some crocodiles, tigers, and other rare animals, according to the account of Julius Capitolinus. (Hist. Aug., edition of Schrev., page 142). Moreover, Dion (book lxxii, page 1211 and page 1219), assures us that Commodus exhibited six upon one occasion, and that he killed one with his own hand upon another. We find by Lampridius (Hist. Aug., page 497), that Heliogabolus was likewise possessed of some; and by Julius Capitolinus, that there were some exposed in the reign of Gordian the Third.

If we may place any reliance upon such authority as the verses of Calpurnius, there were several of these animals at the games of Carinus, in 284*. Nevertheless, the ancient authors posterior to Pliny, and the moderns, as far as Fabius Columna, have not given us a better description of this animal. Oopienus, who calls it a *wild horse*, and assigns it to Ethiopia, does nothing more than paraphrase some passages of Aristotle. Ammianus, too, gives it the shape of the horse, a *short tail* and a *cloven foot.* It is true, as he states, that the hippopotamus had disappeared from Egypt from the time of the Emperor

---

* Calpurnius, Eclogue vii, verse 66.

Spectavi vitules, et equorum nomine dignum
Sed deforme pecus, quod in illo nascitur amni
Qui sata riparum venientibus irrigat undis.

It is rather amusing that Mayrault, the translator of Calpurnius, should have fancied that crocodiles were the animals alluded to, and should call them *enormous lizards.*

Julian. (Ammianus Marcellinus, book xxii, chap. 15.) This is further confirmed by Thémistius, in his twentieth oration.

It is from the circumstance of their having confounded the addition of Gylius with the text of Ælian, that Aldrovandus and Jonston attributed to Ælian a description which Gylius had taken from Diodorus without acknowledgment. (Ælian. Gylii, book xi, chap. 45).

Even the description of Achilles Tatius, an Alexandrian author of the fourth century, pointed out by Schneider as being more correct than his predecessors, is not entirely exempt from errors. "The hippopotamus," says he, "resembles the horse in its belly and its feet, except that in the latter the hoofs are cloven. Its size is equal to that of the largest ox; its tail is short, and, like the rest of its body, is without hair; its head is round, and by no means small; its jaws are similar to those of the horse; its chin is large; its nostrils are very much distended, and give forth a burning sulphur; its canine teeth are bent like those of the horse, but three times the size of the latter*."

The ancient artists have succeeded in giving a better idea of this animal than either the naturalists or the historians. It is represented in a very distinguishable manner, with the ibis, the crocodile, and the lotus plant, on the plinth of the statue of the Nile, which formerly ornamented the Belvidere at Rome, and which is now in the Museum of Arts; the minutiæ of the feet and teeth alone are there deficient in accuracy.

The Mosaic of Palestrinum, which the taste of the ancients led them to decorate with figures of the animals of Egypt and Ethiopia, presents us with three excellent figures of the hippopotamus towards the left base. Two of them are pierced with arrows by the negro hunters, and one is half immersed in the river; but unlike most of the others, these figures are unaccompanied by a name.

Again we find a figure of it, and as in the former instance, accompanied by the crocodile and the lotus, on a carved stone in the cabinet of the Duke of Orleans.

The medals of Adrian, so frequently representing Egypt and its productions, also present us with figures of the hippopotamus, the crocodile, and of the Nile. One of these medals may be seen in the Augustan History of Angeloni (plate 149, fig. 58), and another in the Numismata Imperii Romani of Jacob Biæus (plate 39, fig. 7). On the former of these medals, the hippopotamus is ridden by a child; the crocodile accompanies it on both.

Although the animal's name is not engraved upon those monuments it is not the less certain that the figures represented are those of the hippopotamus, since we learn by the positive testimony of Lucien and Philostratus, that the Nile was never painted or carved without being accompanied by the hippopotamus and crocodile†.

Hence, they apply a very sufficient corrective to the deficiencies in the descriptions of the ancients, and leave no reasonable ground for

---

* Achilles Tatius, book iv, chap. 2.

† Lucian., Rhetor. Præcept., vol. iii, page 2. Philostratus, book i, imag. 5, Leipsic edition.

doubt with regard to the true application of the name of the hippopotamus.

It would not appear that Christian Europe was favoured with the sight of a living hippopotamus, as the descriptions of this animal in the authors of the middle ages*, without even excepting those who, like the Cardinal Jacques de Vintry†, had visited the country it inhabits, are nothing more than compilations interspersed with new absurdities, or misinterpretations of the old. The Arabians were the only people who, at that period, entertained just notions on this subject. Abdallatif, in his account of Egypt, describes the hippopotamus with great justness and propriety‡.

Bélon and Gylius are the first moderns who saw the hippopotamus in its natural state, and perhaps they both saw the same animal, for they both observed it at Constantinople. In his work on fishes, Bélon speaks of it from memory, illustrating his account with a figure copied from the medals of Adrian. He rectified the error of the statue of the Nile, which gave this animal five instead of four toes. Of the teeth, he merely observes, that they approximate to those of the horse.

Gessner restricted himself to copying the account of Bélon. (Gesn. Pisc., art. Hippop.)

Gylius, who, as would appear from a letter to the Cardinal d'Armagnac, quoted by Prosper Alpin (de. reb. æg., i, 248), had also seen one of those animals at Constantinople, probably the same seen by Bélon, and yet, as I have already observed, he contents himself with copying the description of Diodorus Siculus.

It was not until 1603, half a century after Bélon, that an Italian surgeon, named Zerenghi, brought from Egypt some skins of the hippopotamus of both sexes, and published a good description of the species, with a figure of the female‖.

Aldrovandus, who had been shown this female figure by Zerenghi, caused a copy of it to be engraved for his History of Animals. However, he did not publish this figure, but another, which was sent to him, as he tells us, from Padua, no doubt by Prosper Alpin, for we find the same figure recurring in the works of the latter, which was not published until 1735. We may see it in Aldrovandus (De Quadr. Dig. Viv., book i, page 184), with a separate drawing of the head (page 185).

The learned Fabius Columna had a much better drawing of the animal brought home by Zerenghi, executed for his own work. It appeared with a very good description in his Aquat. Obs., page 30, in 1616. Hence, it was prior to that of Aldrovandus, although the latter might have been executed before it, supposing it to have come from Prosper Alpin, for this latter author left Egypt in 1583, after a sojourn of three years, and died professor, at Padua, in 1617.

Ludolphus published some drawings of it, far preferable to those I

---

* Isidore de Séville, Orig., book xii, page 168; Vincent de Beauvais, Spect. Natur., book xvii, chap. 115; Albert le Grand, de Nat. Anim., vol. vi, page 654.

† Jacques Vetriac., Natural History, chap. lxxxvi.

‡ Abdallatif's Account of Egypt, translated by M. de Sacy, page 143.

‖ His dissertation is given as an extract by Buffon, vol. xii, page 24.

have enumerated, in his History of Abyssinia, in 1687, but without any notice of the source from which they were derived.

In 1689, Jean de Thevenot, in his Travels to the Levant, book ii, of the second part, chap. 71, page 787, gives a rather detailed account of an hippopotamus, which was killed at Girge near Cairo, but unaccompanied by an engraving.

Notwithstanding the knowledge which might have been derived from these authentic sources, the publication of the work of Prosper Alpin, which as I have already observed, took place in 1375, was the commencement of a series of embarrasments to the subject.

He headed his twelfth chapter with the title of "*The Chœropotamus and the Hippopotamus*," he there commences with giving the figures of two stuffed skins, the one of a large female, the other of its fœtus, which he had seen in the house of the Pacha of Cairo. These are evidently two skins of the hippopotamus of our times: but the head, and consequently the teeth, had been carried off with the rest of the flesh and the bones.

By the absence of these teeth he was led to conclude, that this could not be the hippopotamus of the Greeks, since, if it were the latter, it must have had its teeth slightly projecting; and having a short time afterwards observed another skull with teeth at Alexandria, he published a drawing of this also (the same which Aldrovandus had published before him), declaring at the same time, that the latter alone belonged to the true hippopotamus, as it corresponded more accurately with the descriptions given by the Greeks.

For the same reason, he concluded that the figures on the plinth of the statue of the Nile, and those of the medals of Adrian, do not represent the hippopotamus, but that imaginary animal whose skin he had seen without the teeth.

It was difficult to avoid this error of the antients, that the teeth projected from the mouth, when there was no opportunity of seeing the living animal. These teeth, and more particularly the canine, are so large, that it is difficult to conceive how they can be contained beneath the lips; now the ancients had seen many of these teeth; and even previous to their having any idea of the figure of the animal to which they belonged, and when they supposed it to be equal to that of an ass, they made then an article of traffic, and used them as ivory in the most precious works of art.

Pausanius speaks of the statue of a goddess, the face of which was formed of those teeth (Pausan Arcad. p. 530), and Cosmas in the time of the Emperor Justin, mentions his having brought home and sold one weighing thirteen pounds, while the largest that we have do not weigh more than six.

This is, doubtless, the reason why the ancients supposed that the teeth of the hippopotamus projected from its mouth like those of the wild boar. Nevertheless, it is an unvarying fact that the hippopotamus does not expose its teeth in the slightest degree when its muzzle is closed: this is attested by many eye-witnesses, and those heads which have preserved their skin, without its becoming contracted by drying, prove it still more decidedly: we have one of these in the Museum.

The ancient figures there, of which I have spoken, give us a faithful

representation of this animal, and it is useless to suppose the existence of another species in order to explain them.

This was done by Prosper Alpin. To this imaginary species he gave the name of *river-hog*, called as he tells us, *Chœropotamus*, by the Greeks.

Now none of the ancient Greek writers, at least that I have been able to discover, ever employed this word *Chœropotamus* to designate a definite animal. The Mosaic of Palostrinum, which, by the by, Prosper Alpin had never seen, exhibits a quadruped with some scarcely decypherable letters, among which people have fancied they could discern χοιροπ. But as the ancients had a chœropotamus or monkey pig, which probably might have been the mandrill, or some *cynociphalus*, and as the figure in question bears some distant resemblance to the latter, we can draw no conclusion from thence, in favour of the existence of a chœropotamus.

Nevertheless, Hermann, in his Table of the Affinities of Quadrupeds, (John Hermann's Tabula Affinitatum Animalium, page 96), admits its existence as if it had been demonstrated; nay, he goes so far as to say, that Prosper has very clearly pointed out the difference between the chœropotamus and hippopotamus; *disertis verbis distinguit* is his expression. Thus it is that the cleverest men are led to adopt errors when the latter are favourable to their general system. Hermann was attempting to prove that all animals bore a certain affinity to each other, and were but as links in the great chain of animated beings; he found the several species of the order of pachydermata too isolated to justify his idea: hence, he was under the necessity of trying to persuade himself that there were still many unknown species of that class; and whatever could lead him to suppose the existence of any one of these, was eagerly embraced by him. Perhaps it may be said, that the object of my present researches gives me an interest precisely contrary, and that I may feel perpetually tempted to efface the traces which might lead to the discovery of unknown living species, in order to render the number of the lost more considerable. I felt conscious at the outset, that I was incurring this risk, and I shall be ever on the watch to avoid it; even at this present moment I am far from denying the existence of species similar to those I have just mentioned; all that I mean to say is, that we are without any proof of it.

It has never been sufficiently explained how the two hippopotami of Zerenghi, and the first of those of Prosper Alpin, had strayed so close to Damietta, and that of Thevenot to Cairo; nor whence came the second, which Prosper Alpin saw at Alexandria; but it is certain that at present not one of these animals is to be seen below the cataracts. All the travellers who have visited Egypt during the eighteenth century are unanimous upon this subject, and the naturalists attached to our expedition to Egypt, who ascended the Nile as far as Sienna, did not meet with a single one. It is only in Abyssinia, and in the regions of Africa to the south of the Atlas, and particularly of the Senegal and the Cape, that the hippopotamus has been observed in latter times.

It was from the Senegal that the fœtus described by Daubenton was brought, as well as the young hippopotamus of the Museum of

Chantilly, at present in that of the king. It is represented in Hist. Nat. Supp. to vol. iii, p. 62.

From the Cape we have an adult hippopotamus of the cabinet of Leyden, described by Allamand (Nat. Hist.) and that of the cabinet of the Stadtholder, at present in our Museum. It was prepared and described by Klockner.—Hist. Nat. Supp., vol. iii, pp. 306 and 308).

It was at the Cape that Sparmann observed the hippopotamus, and that Gordon drew up the description and figures published by Allamand (Nat. Hist. Supp., vol. v, pp. 1 and 2), and afterwards by Buffon.

Finally, it was also from the Cape that M. Delalande brought the skeleton of the adult hippopotamus which conferred an additional value upon this edition. Moreover, the species is becoming so rare in that country, that it is forbidden to hunt it, and M. Delalande was obliged to obtain a special permission in order to procure this skeleton.

As for Senegal, their numbers there must be still more inconsiderable, as I have never been able to obtain one from that country, notwithstanding the express orders of the minister of Marine conveyed to the governor.

Besides the Cape and Senegal, we learn from Barbot and from many other travellers, that there are numbers of them in Guinea and Congo. Bruce assures us that they are very numerous in the Nile, in Abyssinia, and in the lake Tzana. Levaillant observed them in all the districts of Caffraria, through which he passed, so that almost the whole of southern Africa is peopled with them. But are they confined to that part of the world? It is a long established opinion. Strabo (book xv, p. 1012, Amsterdam edit.), speaking on the testimony of Nearchus, and Eratosthenes, denies the existence of any in the Indus, although he admits that Onesicritus affirmed it. Pausanias agrees with them, and although Philostratus and Nonna have adopted the opinion of Onesicritus, it is certain that no traveller of accredited veracity has ever asserted that they are to be found on the Indian continent, even beyond the Ganges. Buffon paid not the slightest attention to the testimony of Michael Boyn, who places some in China; so that we are justified in saying, that it is without the shadow of authority that Linnæus, in his tenth and twelfth editions, supposes that there must be some at the mouths of the rivers of Asia. Hence, too, M. Faujas seemed to proceed upon good authority in denying the existence of the hippopotamus on that continent, but perhaps he should not have extended his negation to the entire of Asia; for Marsden, an author of some repute, places the hippopotamus in the number of the animals of the island of Sumatra. However, it remains to be proved, whether Mr. Marsden has been deceived or not.

This question is very important in its bearings on zoology and the theory of the earth. The solitary testimony of this single traveller, the name hippopotamus thrown into a catalogue, without any further description, raised considerable doubts in my mind; and having, moreover, found that the late Péron, deceived by the equivoque of the name sea calf applied by the Dutch indifferently to the hippopotamus and the doujong, had mistaken the teeth of the latter for the teeth of the hippopotamus, I supposed that the assertion of Mr. Marsden might

have been founded on some similar confusion of names. Mr. Marsden has since informed us, in his third edition, that he did not advance this fact upon his own individual observation, but from a drawing of M. Whalfeldt, an officer employed in surveying the coast, who had met with that animal near the mouth of one of the southern rivers of the island, and had sent a sketch of it to the government. Mr. Marsden proceeds further to point out that the Society of Batavia, in its first volume of 1799, counts the hippopotamus among the animals of Java, and gives it the same Malay name, conda-ayer or küda-ayer, which it bears at Sumatra *.

But does this hippopotamus of the islands of Sunda resemble that of Africa in every particular? This would be a very remarkable phenomenon, and would be far from corresponding with our ideas of the geographical distribution of the great species.

Perhaps this hippopotamus of M. Whalfeldt and of the Society of Batavia, and the succotyro of Java, represented by Niewhoff †, are nothing more than one and the same animal a little disfigured by one of these authors, and miscalled by the others. However this may be, the clearing up of this point is the most interesting task that can fall to the lot of those naturalists who shall have the opportunity of visiting those remote regions.

I pressed my pupil, M. Diard, and my son-in-law, M. Duvaucel, to take up this subject; but although these two young naturalists traversed different parts of the islands of Java and Sumatra; and although they took rhinoceroses of two species, one entirely new, and discovered a new species of tapir, they did not meet with the succotyro or the hippopotamus.

Hitherto I have confined myself to works relating to the exterior of the hippopotamus. Its anatomical construction was very imperfectly known before my time.

Nehemias Grew was the first to publish a figure of the osteology of the head accompanied by some remarks, in his Museum Regalis Societatis, printed in 1681.

Antoine de Jussieu gave some more perfect figures of the same part, with a more detailed description, in the Memoirs of the Academy for 1724. To this he added some details on the teeth, and on the osteology of the toes of the fore feet.

In 1764, Daubenton, in the eleventh volume of his Natural History, published a figure, and a still better description of the head: the osteology of the toes of the fore and hind feet, and that of the second order of the carpus, all taken from adult subjects; and, having occasion in 1712 to trace the origin of some fossil bones, particularly of a femur of an animal from Ohio, he took away the femur of the fœtus of an hippopotamus which was in the Museum, and described and engraved it in order to show that the femur of the fossil animal bore no resemblance to it.

Nevertheless these three authors neglected to examine these teeth

* History of Sumatra, third edition, pp. 116 and 117.

† Niewhoff's figure has been copied into the quadrupeds of Schreber, in the general zoology of Shaw and others. It represents an animal very similar to the hippopotamus with a shaggy tail, and tusks projecting beneath the eyes. The author tells us its figure resembles that of the ox, and that it is rarely caught.

with sufficient attention, and to describe them with that minuteness of detail which the nature of the subject demanded. Daubenton went so far as to find, in those of the mastodons of Ohio and Simorre, an analogy with those of the hippopotamus, which most certainly does not exist. He even gave the title of *teeth of the hippopotamus* to the smaller specimens of Ohio. (Description of the King's Museum in the Nat. Hist., vol. xii, in 4to. pp. 74—78).

Pallas having obtained from Siberia some teeth similar to those of Ohio, and wishing to ascertain their real points of resemblance with those of the hippopotamus, procured from Camper a good drawing of a jaw tooth, which he had engraved in the Memoirs of the Academy of Petersburgh for 1777, part ii, pl. viii, fig. 3; with a view of showing how widely it differed from those of the great fossil animals.

Again Buffon, in the justificatory notes of his Epochs of Nature, printed in 1777 (Suppl. vol. v. plate vi.), published another engraving of the molar tooth of an hippopotamus, with the same views entertained by Pallas, namely to prove how much those teeth differed from those of Ohio, when the latter are not worn. True it is that in the same passage he takes some other teeth of Ohio, which had changed their shape in the process of mastication, for teeth of the hippopotamus; but this is a peculiar mistake to which I shall hereafter have occasion to advert.

Here is a full statement of all the information I was able to collect on the osteology of this great quadruped, at the period of the publication of the first edition of my researches. In fact these documents afforded ample facilities to enable me to recognize many fossil specimens, such as all the species of teeth, the fragments of the head, &c. and as there are specimens of these descriptions in the collections, as well as of the other parts of the body, the osteology of which was then unknown, there was no ground for raising a doubt about the existence of the fossil bones of the hippopotamus, as has been done by M. Faujas de Saint Fond in his Essay on Geology.

Although I felt perfectly convinced of the species of the fossils in question, nevertheless I considered I should be much better qualified to place the truth in its proper light if the entire skeleton of the animal were known; and after various efforts to procure one of an adult subject, being assured that the issue of my researches upon fossil quadrupeds would necessarily require an examination of this subject, I had recourse to an expedient adopted by Daubenton on a similar occasion. He had extracted a single bone from the body of a fœtus: I had the remainder of the skeleton prepared, but as those parts which had not become ossified would have become rigid by exposure to the atmosphere, and would consequently have lost their real shape, I had the the whole preserved in liquor. In this way I obtained with almost perfect exactness, the shapes of all the bones, with the exception of the head, and from them I composed the figure of the skeleton which I then laid before the public.

The head was too large in proportion, and as the teeth had not all emerged from their sockets, nor had the sinuses become developed, its shape was very different from that of the adult. This defect I supplied by replacing it by a head drawn from the adult living animal.

All that was necessary for this, was to estimate the degree of reduction requisite to make it suit my little skeleton, or, what amounted to the same thing, how many times the length of the head is comprehended in the entire length of the body of the adult: the external dimensions given by divers authors, and the stuffed subjects within my reach, made it easy for me to calculate this proportion, but I did not find it equal throughout.

According to Zerenghi for instance, the entire body is 11′ 2″, the head 2′ 4″, or a little more than a fifth.

According to Columna 13—3, or a little less than a fourth.

The figure of Columna gives the proportion of the head to the body as 2 to 7.

According to Daubenton, the body of the fœtus was 1′ 3″ 7‴, the head 5″ 3‴, or more than a third.

The hippopotamus of Leyden, according to Allamand, was 9′ 4″ 8‴, the head 1′ 11″, or a little less than a fourth.

The hippopotamus of the Hague, according to Klockner, was 13′, the head 2′ 9″, or a little less than a fourth.

The figure of the small hippopotamus of Chantilly, gives the proportion of the head to the body as 1 to 4.

According to Gordon, the body of the male is 11′ 4″ 9‴, the head 2′ 8″; corresponding, nearly, with the dimensions given by Zerenghi: that of the female 11, the head 2′ 4″.

From these different proportions I considered that, without deviating far from the truth, I might give the head about a fourth of the total length of the body, not comprehending the tail; and it was upon this scale that I perfected the skeleton which has served as the basis of the comparisons of my first edition; but I have since had the good fortune to procure materials more copious and precise.

In 1811, I observed in the very fine Museum of the late M. Brugmans at Leyden, the extremities of a middle aged hippopotamus perfectly entire; and, in 1820, my anxious wishes were at length gratified by the arrival of an entire skeleton of a full grown hippopotamus, which I had long endeavoured to procure in every direction, and which M. Delalande, a naturalist in the service of the Museum, succeeded in procuring at very great expense and personal risk, on the banks of a stream called the Berg-river, forty leagues beyond the city of the Cape.

From this skeleton, unique in Europe at the present moment, I have drawn my new figures and rectified my former description.

ARTICLE II.

OSTEOLOGICAL DESCRIPTION OF THE HIPPOPOTAMUS.

I. *The Head.*

Though the head of the hippopotamus resembles that of the pig in the details of its sutures and the connexion of its bones, yet it does not fail to present us with a very extraordinary shape, when we come to consider its general conformation.

1st. By the right line of the forehead, from the occipital crest to the edge of the nose, (*a*, *b*, plate 31, figs. 1 and 2).

2nd. By the projection of the orbital vaults, in two ways, namely above the right line (*c*, *ib.*) so as to make the eyes very much raised, and below the middle line, so as to cause the axes of the orbits to form a sort of cross with it.

3rd. By the shape of the snout, at first almost cylindrical, (*c c*, plate 31, figs. 2 and 3), and then suddenly enlarging into four thick turgid excrescences, one on each side, to contain the sockets of the incisores (*a*, *ib.*) and one more external for that of the canine (*b*, *ib.*); an oblique and deep furrow, (*d*), separates these turgid excrescences, and contains the suture, distinguishing the incisor from the maxillary bone.

The root of the snout (*f f*, plate 31, fig. 2,) is flattened and widened, to cover the anterior part of the orbits. This widening is formed by the lachrymal bone, and the base of the jugal. The lachrymal bone (*m m*, *ib.*) is rather singular: on the cheek it forms an oblique little tongue, enlarging towards the base; its narrow part bounds the edge of the orbit, where it has a slope, forming in the interior of this cavity another little tongue, which is continued by passing over the posterior aperture of the sub-orbital canal, and terminates there by a swoln sinus with delicate partitions; nevertheless, the lachrymal duct is very deeply hollowed in the bottom of the orbit.

The temporal fossæ are so deep that the skull is moreover somewhat less in size than the middle portions of the snout. (See *e e*, plate 31, figs. 2 and 3). They leave between them a crest in a right line, and the frontal angle (*x*, fig. 2), which separates them in front, is very obtuse. The frontal is concave between the two orbits.

The bone of the cheek advances very much upon the face, lower still than the lachrymal, with the side of which it articulates, and forms a pointed apophysis (*d*, fig. 2.), which rises behind the orbit, and almost terminates its circle. However, there is a small interval between the summit of the apophysis and the edge of the arch of the eyebrow of the frontal. It is well known that the quadrumanes, ruminants, and the solipedes, are the only animals which have this interval filled by the bone.

The frontal, after having formed the arch of the eyebrow, continues to form a crest, which proceeds obliquely towards the back, distinguishing by its projection the temporal fossa from the orbit. This crest is continued on the parietal and sphenoid bones. The sutures of the frontals and of the parietals form a cross in young subjects.

The upper occipital advances, in an obtuse angle, between the parietals. There is no interparietal.

The parietal does not become united to the sphenoid at the bottom of the temporal fossa, but at an interval of some millimetres.

The palatine bone re-ascends into the orbit, and there advances in front as far as the lachrymal, by a little tongue. The posterior sphenoid there rises almost as high, and the anterior there occupies a place above. They are both partly concealed by the descending crest, which continues on the parietal and on the temporal in the temple, that which the frontal had begun on the orbit.

The zygomatic arch is straight, as well in the longitudinal sense (*d e*, plate 31, fig. 1), as in its horizontal plane, (*f g*, *ib.* figs. 2 and 3);

in this it proceeds outwards as it goes back. Its most prominent part, (*g*), is almost opposite to the articulation of the jaw.

The suture which distinguishes the apophysis of the temporal from the jugal bone, descends obliquely, backwards from the post orbitar apophysis of the latter, to the articulation of the jaw (see *d e*, fig. 1, plate 31). As the temporal fossa is very deep, the distance between the skull and the arch (*e h*, plate 31, figs. 2 and 3) is somewhat greater than the size of the skull, (*e e*, *ib.*)

The hole of the ear is exceedingly small, and placed quite behind the upper edge of the arch. It gives birth to a long meatus, concealed in the thickness of the bone.

The bones of the nose are very long and narrow: they enlarge at their base by a little point, which runs outwards between the frontal and the lachrymal.

The intermaxillary sutures re-ascend obliquely to one fourth of the length of the bones of the nose.

The suborbitar perforation is placed in the middle of the contracted part of the muzzle, and is rather large. The external aperture of the nostrils is vertical and almost round. It is only surrounded by the nasal and incisive bones.

The lower surface of the skull (plate 31, fig. 3) is remarkable for the singular enlargement of the muzzle in front, principally formed by the sockets of the canines, and owing to the two series of grinders being either parallel, or rather a little apart in front. This latter circumstance is, I believe, unparalleled in any other living animal.

The palate is very much slanted in front, *u*, between the incisive bones. There is a double incisive hole, *v v*, and the suture separating the incisive from the maxillary bone, next forms a strong point backwards, *w*, occupying a fourth of the length of the palate. The maxillary bone displays another great hole, at which the small canal terminating at the other incisive hole at *y*, commences. It appears, in general, that the enormous lips of the hippopotamus required thick nerves, for the passage of which these holes are perforated. The palatine bones likewise advance in a sharp point as far as *z*, opposite the interval between the fourth and fifth grinder. The posterior slope, &c. corresponds with the termination of the series of teeth. The sphenoid occupies but a small place in the pterygoid wing, which is quite simple and almost entirely of the palatine bone. The pterygoid bone prolongs the point of the wing into a little crotchet, *x*; the bone of the tympanum $\beta\,\beta$, is irregular, angular, not at all prominent, and contains a cell communicating by a small hole with the real chest, which is very small; the mastoid apophysis is pointed and short, and belongs to the occipital. In general, the whole region of the os basilaire is small in proportion.

The glenoid process of the temporal is slightly concave, and extends obliquely from the outside to the inside, and a little from top to bottom towards the back.

In the orbit, there are two upper orbitar holes, one corresponding with the sphenoid and pterygoid palatine, a small optic hole, a spheno-orbitar hole which also embraces the circle, and an oval hole, which unites

itself to the anterior and posterior so, that, in the skeleton, two-thirds of the os tympani are surrounded by a vacant space.

The shape of the lower jaw is also very remarkable; its two almost parellel branches (*a b*, fig. 4, plate 31), instead of forming a contracted point at their junction, expand themselves at that point into a space almost square, on the anterior edge of which, *c d*, the incisores are implanted on a right line, while its angles *e*, project obliquely in front to sustain the canine teeth.

Viewed on the side, the branch of the jaw is remarkable for the extremely prominent angle (*f*, plate 31, fig. 1), in the form of a half crescent, which it makes below, and which is determined by a large semicircular slant, *g*. The posterior edge of the ascending branch is remarkably thick.

The condyle forms an irregular cylinder, and descends from the outside to the inside. The holes for the issue of the nerve are two or three in number; they are below the first molar, and somewhat forward.

II.—*The Teeth.*

There is no animal which requires to be more studied at different ages, in order to acquire a perfect knowledge of its molar teeth, than the hippopotamus; they change their shape, their number, and their position. The definite number is six on each side, above and below—twenty-four in all; and, as in the horse, there are three in front which are renewed, while the three posterior are not renewed. There is moreover, as is in the horse, a tooth in front (ξ, plate 31, fig. 3), which falls without being replaced.

Hence there are four sucking molars, three that replace others, and three back molars.

The first three sucking grinders and the three that replace the others have a peculiar shape, being conical and much more simple than that of the back grinders.

The fourth sucking grinder, on the contrary, resembles the back grinders in its complicated shape. It is replaced by a simple grinder (*n, ib.*); but as at the same time the last back molar, *t*, emerges from the jaw, the number of complex grinders always remains the same, viz. three.

It is a general rule that the sucking grinders of all animals partake of the complex form of the back grinders in a greater degree than the replacing grinders; and the reason for this is plain, viz. that the sucking grinders might in some measure fulfil the functions of the back grinders, which have not as yet entirely emerged.

This shape, to which I have given the name *complex*, consists more especially in the hippopotamus in four conical hills, ranged two and two, so that one pair may be before the other transversely. Each of these hills is intersected, on the surfaces not contiguous to each other, by two deep longitudinal furrows; so that the crown of the tooth, when it begins to be worn, presents the figure of a double trefoil for each pair of hills. When detrition has descended as far as the point where the hills become united, a quadrilobed figure is formed for each pair.

When the two pairs are united, we can observe nothing more than a large curvilinear square occupying the whole crown of the tooth.

The two last grinders of the lower jaw have one simple hill more than the others, behind the two pairs of furrowed hills, which form upon the crown, by detrition an oval, placed behind two pairs of trefoil figures.

The first three sucking grinders have the form of a cone, compressed at the sides, pointed and almost sharp.

The three replacing grinders succeeding the three last sucking grinders are of a conical form, less compressed, marked with two furrows on the external surface, so that detrition gives to their crown a lobed figure.

Figures 3 and 4 of plate 31 represent the jaws of an hippopotamus almost full grown. Neither in the upper or lower are we able to discover more than the vestiges of the socket of the first sucking tooth, if we may except ξ, where a part of that molar still adheres to the upper jaw.

The points *h i*, are the two first replacing grinders of the lower jaw, and *l m n* those of the upper.

The third lower tooth, *k*, is the third sucking tooth which has not as yet fallen, and like the back grinders it exhibits its trefoil figures: but the third upper, *n*, is a replacing tooth, which has scarcely been worn, as it has only just emerged from the socket, while the first back molar, *o* and *p*, is very much worn in both jaws, and already begins to exhibit considerable expansion in its trefoils; they are narrower in the two last molars, as well below, *q r*, as above, *s t*; moreover, the lower, *q r*, show us the small fang which distinguishes the two last grinders of the lower from those of the upper jaw.

Such are the appearances in the hippopotamus to the time of its having changed all its teeth. The observations I have made upon the other appearances of that animal have been the result of the examination of seven heads, all of different ages, which admit of our following each tooth through its several successive stages, from the germ when all its hills are unimpaired, and covered with enamel, to the period of its being completely worn down by mastication.

Hence then we are provided with the means of recognizing the fossil grinders of the hippopotamus, if we should meet with them, no matter in what state, or at what age they may have been cast.

The incisores and the canine teeth are still more easily recognized.

The lower incisores are directed outwards, as in the pig: they are cylindrical, and become somewhat worn at the point; their radical part, or that which is contained within the socket, is longitudinally channelled in its periphery. The two middle ones, *v v*, (figs. 1 and 4, plate 31), are much thicker and four times longer, externally, than the laterals δ δ.

This difference is determined by the position of the upper incisores. They are bent almost vertically downwards, and those on the outside (*a*, figs. 1 and 3) are placed much more backwards than the intermediate teeth, ϵ, so as not to allow the lower laterals, ς, to advance in front.

The upper intermediate teeth are worn on their internal surface; the lateral on their external surface and a little lower: the contrary is the case with the inferior incisores.

The lower canine teeth, *η*, are enormous, curved into the arc of a circle, triangular in their profile, channelled on their two anterior surfaces, and worn on almost the entire of their posterior surface.

The upper, *δ*, are much shorter, equally triangular, and mastication produces an oblique plane, cutting these two anterior surfaces. The posterior is intersected by a deep longitudinal furrow.

Moreover, the twelve anterior teeth of the hippopotamus are more easily distinguishable by the peculiar texture of their osseous substance. It is extremely hard, and, though ever so well polished, we may observe upon its surface extremely fine and close stria, all concentric with the section of the tooth. Their enamel is moderately thick.

The hippopotamus has then in all thirty-six teeth: namely, eight incisores, four canine teeth, and twenty-four grinders; and, counting the anterior sucking teeth, which are cast without being replaced, it may be said to have forty.

III. *The Vertebræ.*

There are seven cervical vertebræ, fifteen dorsal, four lumbar, seven sacred, and fourteen coccygin; forty-seven in all.

The atlas (plate 30, figs. 2 and 3), and the axis (ib. figs. 4 and 5), have very common forms in the large animals. The transverse apophyses of the atlas enlarge towards the back part, so that their anterior angle is obtuse, and the posterior acute. The superior crest of the axis is long and strongly defined; it rises higher behind. Its transverse apophysis are slight, and terminate in a small tuberosity. Its odontoid apophyses is inserted in a peculiar ring of the atlas, below the medullary canal.

What may strike as being peculiarly remarkable is, that the atlas and the axis, besides the common articulating surfaces, have each two additional ones, towards the dorsal part.

The transverse apophyses of the next cervical vertebræ are two-pronged. The upper lobe is horizontal, oblong, and terminates in a vertical surface, which goes on increasing in size as far as the seventh.

The lower lobe is almost vertical; it enlarges very much towards the back, and goes on increasing to the sixth; but it is completely lost in the seventh.

The fourth cervical may be seen in plate 30, figs. 6 and 7.

The spinal apophyses are compressed and pointed: their length is moderate; it increases, however, as far as the seventh.

The body of all these vertebræ is transversely oval, a little convex in front, and concave behind; it is broader than it is long, without apophyses below, but with a slight crest in the anteriors. On the whole, these vertebræ approximate more closely to those of the pig, in the shape and details of the arterial apertures, &c.

The dorsal vertebræ are furnished with long spinal apophyses, compressed and directed backwards; they increase as far as the third, and then diminish gradually to the ninth, after which they become short, cut into squares, almost equal in height, but always becoming broader from front to rear. The last spinal vertebræ of the back and those of the loins take a more forward direction.

The surfaces of the articulating apophyses become horizontal as far

as those uniting the tenth to the eleventh; the latter rise up, and after these they are all almost vertical. In the dorsal as in the lumbar vertebræ, each anterior vertebræ embraces the posterior of the preceding vertebræ, below. The third dorsal vertebræ is represented on plate 30, figs. 8 and 9. The transverse apophyses of the loins are very large, very wide, inclining to the front and pointed. The last but one has its transverse apophysis articulated by a facette with the last. The latter (plate 30, figs. 10 and 11), has its body depressed, and its transverse apophysis, which is very large at the base, articulates by very large facettes with that of the first sacred vertebræ.

The os sacrum has an elongated shape, narrowing a little towards the back. The last vertebræ alone is distinguished from the preceding by a slant; the remainder are only marked with holes. All the spinal apophysis, except the first are united in a slightly elevated crest, with an expanded edge flattened at the top. The transverse apophyses beyond the os ilium are also united in a similar crest. The first, or that which principally joins the os ilium, is much broader than the rest.

The first coccygin vertebræ have moderate transverse apophyses, spinals with slightly elevated crests but stretching longitudinally, and anterior articulators without corresponding posteriors. Beyond the fourth the spinals disappear; they have each four tuberosities below. The succeeding coccygin vertebræ are compressed with three tuberosities above, one on each side and three below. The last have only two above and two below. The body of all the vertebræ, except the cervical, are almost plane.

There are fifteen ribs; seven of which are real, and eight false: they are almost as much knobled as those of the rhinoceros, from which, as well as from those of the elephant, they are distinguished by being broader and flatter at the part adjoining the vertebræ than at their opposite side. The anterior portion of the sternum is compressed like a plough share, and advances in an obtuse point beyond the first rib. The remaining portion is depressed: the component pieces are seven in number.

IV. *The Anterior Extremity.*

The shoulder blade (plate 30, fig. 1, A, and plate 31, fig. 6), is easily distinguishable from those of the rhinoceros and the elephant, being larger than the former and smaller than the latter, besides being quite differently shaped: its superior edge is almost on a level with the inferior, which is almost rectilinear. The anterior has a curve, convex towards the centre and afterwards concave, terminating by a very prominent coracoidal tuberosity; its spine, *a c*, is more salient towards the humeral articulation than anywhere else: by means of a slope it there produces an apophysis or species of acromion in the shape of a crotchet, *a*, which advances, as does its base, *d*, but is far from reaching the level of the articulating surface; its edge is very thick at one half of its length, *b*; the glenoid cavity (*g h*, plate 31, figs. 5 and 6), is elliptic, rounded, and broader towards the back, and more pointed in front.

The general form of this shoulder-blade reminds us a little of that of the pig, but it approximates more closely to that of the ox, as far as regards the spine and the articulation, characteristics far more essential on account of the play and fastenings of the muscles.

The humerus (plate 30, fig. 1 B, and plate 31, figs. 7, 8, 9, 10), has its large tuberosity, *a*, very much elevated, very salient in front, and dividing itself into two lobes, the posterior of which, *á*, is the smaller; the anterior curves forward from the bicepital groove, which is very deep and smooth; the smaller, *b*, is lower down. The articulated head, *c*, is directed very much towards the back, and is oval; the sharp line stretches obliquely along the whole of the bone; at first it is not at all salient, but it swells, immediately below the upper third of the bone, into a tuberosity, (*d e*, figs. 7 and 8); the external condyle, *g*, is more salient than that of the internal, *f*: but its crest does not project beyond it along the bone as it does in the elephant: the articular pulley, *h*, is oblique from the out to the inside, thicker on the internal side, with a wide gorge very slightly concave, and a strait still less concave on the outside. To the rear between the two condyles (*i*, fig. 8), is a fossa for the olecranon, very deep, but not piercing the bone. Neither is there in the internal condyle any hole for the cubital artery. This humerus bears a singular resemblance to that of the ox, which is merely shorter in proportion, and has the grooves of its pulley more marked; that of the pig has also some relation to it, but is not so large at the base.

The radius, E, (fig. 1, plate 30), and *a b*, (fig. 11, plate 31), is thick and short, somewhat flattened from front to rear. Its upper head, *c d*, (fig. 12, *b*), is transversely oblong, larger on the inside, and rather salient in the centre, *e*, which only allows it a flexional movement on the humerus. It very soon adheres by its posterior margin to the inferior margin of the sigmoid facette of the cubitus. Its anterior surface represents, though irregularly, a portion of a cylinder: the internal surface is level. It adheres by the whole exterior margin of this surface, to the anterior margin of the cubitus.

Its lower extremity (*e f*, fig. 11), presents two oblique concave facettes below, *g* and *h*, for the two first bones of the carpus, and two thick tuberosities in front. The external margin of the second facette becomes united to the anterior or internal margin of the cubital facette.

The cubitus, F, (plate 30, fig. 1), and *c d*, (plate 31, fig. 11), is compressed; the olecranon, *c*, is rather prolonged, and its posterior margin almost sharp: to the rear it is somewhat rounded, and is rather sharp above. At the extremity, this sharp margin bends inward in the form of a crotchet. The sigmoidal facette is narrow above; towards the base it enlarges, and becomes two-pronged, as in most other animals; but this latter quality is separated entirely from the other by a deep fossa, and forms a distinct facette.

The lower facette of the cubitus is small, concave, and becomes united to a slight portion of the radius, to form a third oblique pulley for the corresponding bone of the carpus.

The two bones just mentioned form in reality but a single one in the hippopotamus, for they become identified with each other very soon, merely leaving between them on the external side a rather deep furrow, which occupies three quarters of the length of the radius, and on the internal side a simple aperture towards the upper quarter.

The fore-arm of the ox is very similar to that of the hippopotamus; but it is more elongated, and the articulations of the lower extremity are less oblique.

The carpus of the hippopotamus is in its general form shaped on the model of that of the pig, but its bones are less elevated and more depressed. Those of the first rank have their superior surfaces more concave from front to rear. The scaphoid, *a*, (fig. 13, plate 31), has a posterior tuberosity more salient. The semi-lunar, *b*, (*ib.*) has its anterior surface rising more obliquely towards the outside, and its superior external angle more pointed. The os cuneiforme, *d*, is less compressed on its sides. The os pisiforme, *e*, is also less compressed; it has a thick round projection on its external surface, which gives it a crooked appearance.

In the second rank, a small pointed bone, *f*, almost similar to the os pisiforme, serves for a toe and a trapezium. The trapezoid, *g*, is not compressed on the sides, like that of the pig, but is broader than it is high. The facette for the trapezium occupies the whole height of its external surface. Its superior surface is a slightly convex trapezium. The large bone, *h*, has scarcely any anterior surface, it is so much depressed; and behind its double upper surface it has a tuberosity, or more properly a long crooked pediculum, which does not exist in the pig.

The ridge which separates the two upper facettes in the unciform, *i*, is less oblique than in the pig; the exterior of the two is less extended on the outside; and there is, behind, a pediculum, as in the great bone, which does not exist in the pig.

All these characters of the carpus of the hippopotamus are as strongly distinguished from those of the ox as from those of the pig.

Its metacarpus, only, can bear comparison with that of the pig, but all its bones are thicker and shorter. The two extremes, *k*, *l*, (fig. 13, plate 31), are shorter, but thicker than those of the centre, *m* and *n*; the antero-posterior diameter of their upper extremities is more considerable in proportion, and the articular pullies of their inferior extremities are simple, scarcely discovering behind the vestige of a middle edge. The phalanges have the common articulations. The second are shorter by one half than the first; and the third are the smallest of the set, and are of a semicircular form.

V. *The posterior Extremity.*

The pelvis of the hippopotamus, G, (fig. 1, plate 30, and fig. 14, plate 31), is easily distinguished from those of the elephant and the rhinoceros, as it is much smaller in the direction of the ilia, and as the large iléal wings approach nearer to a common plane than the necks of the ossa ilium: the ischia and the pubis are more elongated, and the latter less salient, so that the strait is very oblique, and the small pelvis very much elongated. Here, again, it is the ox which approaches the nearest to it in these particulars; but, in the hippopotamus, the smaller pelvis and the ovalar holes especially are more elongated. The shape too of the widened part of the ossa ilium is also very different; their two wings are almost equally exuberant; the external is larger and more rounded than the other, which is more pointed. The contrary is the case in the ox and in the camel. The anterior margin which unites them forms the convex are of a circle; in the ox it is shaped thus, ∞. The camel has it in common with the hippopotamus, but without any direct resemblance in other respects. For instance, the tuberosity of

its ischium is transverse, and in a right line with its corresponding one. In the ox, they form together an angle of 45 degrees; in the hippopotamus they are almost parallel.

The os sacrum, *a b* (*ib.*), is very large; the external part of the os ilium, *c d*, is very much widened, and almost in the same plane. The part situated towards the back of, or rather above, the os sacrum rises gently. The neck of the bone, *e e*, is broad and short, and the bone itself is more broad than long; its external edge is as long as the internal; its posterior surface is concave; what we can see of the anterior, without displacing the os sacrum, is plane. The pubes, *f s*, are not strongly defined, so that the cavity of the pelvis is small. The antero-posterior diameter, *g h*, is nevertheless longer by a third than the transverse, *i k*. The perspective renders it difficult to judge of this proportion.

The shape of the anterior strait is oblique towards the back part. The posterior part of the ischium, *m m*, is very much enlarged.

The femur, K K (plate 30, fig. 1, and plate 31, figs. 15, 16, and 17), is finely and straightly shaped. Its shaft is almost even from top to bottom, regularly cylindrical in front, with two sharp lines, an internal and a posterior, slightly marked. Its great trochanter, *a*, compressed at the sides, does not surpass the height of its head, *b*; the smaller, *c*, is moderate; they form a junction by an oblique salient rib, in front of which is a deep and rounded fossa. There is no third, as in the rhinoceros, the tapir, and the horse. The lower extremity is very thick. The internal condyle is larger by one third than the other. They are both rather prominent behind. The pulley of the rotula, *d*, is not very deep, its edges are rather blunt. The internal rises higher than the external.

It does not resemble any but the femora of the great ruminants; but its upper head is much more detached, more spherical, and the inferior is larger, particularly at the back part.

These differences will be of use in enabling us to distinguish it from the femur of the ox: that of the giraffe, which might more easily mislead us, as being of the same size, besides having its upper head closer to the body, has moreover its condyles smaller, and the internal edge of the pulley of the rotula much more elevated and more salient: the femur of the pig bears a great resemblance to it in its upper part, but much less in its lower; and, besides, its dimensions do not admit of the possibility of a mistake.

The tibia, L L, (plate 30, fig. 1, and plate 31, figs. 18 and 19), is shorter and thicker than that of any known animal, particularly at the extremities; it is triangular throughout; however, its anterior edge, *a b*, which is very prominent in the two thirds of the upper part, and slanted at the top, has a defection at the base towards the internal malleolus, *b*.

The external malleolus is formed, as in the pig and in the ruminants, by a peculiar little bone, *c*, which articulates with the fibula, the tibia, the astragalus, and a particular facette of the calcaneum. The superior head has a very curious shape, being rounded into a semicircle on the internal side, deeply sloped towards the back and on the front of the external side. The external condyle is almost square; the internal is larger and triangular; the anterior edge forms, in front of the slope on the external side, a large rounded tuberosity. The surface of the astra-

galus, *e* (fig. 19), is larger on the internal side, where the malleolus forms an acute angle.

It resembles the tibia of the ox more than that of any other animal, but the latter is more elongated. The projection of the anterior edge does not descend so low in the latter, and is not so flattened and so slanted at the top. That of the pig is also more elongated, and the slopes of its upper extremity are less marked.

The fibula, *d* (fig. 18), is very rough and very much separated from the tibia throughout, except at the two extremities. The malleolar little bone becomes instantly united to the inferior extremity.

It is also after the model of that of the pig that the tarsus of the hippopotamus is principally constructed.

The astragalus, A (plate 31, fig. 20), is larger in proportion; as in the ruminants and in the pig, its lower pully is divided into two gorges, *a b*, separated by a blunt edge; but these two gorges are almost equal and very slightly concave; the external, *a*, answers to the cuboid; the internal, *b*, to the scaphoid. The tibial pulley, *c*, is strongly defined; on the posterior surface there is a large facette for the articulation with the calcaneum, and two others in the external surface. This surface shews, moreover, another for the articulation with the malleolar extremity of the fibula, *c* (fig. 18), and there is one almost similar on the internal surface, for the internal tibial malleolus.

The calcaneum (plate 31, fig. 20, B), has the same surfaces and facettes as that of the pig; but its body is thicker, shorter, and less compressed. Its great astragalian surface is likewise broader. These characters also serve to distinguish it from that of the ox.

The cuboid (*ib.* C), corresponds in shape with the two preceding; the surface towards the calcaneum is a little narrower than that towards the astragalus, and its anterior surface, *c*, is somewhat in the form of a carpenter's square. The inferior presents two facettes for the two external bones of the metatarsus. Of these the external is very narrow, and above it on the external surface of the bone there is another. The scaphoid (*ib.* D) is separated from the cuboid as it is in the camel and the pig; the posterior tuberosity does not rise as in the latter. Its inferior surface presents three facettes, two of which are for the two cuneiforme bones, E and F, which answer to the two external bones of the metatarsus, and the third is for a small supernumerary bone, partaking at once of the first cuneiforme and of the toe. The cuneiforme of the internal side is three times smaller than the other. What has been said of the toes of the fore feet is also applicable to those of the hind feet. The bones of the metatarsus and the phalanges bear the same resemblances and the same differences to the analogous bones of the pig.

From this description it results, as may have been seen, that the hippopotamus approximates to the pig and the ox in the structure of its skeleton, while, at the same time, each bone furnishes such distinct characters as must at once prevent its being confounded with that of any other animal.

All that now remains for me is, to give the dimensions of the different parts of my skeleton, in order to convey a more correct idea of its proportions.

Dimensions of the Skeleton of an Hippopotamus, measuring, when alive, eleven feet in length.

HEAD.

From the summit of the occipital crest to the edge of the exterior aperture of the nostrils: upper part	0,584
From the superior edge of one orbit to the other, backwards	0,336
From the most prominent part of one zygomatic arch to the other	0,440
Size of the occipital crest between the arches	0,172
Size of the head taken above, opposite the suborbital holes	0,153
Size of the head taken above, from the alveolus of one canine to the other	0,350
Same dimension taken below, from the most exterior part of the tuberosity bearing the two incisors on one side, to that of the opposite side	0,243
Height of the head, taken opposite the suborbital hole, from the alveolar edge	0,167
Distance from the posterior extremity of the zygomatic apophyses of the bone of the cheek, to the edge of the suborbital hole	0,280
From the same extremity to the middle part of the occipital crest	0,290
Antero-posterior diameter of the orbits	0,181
Depth of the zygomatic fossa, taken from the internal surface of that part of the arch which is most remote from the skull, to the latter	0,133
Height of the head, taken from the superior edge of the occipital hole, to the middle of the crest of the same name	0,135
Size of the head in the same place, taken from one inferior angle of the occipital crest to the other	0,292
Height of the occipital hole	0,058
Size of the same hole	0,070
Length of the alveolar edge of the grinders	0,300
Distance from the anterior extremity of the alveolar edges of the grinders to the alveolus of the canine teeth	0,117
From the same place to the alveolus of the middle incisor	0,128
From the occipital hole to the posterior spine of the palatine vault	0,148
Height of the aperture of the back nostrils	0,065
Breadth	0,081

LOWER JAW.

Size of the jaw, taken from the external alveolar edge of one canine to the other	0,370
Size of the alveolar edge of the incisors	0,182
Distance from one condyle to the other, taken from the external part of each condyle	0,407
Distance from one coronoid apophysis to the other	0,230
Interval between the coronoid apophysis and the condyle on the same side	0,079

Height of the branches of the jaw, taken from the angle to the summit of the condyle	0,340
Length of the jaw, from the upper anterior edge of the alveolus of one canine to the most remote part of the branch on the same side	0,575
Length of the alveolar edge of the grinders	0,280
Distance of the lower angles	0,420

THE SPINE.

Length of the cervical part, without comprehending the intervertebral cartilages	0,478
Length of the dorsal part, without comprehending the intervertebral cartilages	1,050
Length of the lumbar part, ditto	0,370
Length of the os sacrum	0,412
Length of the tail bone	0,480
Total length of the spine and of the head	3,374
Length of the atlas	0,074
Greatest breadth	0,308
Length of the axis, comprehending its odontoid apophysis	0,156
Breadth	0,222
Height of the first spinal apophysis of the back	0,227
Height of the third, which is the longest	0,279
Height of the last	0,088
Breadth of the last lumbar, from the extremity of one transverse apophysis to the other	0,460

ANTERIOR EXTREMITY.

Length of the shoulder-blade, from the superior anterior border of the cotyloid cavity to the superior anterior angle	0,472
From the posterior border of this cavity to the superior posterior angle	0,340
Length of the border comprehended between the two superior angles	0,326
Size of the neck	0,089
Length of the spine, from the edge of the shoulder-blade to its point	0,400
Elevation of the spine	0,093
Length of the cotyloid cavity	0,084
Breadth	0,073
Elevation of the coronoid apophysis above the edge of the cavity	0,084
Length of the humerus, from the summit of the great tuberosity to the base of the external condyle	0,454
Antero-posterior diameter of its upper head, comprehending the tuberosity	0,188
Transverse diameter	0,135
Diameter of the lower head, from one condyle to the other	0,136
Transverse breadth of the articular pulley	0,097
Antero-posterior diameter of the narrowest part of this pulley	0,051
Antero-posterior diameter of the segment of the sphere forming the arthrodial facette of its upper head	0,085