II. *On the Osteology of the genus* Glyptodon. *By* Thomas H. Huxley, *F.R.S.*

Received December 30, 1863,—Read January 28, 1864.

Part I.—The history of the discovery and determination of the remains of the *Hoplophoridæ*.
Part II.—A description of the skeleton of *Glyptodon clavipes*, Owen (*Hoplophorus Selloi*, Lund ?).
§ 1. Description of the Skull.
§ 2. Description of the Vertebral Column.

Part I.—*The history of the discovery and determination of the remains of the* Hoplophoridæ, *or animals allied to, or identical with,* Glyptodon clavipes.

The earliest notice of the discovery of the remains of *Glyptodon*-like animals is contained in the following extract from a letter, addressed to M. Auguste St. Hilaire by Don Damasio Larañaga, Curé of Monte Video, which appears in a note at p. 191 of the fifth volume of the first edition of Cuvier's 'Ossemens Fossiles,' published in 1823:—

"I do not write to you about my *Dasypus* (*Megatherium*, Cuv.), because I propose to make it the subject of a memoir which, I trust, may not be unworthy of the attention of those European savants who take an interest in fossils. I will merely say that I have obtained a femur, which was found in the Rio del Sauce, a branch of the Saulis Grande. It weighs about seven pounds, and may be six or eight inches wide. In all points it resembles the femur of an Armadillo. I will send you one of its scales. The tail, as you have seen, is very short and very large; it also possesses scutes, but they are not arranged in rings, or in whorls. These fossils are met with, almost at the surface, in alluvial, or diluvial, formations of a very recent date. It would seem that similar remains exist in analogous strata near Lake Merrim, on the frontier of the Portuguese colonies."

Cuvier expresses no opinion as to the accuracy, or otherwise, of Don Damasio Larañaga's identification of his *Dasypus* with the *Megatherium*, an identification which, it will be seen, was erroneous.

The volume of the Transactions of the Royal Academy of Sciences of Berlin for the year 1827 contains a memoir by Professor Weiss* upon the collections of fossils and minerals gathered in South America by Sellow, accompanied by five plates, four of which display excellent representations of various portions of the dorsal and caudal dermal armour, and of part of a femur, of one or more species of *Glyptodon*. Some of these fossils (the fragments of the dorsal dermal armour) were obtained at three feet from the surface, in the marly clay of which the banks of the Arapey Chico (a branch

* Ueber das südliche Ende des Gebirgzuges von Brasilien in der Provinz San Pedro do Sul und der Banda Oriental oder dem Staate von Monte Video: nach den Sammlungen des Herrn Fr. Sellow, von Herrn Weiss (Gelesen in der Akademie der Wissenschaften am 9. August 1827, und 5. Juni 1828).

of the Arapey Grande, an affluent of the Uruguay) are formed. The skeleton of the *Megatherium* now at Madrid was found in a similar clay which underlies Buenos Ayres. The femur and the fragment of caudal armour were procured from the banks of the Quegnay, a more northern affluent of the Uruguay than the Arapey.

Weiss remarks upon these fossils (*l. c.* p. 276) "that it can hardly be doubted that they belonged to no other animal than the *Megatherium*, Cuv. Cuvier himself published, in a note to p. 191 of his 'Recherches sur les Ossemens Fossiles,' t. v. 1e partie, the first information which he received, in 1823, that his *Megatherium* was a loricated animal. M. Larañaga, parish priest of Monte Video* (from whom this information was derived, and in whose house M. Sellow, in 1822, saw two fragments of the armour, one belonging to the back and the other to the tail, which were found between Monte Video and Maldonado, in a gully opening into the Arroyo de Solis), believed the animal to be an Armadillo, *Dasypus*; Cuvier had already pointed out the similarity of the extremities to this genus and to *Myrmecophaga*. However, the armour plates found on the Arapey show no trace of a zonary arrangement, and the fragments possessed by M. Larañaga also leaving a doubt on this point, it may remain an open question whether the Megatherium possessed a veritably jointed armour, or whether it was not more probably provided with a solid shield."

The figures show, and Professor Weiss remarks upon, the raised conical form of the marginal pieces of the carapace.

In the course of his description of the parts of the skeleton of a Megatherium sent to this country by Sir Woodbine Parish, Mr. Clift† remarks, "In these latter instances the osseous remains were accompanied by an immense shell or case, portions of which were brought to this country; but most of the bones associated with the shell crumbled to pieces after exposure to the air, and the broken portions preserved have not been sufficiently made out to be, at present, satisfactorily described. Representations, however, of parts of the shell in question are given in the plate annexed."

The plate (46) to which reference is here made exhibits views of the inner and outer surfaces of parts of the carapace of a *Glyptodon*. In a note (p. 437) Mr. Clift mentions that casts of the principal bones in question have been sent, among other places, to the Jardin des Plantes at Paris.

The next work upon this subject in the order of time, is the very valuable essay communicated by Professor E. D'Alton to the Berlin Academy in 1833‡. Sellow had

* ["A friend of natural history and, in every way, an estimable man, who has now unfortunately become blind," writes M. Sellow regarding him to M. von Olfers on the 10th October 1829. We can therefore no longer look for the appearance of his promised essay on these fossil remains.]

† "Some account of the Remains of the Megatherium sent to England from Buenos Ayres by Woodbine Parish, jun., Esq., F.G.S., F.R.S." By William Clift, Esq., F.G.S., F.R.S. Read June 13, 1832. Transactions of the Geological Society, vol. iii. 2nd series.

‡ "Ueber die von dem verstorbenen Herrn Sellow aus der Banda Oriental mitgebrachten fossilen Panzer-Fragmente und die dazu gehörigen Knochen-Ueberreste," with four plates. The volume of the 'Abhandlungen der Königlichen Akademie der Wissenschaften,' in which this essay appears, was published in 1835.

been compelled by the local authorities to send to Rio Janeiro all the bones and the finest pieces of the carapace, which he discovered in association with the fragments of dermal armour figured by Weiss*; but, by good fortune, these additional materials at length found their way into the Berlin Museum, and afforded D'Alton the materials for his memoir, in the first section of which the pieces of the carapace of the fossil animal are described; while the second section is devoted to an account of the structure of the dermal armour of living Armadillos, and the third to a description of the fossil bones found in juxtaposition with that dermal armour.

The results of the comparison of the fossil armour with that of existing Armadillos are thus stated:—

"If we compare these fossil dermal plates with those of living species of *Dasypus*, it becomes obvious that all the peculiarities of the former may be paralleled by the latter; but with this difference, that while, as appears from Sellow's report, all the fossil plates belonged to one and the same animal, their peculiarities are not all found associated together in any one living species. The majority of the fossil plates which were distant from the margin, *e. g.* those represented by Weiss in figs. 1, 4, & 5, and many described above, exhibit the greatest similarity to the dermal plates of *Dasypus niger*; and thence it may be concluded that the epidermis of the *Dasypus* of the ancient world (if for brevity's sake I may so name the animal), like that of the *Dasypus niger*, was divided differently from the bony plates, and that strong hairs were arranged in the interstices of the epidermic scales.

"The pieces which belonged to the edge, or the pointed marginal scutes (Zacken), most nearly resemble those of *D. Poyou* (fig. 12 of our first Plate), and *D. grandis* shows a somewhat similar formation. In addition, the thoracic shield and the moveable zones of *D. villosus* (fig. 18) are also provided with pointed marginal scutes; and, according to Azara, the *Tatou pichey* exhibits similar structures. But in all the animals provided with such pointed scutes, they are directed from above, and forwards, downwards, and

* Professor Owen writes (On the *Glyptodon clavipes*, Geol. Trans. vol. iii. pp. 82, 83), "The portions of the tessellated bony armour figured by Professor Weiss, pl. 1 and 2, and described at p. 277 of his memoir, were obtained by Sellow on the Arapey-Chico in the province of Monte Video; but no bones either of the Megatherium, or any other animal, are mentioned as having been associated with them. A third series of fossils, in which fortunately some bones of the extremities were discovered associated with the tessellated bony case, was presented to Sellow by the President of the province of San Pedro, with the information that they had been originally discovered in the proximity of Rio Janeiro."

This, however, appears to be a misapprehension of the state of the case. The armour figured by Weiss in pl. 1 and 2 of his memoir, and the "third series of fossils" were associated together; and so far from the President of the province of San Pedro having presented anything to Sellow, it was Sellow who was obliged to present the fossils to the President, or at any rate, to dispose of them according to his orders. "Denn die Aufforderung des damaligen Präsidenten der Provinz San Pedro, des Visconde des S. Leopoldo, nöthigte ihn [Sellow] den hauptsächlichsten Theil dieser fossilen Ueberreste nach Rio Janeiro abzuliefern."

It is therefore sufficiently obvious that the fossils were not found *at* Rio Janeiro, but were sent *to* that place from Arapey-Chico.

backwards; and therefore some of the fragments may be referred to the left, and some to the right side .... From the preceding comparisons it follows that the fossil scutes are similar to those of the thoracic and pelvic shields of different living Armadillos, although they differ from them in many respects. But if objections should still be raised to regarding the animal which bore the fossil armour as an Armadillo (Gürtelthier), two replies may be made. In the first place, neither the entire skeleton nor the perfect shell of the animal have been obtained. Of the skeleton, the vertebral column, the ribs, and sternum are wanting—or exactly those parts which the moveable zones (Gürtel) would have covered. Secondly, the moveable zones themselves, although among the characteristic features of the Armadillos, are of less importance than was formerly believed, as AZARA has already pointed out."

The state of the bones indicated that they appertained to a young animal, the epiphyses being distinct. Those described belonging to the fore limb are, a part of the scapula (?), the distal end of the left humerus, the radius and ulna, nearly perfect, and eighteen bones of the fore foot. Of the latter, five belonged to the carpus, of which the three proximal are interpreted by D'ALTON as the *semilunare* (Mondbein), *cuneiforme* (das dreieckige Bein), and *pisiforme* (Erbsenbein). I shall endeavour to show, in the course of my description of the specimen which forms the subject of this memoir, that the determinations of the *semilunare* and *cuneiforme* are perfectly correct, but that the so-called *pisiforme* is not rightly named. The distal bones are, according to D'ALTON'S interpretation, which I can fully confirm, the *magnum* and the *unciforme*.

Two entire metacarpal bones, and fragments of another, are considered by the author of the memoir to correspond with the third, fourth, and fifth of an ordinary five-toed fore foot; but they are really the second, third, and fourth, Professor D'ALTON having taken the surface of the cuneiform, which articulates with the fifth metacarpal, for the surface of articulation with the pisiform. The phalanges of the digits belonging to these metacarpal bones, and three of their sesamoid bones, are carefully described and figured.

The resemblances of the bones of the forearm with those of the existing Armadillos are pointed out, especial weight being laid upon the extension of the cuneiform round the unciform, and its articulation with what D'ALTON supposes to be the fifth metacarpal; and certain analogies of the fore foot with that of the mole are indicated.

A fragment of the distal end of a leg-bone, the seven tarsal bones, the four outer metatarsal bones; their digits, except the ungual phalanges; and some other bones of the hind foot, in a more or less fragmentary state, are described and figured, and attention is drawn to the remarkably short and strong character of the foot.

In conclusion D'ALTON remarks, "Though, as I have endeavoured to show above, there is a certain agreement between the *manus* of the fossil animal and that of the Armadillos, yet the foot shows us no greater similarity than may be observed between it and many other five-toed animals. Hence the osteology of the primeval animal does not afford a sufficient confirmation of the view which we derived from the consideration of the carapace, viz. that the bones, together with the fragments of dermal armour,

might have belonged to an animal nearly allied to the Armadillos, or perhaps even to a very large, probably extinct, species of *Dasypus*. The fossil bones are too few to afford a safe foundation for so decided an opinion respecting the zoological affinities of the animal. A tolerably perfect skeleton is necessary in order to enable us, from the bones alone, to draw a safe conclusion as to the structure of the remainder of an animal."

Singularly enough, D'ALTON does not mention the *Megatherium* throughout this paper, which however affords, by implication, an ample demonstration that the bony armour described has nothing to do with that animal*.

In 1836, LAURILLARD, in editing the eighth volume of the second edition of CUVIER'S 'Ossemens Fossiles,' appends the following note to the letter of Don D. LARAÑAGA, quoted above:—

"It is very possible that the *Megatherium* was, in fact, covered by a scaly cuirass; but the great fragments which have been found must not be hastily attributed to it; for the plaster casts sent from London† prove that an Armadillo of gigantic size coexists with the *Megatherium* on the plains of Buenos Ayres. These characteristic fragments consist of a calcaneum, an astragalus, and a scaphoid, which depart from those of existing Armadillos only in size, and by purely specific differences."

In 1836, then, it was clearly made out that the cuirassed extinct animal of South America is *not* the *Megatherium* and *is* allied to the Armadillos. However, Dr. BUCKLAND, whose Bridgewater Treatise appeared in this year, and who therefore could hardly have been acquainted with the views of D'ALTON and of LAURILLARD, still associated the dermal armour with the Megatherium—supporting his views by an elaborate and ingenious teleological argument, which, like most reasonings of the kind, appeared highly satisfactory. But, in 1837, all further doubt upon the subject was removed by the discoveries of Dr. LUND, who, in that year, despatched to Copenhagen the second of the remarkable series of memoirs in which he reconstructed the ancient Fauna of Brazil‡. In this paper Dr. LUND established the genus *Hoplophorus* upon the dermal armour and certain bones of an edentate quadruped closely allied to, if not identical with, the "Dasypus" of LARAÑAGA.

Hoplophorus euphractus, the sole species of the new genus described in the memoir, was estimated by its discoverer to be of the size of an ox, and to have been provided with a carapace most nearly resembling that of *Tolypeutes*, but of an astonishing thickness. The extremities are said to have the general structure of those of the Armadillos,

* Thus MÜLLER says in his memoir on the hind foot, cited below, "In der letzten Abhandlung ist von Herrn D'ALTON bewiesen, dass der Panzer nicht dem *Megatherium* angehört."

† *Vide supra*, p. 32. Mr. PENTLAND appears to have been led to the same opinion by the examination of these casts in 1835. See Transactions of the Geological Society, vol. vi. ser. 2nd, p. 85, and Mr. PENTLAND'S letter to M. ARAGO in the 'Comptes Rendus' for March 11, 1839.

‡ "Blik paa Brasiliens Dyreverden för sidste Jordomvæltning. Anden Afhandling: Patte dyrene. Lagoa Santa, 16de Novbr. 1837," published in 'Det Kongelige Danske Videnskabernes Selskabs Naturvidenskabelige og Mathematiske Afhandlingar,' Ottende Deel, 1841, p. 70. A notice of LUND'S labours, containing the names of his genera, is to be found in the 'Oversigt over det Kongelige Danske Videnskabernes Selskabs Fordhandlingar i Aaret 1838,' published by ÖRSTED, the Secretary of the Academy.

the feet being short and thick, with remarkably broad and short nails; so that they must have resembled those of an Elephant, or a Hippopotamus. The skull was sloth-like, and its jugal arch exhibited the structure characteristic of those animals. The teeth were similar to the molars of *Capybara*, but simple instead of being made up of many plates.

Professor Bronn, publishing the second edition of his 'Lethæa Geognostica' in the spring of 1838, and unacquainted with Lund's labours, proposed the name of *Chlamydotherium* for the animal to which the carapace described by Weiss and D'Alton belonged, in case the foot should really appertain to it; and *Orycterotherium*, in case the foot should belong to a different animal.

In March of the same year, it appears that M. Vilardebo, Director of the Museum of Monte Video, and M. Isabelle published conjointly, in Nos. 2551, 2553, and 2555 of a journal, the 'Universal,' an account of an animal which they had discovered on the Pedernal, in the Department of Canelones*.

After removing a thin layer of clay, these observers met with a shield formed of pieces of bone separated from one another by a slight interval; these pieces, 25 to 50 millimetres in diameter, and varying in thickness from 12 to 40 millimetres, were hexagonal: the largest occupied the dorsal region of the carapace, and the smallest its lateral regions. Each polygon presented a central disk (14 to 27 millimetres in diameter), from whence radiated six or eight lines, between which as many quadrangular areæ were left. These pieces of bone were symphysially united so as to form a very regular mosaic: the carapace appeared to be fringed with conical pieces forming a semicircle of 24 centimetres. The carapace was about 4 metres wide, and was as convex as a cask. The bones discovered in it were lumbar vertebræ and pelvic bones. In another place was discovered a femur about 0·57 metre long, with many plates of the carapace, and a tail formed of a single mass of bone (covered nevertheless by pieces soldered together), in the middle of which were widely separated caudal vertebræ. The tail was more than 0·50 metre long, and more than 0·36 metre in diameter at the base.

The authors discuss the question—to what class do these fossils belong?—with much sagacity, and conclude by expressing the opinion that they appertain to a species of *Dasypus*, which they term *D. antiquus*, and which they briefly characterize as follows: "*Cingulis dorsalibus nullis: verticillis caudalibus nullis.*"

The volume of the Transactions of the Danish Academy, already cited, contains another communication from Dr. Lund, dated Lagoa Santa, September 12, 1838, in which he speaks of the fossils described by D'Alton, and identifies the animal to which they belonged, generically, with *Hoplophorus*, though he regards it as a distinct species, and names it *Hoplophorus Selloi*. Accompanying this paper are sundry figures of parts of the carapace and of bones of the hind foot of *Hoplophorus*.

Dr. Lund returns to the subject in a long letter addressed to M. V. Audouin, dated the 5th of November 1838 (extracts from which are published in the 'Comptes Rendus' for the 15th of April 1839), which contains an enumeration, with brief descriptive notices, of the seventy-five species of fossil Mammalia which this untiring explorer had

* See the Bulletin de la Société Géologique de France, t. xi. p. 159 (1840).

extracted in the preceding five years from the caverns of Brazil. Among the rest the writer describes:—

"6°. *Hoplophorus*, a genus very remarkable for the heavy proportions of its species, for their gigantic size, as well as for the singular manner in which it combines different types of organization; however, their characters approximate them most nearly to the Sloth family. These strange animals were armed with a cuirass which covered all the upper part of the body, and which was composed of little hexagonal scutes, except in the middle of the body, where the scutes took a quadrate form, and were disposed in innumerable transverse bands. The bones of the trunk, as well as the great bones of the extremities, are also very similar to those of the Tatous, and particularly to those of the Cachicames; but the bones which compose the feet are so shortened and have their articular faces so flattened, that nothing similar is to be seen in any animal skeleton, and that it is inconceivable how such feet should have been used in digging. The form of the teeth also indicates that these singular animals could feed only on vegetable substances, and it is to be supposed that they grazed after the fashion of the great Pachyderms. However this may be, the *Hoplophorus*, of which M. LUND describes two species, present the peculiarity, hitherto regarded as special to the Sloth, of having a descending branch to the zygomatic arch. These two species were as large as an ox. Fragments of the skeletons have already been described by MM. WEISS and D'ALTON of Berlin."—*Loc. cit.* pp. 572, 573.

A summary of LUND'S researches, despatched by him from Lagoa Santa on November 5, 1838, and published in the Annales des Sciences Naturelles for 1839, under the title of "Coup d'œil sur les espèces éteintes de mammifères de Bresil: extrait de quelques mémoires présentés à l'Académie Royale des Sciences de Copenhague," gives a substantially similar account of *Hoplophorus*. The species *Hoplophorus Selloi* is identified with the cuirassed animal described and figured by WEISS and D'ALTON.

The sixth volume of the second series of the Transactions of the Geological Society contains an elaborate memoir by Professor OWEN* on the bones associated with the dermal armour, figured by Mr. CLIFT in the memoir already cited; and on certain teeth, upon which the genus *Glyptodon* was founded by the same writer, in Sir WOODBINE PARISH'S work on Buenos Ayres†.

Professor OWEN considers these remains to be specifically identical with those collected by SELLOW, and described by WEISS and D'ALTON; so that if LUND was right in ascribing the same fossils to his genus *Hoplophorus*, *Glyptodon* becomes a synonym of the latter.

In the memoir under consideration the general form and the minute structure of the

* "Descriptions of a tooth and part of the skeleton of the *Glyptodon clavipes*, a large quadruped of the edentate order, to which belongs the tessellated bony armour described and figured by Mr. CLIFT in the former volume of the Transactions of the Geological Society, with a consideration of the question whether the Megatherium possessed an analogous dermal armour." By RICHARD OWEN, Esq., F.G.S., F.R.S. (Read March 23rd, 1839: an abstract of this paper appeared in No. 62 of the 'Proceedings.')

† 'Buenos Ayres and the provinces of the Rio de la Plata,' 1838, p. 178 *e*.

teeth, the distal end of the humerus, the radius, two phalanges of the fore foot, "the anchylosed distal extremities of the tibia and fibula, an astragalus, calcaneum, scaphoides, cuboides, external cuneiform bone, the three phalanges of the second toe, and the middle and distal phalanges of the third and fourth toes, with a few sesamoid bones," all belonging to the left side, are described; while the tooth and the bones of the leg and foot are figured.

Professor OWEN considers that the dental characters "seem to indicate a transition from the *Edentata* to the pachydermatous *Toxodon*," and sums up his general conclusions as to the affinities of *Glyptodon* thus:—

"It may be concluded, therefore, that the extinct edentate animal to which belongs the fossil tessellated armour described by WEISS, BUCKLAND, and CLIFT, cannot be called an Armadillo, without making use of an exaggerated expression, and still less a species of *Megatherium*; but that it offers the type of a distinct genus, which was much more nearly allied to the Dasypodoid than to the Megatherioid families of Edentata, and most probably connected that order of quadrupeds with the heavy coated Rhinoceros of the Pachydermatous group" (*l. c.* p. 96).

In the same year (1839) Professor D'ALTON proposed for the animal, the remains of which he had originally described, the name of *Pachypus*; so that by this time no fewer than six names had been applied to mammals all of which are certainly closely allied to the *Hoplophorus* of LUND, whether they are, or are not, generically identical with it, and which may therefore be appropriately termed *Hoplophoridæ*.

In 1845 Professor OWEN returned to the *Glyptodon* question, in the 'Descriptive and illustrated Catalogue of the Fossil Organic Remains of Mammalia, and Aves contained in the Museum of the Royal College of Surgeons of England.'

It is here stated (p. 107) that "those specimens of the present genus which were presented to the College by Sir WOODBINE PARISH are from a low marshy place, about five feet below the surface, in the bank of a rivulet, near the Rio Matanza, in the Partido of Canuelas, about twenty miles to the south of the city of Buenos Ayres." The parts thus found associated are not stated, with the exception of the bones of the left hind leg and foot (p. 111), to have belonged to the same individual. They consist of a molar tooth, part of the left ramus of the lower jaw, a fragment of the humerus, the left radius, a metacarpal bone and two phalanges, the shaft and distal epiphyses of the femur (?), the anchylosed distal ends of the tibia and fibula, and numerous bones of the left hind foot. These had already been described and figured in the Geological Society's Transactions.

As new specimens, there are described and figured an almost entire carapace of *Glyptodon clavipes*, from the Pampas of Buenos Ayres, and many dermal bones, all of which are marked "Purchased," and appear not to have been accompanied by bones of the endoskeleton. Nos. 551, 552, 554, 555, 556, 557 are fragments of carapace, all presented by Sir WOODBINE PARISH, and obtained from the locality mentioned above. They are ascribed by Professor OWEN to no less than three distinct species, however,

viz. *Glyptodon clavipes*, *G. reticulatus*, and *G. ornatus*; a fourth species, *G. tuberculatus*, is based upon purchased specimens, from the Pampas of Buenos Ayres, the precise locality of which is not stated.

The fact that the dermal ossicles of three species of *Glyptodon* were found in the same locality as the bones described, and the absence of any evidence demonstrating the association of the ossicles ascribed to *G. clavipes*, rather than those attributed to the other species, with the bones, throws, it will be observed, some doubt upon the certainty of that ascription, and opens the question whether the bones really belonged to one form of carapace or to another.

Of the Plates which illustrate the 'Catalogue,' the first contains a side view, partly restored, of the *Glyptodon clavipes*; the second, views of the carapace and tail; the third, of the skull; the fourth and fifth, of parts of the carapace; and the description of the Plates comprises accounts of the structure of the skull and of the tail, parts which had not been received until after the printing of the body of the catalogue.

In what locality the skull and the tail were obtained, and upon what evidence they are ascribed to the particular species, *G. clavipes*, is not stated. The lower jaw and the defensive bony covering of the skull in plate 1 "are restored on the authority of an original sketch of an entire specimen of this species of *Glyptodon* transmitted to Sir Woodbine Parish from Buenos Ayres." The bones of the fore foot are given in outline after D'Alton.

On the 8th of June, 1846, the late Johannes Müller read a short paper to the Berlin Academy upon the bones of the leg and hind foot described by D'Alton, which had been worked out and mounted by the help of Professor Owen's memoir. This paper, accompanied by an excellent plate, was published in 1849*.

The number of the 'Comptes Rendus' for August 28, 1855, contains a "Description d'un nouveau genre d'Edenté fossile renfermant plusieurs espèces voisines des Glyptodons, et classification méthodique de treize espèces appartenant à ces deux genres," by M. L. Nodot, Director of the Museum of Natural History at Dijon; and this essay, enlarged and illustrated with plates, appeared two years later in the 'Mémoires de l'Académie Impériale de Dijon,' Deuxième Série, tom. v. 1857†.

M. Nodot, in his introductory remarks, states that Vice-Admiral Dupetit brought back from Monte Video, in 1846, a great number of fossil bones which had been collected by Dr. Numez on the banks of the river Lujan, and were given to the Vice-Admiral by the orders of the Dictator Rosas. Admiral Dupetit presented most of these remains to the Museum of the Jardin des Plantes in Paris; but dying before

* "Bemerkungen über die Fussknochen des fossilen Gürtelthiers (*Glyptodon clavipes*, Ow.)," Abhandlungen d. Konigl. Akad. d. Wissenschaften, 1849.

† Under the title "Description d'un nouveau genre d'Edenté fossile renfermant plusieurs espèces voisines du Glyptodon, suivie d'une nouvelle méthode de classification applicable à toute l'histoire naturelle et spécialement à ces animaux. Avec un atlas de douze planches lithographiées."

he had disposed of all, his widow bestowed two boxes full of detached dermal ossicles on the Dijon Collection. Out of these, by dint of four months' constant toil, M. NODOT reconstructed the carapace.

Subsequent investigations in the store-rooms of the Jardin des Plantes revealed almost the whole of the tail, and many important parts of the skeleton, of what M. NODOT believed to be the same individual animal, mixed up, however, with fragments of *Mylodon*, *Megatherium*, and *Scelidotherium*. Besides these, M. NODOT found the tolerably complete extremity of the tail of another individual of the same genus in the Geological Gallery, and the right half of a lower jaw with the teeth, which he judged to belong to this individual.

The bones which M. NODOT, guided as it would seem chiefly by their colour, identifies as belonging to the same individual with the carapace, are, "the lateral and posterior part of the cranium, the occiput, the meatus auditorius, the zygomatic arch and its long apophysis, three alveoli, and the sagittal crest; the atlas, the axis, the vertebra of the fifth ring of the tail; the two femora entire; the tibiæ and fibulæ anchylosed; the calcanea; the astragali; the other tarsal bones; the left metatarsus; the three external toes of the left hind foot; the left radius; the ungual phalanx of one of the digits of the fore foot; and the ungual phalanx of an internal toe of the hind foot." The carapace and the tail are fully described by M. NODOT, who considers their peculiarities sufficient to justify him in establishing for these remains the new genus *Schistopleuron*.

How far he was justified in so doing is a point which must be discussed at the end of this memoir; but there can be no question that "*Schistopleuron*" is one of the *Hoplophoridæ*, closely allied to *Glyptodon clavipes*; and hence M. NODOT'S descriptions of the mandible, sternum, and femur constitute substantial additions to our knowledge of the organization of that family.

The mandible is unlike the sketch furnished to Professor OWEN and adopted by him, but very like that which will be described below. The first piece of the sternum and the first two ribs were so anchylosed together as to leave no trace of their primitive separation.

On the 14th of November, 1862, I presented to this Society a "Description of a new Specimen of *Glyptodon*, recently acquired by the Royal College of Surgeons of England," which was published in the fifty-third Number of the 'Proceedings of the Royal Society.' The remains of the specimen, described briefly in this preliminary notice and, in full, in the present memoir, were presented to the Royal College of Surgeons by Señor Don MAXIMO TERRERO, having been discovered in 1860 on the estate of his brother, Señor Don JUAN N. TERRERO, which is situated on the banks of the river Salado, in the district of Monte, in the Province of Buenos Ayres, and about eighty miles due south of the city of that name.

No portions of any other animal, nor any duplicate bones, have been discovered among the osseous relics the description of which has been entrusted to me by the authorities

of the College of Surgeons—a circumstance which justifies the belief that they all belonged to one and the same animal, and gives them a peculiar value, the more especially as there can be little doubt of the specific identity of the new specimen with the animal to which the skull ascribed by Professor OWEN to *Glyptodon clavipes* belongs.

I have thus been enabled to add to what was already known of *Glyptodon clavipes*, descriptions of the most essential peculiarities of the fore part of the skull, the entire palate, the mandible, the greater part of the spinal column, the pelvis, and the complete fore and hind feet, and to announce the existence, in this animal, of a conformation of the spinal column hitherto unknown in the Mammalian, and, indeed, in the Vertebrate series—the last cervical and two anterior dorsal vertebræ being anchylosed together into a single osseous mass articulated by ginglymi with the rest of the vertebral column. As another very remarkable peculiarity of this genus, I have pointed out the extraordinary characters of the pelvis, and the fact that the cuneiform bone in the carpus articulates with two metacarpal bones, the fourth and fifth, while the unciform does not articulate with the fifth at all.

Since the appearance of my paper in the 'Proceedings of the Royal Society,' and indeed not until the months of May and June 1863, M. SERRES, apparently unacquainted with what had been done in these matters, has redescribed the joint between the second and third dorsal vertebræ, though he appears to be still unaware of the existence of the 'trivertebral bone.' In addition, M. SERRES makes known the interesting circumstance, that the posterior edge of the *manubrium* of the sternum, anchylosed (as M. NODOT had pointed out, though M. SERRES does not refer to him) with the first pair of ribs, presents two concave articular facets, by which it was united with the rest of the sternum, which must have presented two convex surfaces adapted to the foregoing in order to allow of a movement of flexion. M. SERRES is of opinion that this mechanism is intended to allow of the retraction of the head: "Il est donc vraisemblable qu'au moment du danger, peut-être même que dans le repos ou le sommeil, le *Glyptodon* fléchissait le col pour ramener la tête sous la coupole de la carapace"*.

In his second communication to the Academy, M. SERRES still speaks of the "anchylosis of the first two dorsal vertebræ" only†.

Professor BURMEISTER, Director of the Museum at Buenos Ayres, has been good enough to communicate to me a letter, addressed by him to the Editor of the 'Nacion Arjentina' on the 5th July, 1863, commenting upon a lecture upon the Glyptodon which I delivered before the President and Council of the Royal College of Surgeons, which was published in the Medical Times and Gazette for the 28th of February and

* "Note sur deux articulations ginglymoïdes nouvelles existant chez le Glyptodon, la première entre la deuxième et la troisième vertèbre dorsale, la seconde entre la première et la deuxième pièce du sternum. Par M. SERRES" (Comptes Rendus, May 11, 1863).

† "Deuxième Note sur le développement de l'articulation vertébro-sternale du Glyptodon, et les mouvemens de flexion et d'extension de la tête chez cet animal fossile. Par M. SERRES" (Comptes Rendus, June 1, 1863).

7th of March, 1863, and which contains the substance of the statements previously published in the 'Proceedings' of this Society.

Professor BURMEISTER affirms that the skeleton of the *Glyptodon* in the Museum of Buenos Ayres is much more perfect than that in the Royal College of Surgeons; that it has the seven cervical vertebræ complete; and that the five middle cervical vertebræ are anchylosed together, while the seventh is very delicate and fragile. Under these circumstances, it would appear that Professor BURMEISTER considers the trivertebral bone (my description of which he confirms) to be composed of the three anterior dorsal vertebræ.

Professor BURMEISTER is further of opinion that the peculiar mechanism of the joint formed by the trivertebral bone with the rest of the spinal column has not that respiratory function which I have ascribed to it; but, with M. SERRES, he thinks that its object is to allow of the application of the cephalic shield to the anterior aperture of the shield of the body. Professor BURMEISTER goes on to remark—

"As little do I agree with Mr. HUXLEY as to the immobility of the ribs, which are wholly wanting in the London skeleton. The skeleton of the Museum of Buenos Ayres has nine ribs, three of which being complete, prove that they possess a certain mobility, moving downwards and backwards on their articulations with the spinal column, as in other Mammalia, but without doubt in a manner somewhat different from the ordinary way."

I am at a loss to divine on what grounds Professor BURMEISTER ascribes to me the opinion that the ribs are immoveable, and why he affirms that they are wholly wanting in the London skeleton. What I have stated is, that the first rib is immoveable; and so far from the ribs being wholly wanting, I have particularly mentioned their presence*, and have alluded to the characters of the first†.

Professor BURMEISTER adds that I am in error in supposing that the dorso-lumbar vertebræ were immoveably united. I believe, however, from Professor BURMEISTER'S own words, that my description is substantially accurate. These words are:—

"There exists a moveable place between the dorsal and the lumbar vertebræ, though the mobility is not so complete as that of the three first anchylosed vertebræ upon the following ones. In this part, the skeleton of Buenos Ayres presents a complete column, formed by eleven vertebræ incorporated into a solid piece, of a very peculiar form, with three crests in the upper part, the two lateral of which bear the ribs in articular excavations. The total number of dorsal vertebræ and of ribs is therefore fourteen. Then follow on these the lumbar vertebræ, all anchylosed together and immoveably united with the sacrum."

I do not venture to doubt the accuracy of Professor BURMEISTER'S description of the specimen under his own eyes; but nevertheless, as will be seen by-and-by, it is also true that the account I have given of the *Glyptodon* in the College Museum is quite accurate. And indeed, as Professor BURMEISTER admits that all the dorsal and all the

* Proceedings of the Royal Society, *l. c.* p. 317. † Ibid. p. 319.

lumbar vertebræ respectively were anchylosed together, with only an imperfect mobility at the junction of the two solid masses, I do not see how, in any important respect, his view of the matter differs from mine.

The last criticism which Professor BURMEISTER offers, refers to what he terms my error in ascribing five toes to the fore foot, when, as he affirms, it possesses only four. Professor BURMEISTER states that I have figured five toes to the foot of the *Glyptodon* in the lecture already referred to; but he is mistaken; only four toes are there represented, numbered, according to the digits of the typical foot which they represent, 2, 3, 4, 5. In the 'Proceedings' (p. 325) I have expressly stated—

"The trapezium possesses only a very small double articular facet on its palmar face. If this gave support to a metacarpal, it must have been very small; and as at present neither it nor any of the hallucal phalanges have been discovered, it is possible the pollex may have been altogether rudimentary. In any case the pollex must have been so much smaller and more slender in proportion than that of *Dasypus*, that the animal must have had a practically tetradactyle fore foot."

The errors, therefore, to which Professor BURMEISTER adverts, appear to me to arise to a great extent from his not having rightly comprehended my statements; and in part, it may be, from our having to deal with different objects.

PART II.—*Description of the Skeleton of* Glyptodon clavipes, OWEN (*Hoplophorus Selloi*, LUND ?).

The materials which have been available for the following description of the osteology of *Glyptodon* are, in the first place, the skeleton referred to in the previous section as having been presented by Señor TERRERO to the Royal College of Surgeons; secondly, the detached parts which have been already described by Professor OWEN, and are now contained in the Museum of the Royal College of Surgeons; thirdly, some fragmentary specimens in the British Museum; and fourthly, photographs of a skeleton of *Glyptodon* in the Museum of Turin. The two latter sources of information, however, are of altogether secondary importance, and will be adduced merely in confirmation of the results obtained from the study of the two former series of materials,—in treating of which, I shall speak of the fragments of *Glyptodon clavipes* described by Professor OWEN as the "type specimen," and of the skeleton presented by Señor TERRERO as the "new specimen."

§ 1. *Description of the Skull of* Glyptodon clavipes.

In the new specimen* the anterior part of the skull, from a line drawn transversely, immediately behind the zygomatic processes, to the anterior end of the snout, is in a remarkably good state of preservation—the boundaries of the anterior nares, the antero-lateral parts of the maxillary bones, the nasal, and the fore part of the frontal, bones being quite uninjured. Behind the imaginary transverse line in question this cranium

* Plate IV. figs. 1 & 3, Plate V., and Plate VI. figs. 1, 2, 4, & 5.

is very imperfect—the entire roof and sides, and the greater part of the base of the skull being absent, while a small portion only of the sphenoidal region is preserved.

Of the facial bones, those entering into the palate are preserved almost in their entirety, and one ramus of the lower jaw is nearly complete. This skull therefore supplies almost all those parts which were wanting in the cranium of the type specimen, in which the whole of the roof of the skull, from the nasal bones to the supra-occipital inclusive, most of the exoccipital, alisphenoidal, and orbitosphenoidal regions of the lateral walls, and of the basioccipital, basisphenoidal, and presphenoidal parts of the base, together with the temporal bones, are in good condition, while the premaxillary, maxillary, and palatine bones, with the mandible, are absent.

In order to give a tolerably complete view of the structure of the skull, I shall, in the first place, describe that of the new specimen; I shall next proceed to a comparison of the parts common to this fossil and the skull of the type specimen, in order to demonstrate the specific identity of the two; and then I shall endeavour to supply what is wanting in the new specimen by information derived from the study of the type.

The skull of the new specimen of Glyptodon clavipes.—The anterior nares have a trapezoidal form, the upper of the two parallel sides of the trapezoid being nearly three times as long as the lower, so that the two lateral boundaries converge from the roof towards the base of the nares (Plate VI. fig. 1).

The upper boundary of the anterior nares is formed by the anterior edges of the thick nasal bones, which are bevelled obliquely from below upwards, and so rounded off laterally that the contour of the two forms a large arc of a circle, the chord of which measures 3·4 inches (Plate IV. fig. 1). The upper surface of each nasal bone is rough and perforated by many vascular foramina, which open forward; and the two nasal bones are separated by a suture, which can be traced backwards in the middle line for 2·2 inches, and then comes to an abrupt termination. I presume that the extent of this suture indicates the distance to which the nasal bones reach backwards; but there are no traces of the nasofrontal, or nasomaxillary sutures. The middle of the under surface of each nasal bone presents a strong, rounded, longitudinal ridge, on each side of which there is an equally distinct concavity, and the apposed slightly thickened inner edges of the two nasal bones form a third, less marked, median ridge. The expanded upper edge of the perpendicular plate of the ethmoid embraces this middle ridge, while the nasal turbinal bones are continuous with the ridges on each side of it (Plate VI. fig. 1).

A well-marked notch, or sinuosity, separates the upper from the lateral contour of the anterior nares; and, about an inch below this, the inner surface of the outer wall of the nostril exhibits a rounded elevation or thickening. Still more inferiorly, the wall of the nasal cavity is somewhat excavated, so as to present a thin anterior edge, which passes into the trough-like lower boundary, constituted by the palatine portions of the præmaxillæ. These are separated throughout their whole length in the middle line (a distance of rather more than an inch) by a fissure less than one-tenth of an inch in diameter posteriorly, but twice as wide in front, the præmaxillæ becoming more

distant by the divarication of their anterior and internal angles. The thick and rough anterior edges of the præmaxillæ diverge obliquely from one another, both forwards and outwards and upwards and outwards, at a very obtuse angle, the interval between their anterior and external terminations amounting to 1·5 inch (Plate IV. fig. 3). Viewed laterally, the anterior ends of the nasal bones are seen to project about half an inch beyond the upper part of the lateral boundary of the nares, which slopes upwards and backwards with a slight forward concavity from the palatine portion of the præmaxilla (Plate V. fig. 1).

The nasal cavity is divided, longitudinally, by a very strong osseous septum, which extends to the posterior end of the premaxillary fissure below, and to within 0·4 inch of the anterior contour of the nasal bones above (Plate VI. fig. 1). This septum terminates, in front and below, in a thin jagged edge; but above, it expands into a broad plate 1·2 inch wide, presenting a deep and broad notch above, into which, as I have previously stated, the conjoined median edges of the nasal bones are received. The septum is about 2·6 inches high in front; and of this height 2·2 inches, or about five-sixths, is formed by the perpendicular plate of the ethmoid, while the rest belongs to the vomer (*Vo.*). The ethmoidal plate is thin in front, thicker in the middle, and thin again posteriorly. The lower half is somewhat excavated on each side, from above downwards; it ends in an inferior edge, or rather surface, 0·7 inch in diameter, anchylosed with the upper edge of the vomer, which has, in front, a corresponding thickness. The floor of the anterior part of the nasal cavity (*i. e.* as far as the level of the fourth alveolus) is concave from side to side, and convex from before backwards, its convexity corresponding with, but being much more strongly marked than, the concavity of the arched roof of the palate.

At about 2 inches from the anterior boundary, a sharp longitudinal ridge commences upon the floor of each division of the nasal cavity, and extends backwards, for a distance of about $1\frac{1}{2}$ inch, to the summit of the arch formed by that floor (Plate VI. fig. 1, *a*). Each ridge has a sloping convex external face, and a perpendicular concave inner face, 0·2 inch high. Between the latter and the side of the vomer, which is excavated for a corresponding distance from above downwards, lies a canal, a quarter of an inch wide, and open above and at its ends. The floor of each nasal chamber rises gradually into its lateral wall; and upon this, about three-fourths of an inch from the floor, appears a ridge which, at about an inch from the antero-lateral margin of the nostril (or just above the anterior end of the ridge on its floor), passes backwards into the commencement of the inferior spongy bone (Plate VI. fig. 1, *b*). The root of attachment of this bone to the maxilla is, as usual, a narrow and thin, though long, bony plate, which on its free, or inner, side is continued into two scroll-like lamellæ, an upper and a lower. The upper scroll comes much further forward than the lower, and is a stout plate of bone, slightly concave inwards and convex outwards. In front, it ends in a thin free edge. Superiorly, its margin is folded over outwards, and becomes anchylosed with the lateral wall of the nasal chamber.

The inferior lamella commences about an inch behind the superior one. It is thick,

convex inwards and concave outwards, and its inferior edge becomes much thickened as it curves outwards. It is attached to the maxilla by an anterior and superior thin, and a posterior and inferior, much thicker, plate of bone. Three passages, consequently, lie between the lateral walls of the nasal chamber and the 'scrolls' of the inferior turbinal,—an upper, long, narrow, and flattened from side to side; a middle, reniform in section; and an inferior, rounded in contour. The ridges upon the under surfaces of the nasal bones are continued, as I have stated above, into two thick plates of lamellated bone (Plate VI. fig. 1, *c*), which increase in depth from before backwards and pass into what are, probably, the superior ethmoidal turbinals. Their inner surfaces are flattened and parallel with the sides of the perpendicular plate of the ethmoid. Their outer surfaces, irregularly concave, are separated by but a narrow interval from the concave faces of the superior scrolls of the inferior turbinal bone.

The posterior view of this fragmentary skull (Plate VI. fig. 2) affords a further insight into the arrangement of the bones which contribute to the formation of the olfactory chambers. The aspect presented is that of a transverse section taken just in front of the anterior end of the cranial cavity. The comparatively thin posterior part of the *lamina perpendicularis* of the ethmoid (*Eth*) is seen abutting, above, against the frontal bones (*Fr*), and, below, becoming connected with the vomer (*Vo*), the posterior nearly straight free edge of which bone ends on the floor of the nostrils, at the level of the posterior margin of the third molar tooth, and thence slopes obliquely upwards and backwards.

The ethmovomerine plate, however, is not free from all lateral connexion with the turbinal bones, as is commonly the case; but a thin plate of bone, convex forwards and concave backwards, passes, on each side, from the vomer and the lamina perpendicularis to the lateral masses of the ethmoid. The inner surfaces of these are marked by broad flattened grooves, directed forwards and downwards, and separated by sharp ridges, which, in the recent state, were probably produced into delicate plates of bone.

The lower portion of the lateral mass of the ethmoid, which represents the middle turbinal, is continuous with the inferior turbinal. The upper portion, representing the superior turbinal, is similarly continuous with the nasal turbinal. The superior turbinal of each side forms the floor of a considerable cavity (Plate VI. fig. 2), which is walled in, externally and above, by the frontal bone, and represents a frontal sinus. A rounded dome (*a*) of bone projects backwards from the anterior wall of this cavity, which appears to communicate with the nasal fossæ only by a few foramina, situated around the margins of the dome.

The palate (Plate IV. fig. 3) is singularly narrow, seeing that its length, measured in a straight line, is about $9\frac{1}{2}$ inches, while its width, between the outer edges of the alveoli, nowhere exceeds 3 inches. The longitudinal contour of the palate is concave anteriorly, convex posteriorly (Plate V. fig. 1). The crown of the arch of the anterior concave portion is opposite the hinder margin of the third alveolus; from thence the roof of the palate slopes, downwards and forwards, to the free premaxillary edge. From the same point it slopes, downwards and backwards, to the level of the hinder margin

of the fifth alveolus, while behind the sixth it ascends, somewhat abruptly, to its posterior termination.

Throughout the posterior two-thirds of its length, the palate is slightly and evenly concave from side to side; but, from the third alveolus forwards, its middle part rises to form a median convexity, which ends by a rough, abruptly truncated ridge (Plate IV. fig. 3, *a*), behind the premaxillary fissure. It forms, in fact, the posterior boundary of a transverse fissure ending in a notch, or short canal, at each extremity, which represents the anterior palatine foramen, and which, taken together with the intermaxillary fissure, simulates very closely the form of a T. A deep groove (*b*) separates the raised part of the palate from the alveolar margin, and ends, behind, in a canal which burrows into the substance of the bone opposite the anterior edge of the third tooth on both sides. On the left side, however, the hinder part of the groove is bridged over by a bar of bone. Large foramina are situated, along a line continuing the groove, opposite the third and fourth alveoli; but no such apertures appear in the posterior part of the palate until quite its hinder extremity is reached, when, on each side, two crescentic fossæ (Plate IV. fig. 3, *c*), wider in front than behind, lie on the inner side of the last alveolus, and appear to separate the palatine from the maxillary bones. They end cæcally above.

The bony palate exhibits no distinct sutures, except a trace of a maxillary suture behind the anterior palatine foramen, and of a palatine suture, which widens behind into a cleft, separating the arcuated, divergent inner and posterior boundaries of the palatine bones. The free surfaces of the bony masses which bound the palate, posteriorly, are so smooth and unbroken, that I suspect the pterygoid bones must be represented in them.

As the palate presents very nearly the same width throughout, while the roof-bones of the skull are always much wider than it, it follows that any vertical section of the skull, perpendicular to its long axis, in the palatine region, would exhibit a trapezoidal form, like that of the anterior nares—the predominance of the upper side over the lower being still more marked. But in the antorbital region the roots of the zygomatic processes are so large, and stand out so much from the sides of the head, that the skull, viewed in front, looks almost like a cube, with its lower face produced forwards and downwards into a truncated wedge (Plate VI. fig. 1). The only trace of a suture visible upon any part of the sides of the facial wedge is an almost obliterated one (Plate V. fig. 1, *a*), which runs from a slight notch, opposite the level of the anterior palatine foramen and in front of the first alveolus, upwards and slightly backwards, and marks off the ascending process of the præmaxilla from the maxilla. This ascending process, very narrow in the middle, widens above and joins the nasal bone, so that the circumference of the anterior nares is completed by the præmaxillæ and nasal bones only.

Opposite the second and third alveoli, the maxillary bone, as I have stated above, widens out and expands into the root of a stout zygomatic arch, whence a process, nearly 6 inches long by 2 inches wide, passes directly downwards. The process is much flattened from before backwards (Plate VI. fig. 1), and is arched from above downwards (Plate V.

fig. 1), so as to be convex in front and concave behind. Its inner edge is thick and rounded, except towards its termination, where it presents some slight irregularities or digitations. The outer edge is comparatively thin and rugose; it is bevelled off inferiorly, and more obliquely on the right side than on the left. The inner part of the front face of the process looks almost directly forwards, and is very smooth; but the outer part of that face looks outwards more than forwards, and is rugose (Plate VI. fig. 1). The hinder, concave face of the process (Plate VI. fig. 2) is divided by an oblique ridge (*b*), which passes from its superior and external to its inferior and internal angle into two areæ—an inner, smooth, and an outer, rough and tuberculated. The superior and external part of the process, where it was doubtless continued into the zygoma, is evidently fractured. The root of the zygoma is perforated near its origin by a large, oval, infraorbital canal, the lower edge of which is rather more than an inch distant from the lower margin of the root of the zygoma. The canal is short, and is directed forwards and outwards.

The lachrymal foramen is a round aperture, placed upon the anterior edge of the orbit, 1·6 inch above the infraorbital canal (Plate V. fig. 1, *b*).

The internal walls of eight alveoli, on each side, are preserved. The external walls of the anterior four upon the left side, and of the anterior three upon the right side, are almost entire; but, posteriorly, the external walls of all the other alveoli, upon each side, are broken away (Plate V. fig. 1).

Measured in a straight line, the eight alveoli occupy a space of 8 inches, and each alveolus is, on an average, 0·9 inch long. The teeth which occupy the alveoli are sensibly equal in long diameter; but the anterior tooth is much narrower than the others, measuring only 0·35 inch in this direction, while the other teeth have a transverse diameter of 0·6 inch, or nearly double that of the first.

None of the teeth are entire upon the right side. Of the left series, the crowns of the first, third, fourth, and sixth are in very good condition, while the second is much damaged; of the fifth, only the middle lobe exists, and of the seventh only the two anterior lobes (Plate IV. fig. 3).

The alveoli are exceedingly long, and the outer walls of the third and fourth, on each side, are so much broken away, that the whole length of their alveoli can be observed and measured. The fourth is 4·5 inches long, and bends outwards and forwards as it passes upwards, to terminate nearly on a level with the lachrymal foramen. The tooth which filled the alveolus must have had a corresponding length and curvature; for the two longitudinal ridges of bone, which partially subdivide the alveolus into three chambers near its free end, are continued quite up to its closed extremity, and are lined by a shell of dental substance, which gradually thickens below and becomes continuous with the body of the tooth (Plate V. fig. 1. 4, 4′).

The third alveolus presents the same general curvatures as the fourth, but is inclined somewhat further outwards at its upper end, which lies close to, and about an inch above, the hinder end of the infraorbital foramen.

The wall of the upper end of the first alveolus has been broken through on the right side. It lies on a level with the upper edge of the infraorbital foramen, and immediately behind the premaxillary suture.

From what remains of the hinder alveoli and teeth, I suspect they become more and more nearly straight posteriorly.

The external vertical contour of each tooth must be very similar to that of the maxillary surface between the upper end and the edge of the alveolus.

The lateral faces of all the teeth are divided by two longitudinal grooves, placed opposite to one another on the two sides of each tooth, into three lobes.

In the first tooth these grooves are very shallow, so that the thickness of the tooth, between the grooves, is far greater than the depth of a groove. In all the other teeth, the thickness of the teeth between the grooves, or of the isthmus by which the lobes of each tooth are connected, is much less than the depth of a groove.

The view of the palate (Plate IV. fig. 3) shows that lines following the planes of the anterior surfaces of each of the four anterior teeth are directed inwards and forwards; while in the sixth and seventh teeth, if not in all four posterior ones, such lines are directed inwards and backwards. The anterior surfaces of all the teeth, but the first, are concave, the posterior surfaces convex. The grinding-surfaces of all the teeth are directed a little outwards as well as downwards. Each surface is ridged in the middle and surrounded by a thin raised margin, and the general arrangement of the ridges is such that one is median, traversing the longitudinal axis of the grinding-surface, and three are disposed at right angles to these, in the longitudinal axes of the three lobes. The transverse ridges are continuous with the longitudinal, where they cut it (Plate V. figs. 3 & 4).

Sometimes a transverse ridge may be bifurcated at its extremity, or accessory branchlets may be given off from the transverse, or from the longitudinal, ridges.

A large pulp-cavity occupies the upper portion of each tooth; but as its walls begin sensibly to thicken at about the junction of the upper and middle thirds of the tooth, the pulp-cavity diminishes in a corresponding ratio, and, rather below the middle of the tooth, it becomes obliterated.

*The Mandible**.—The lower jaw of *Glyptodon* is very remarkable, partly on account of the trough-like projection of the symphysis, but more especially by reason of its great height in relation to its length. The height, as measured from any horizontal surface on which the jaw is allowed to rest, to the summit of the articular condyle, is 9·25 inches;

* Leaving aside for the present M. Nodot's "Schistopleuron," the only fragment of the lower jaw of *Glyptodon clavipes* yet described is that mentioned in the Catalogue of the Royal College of Surgeons under "No. 517. A fragment of the anterior part of the left ramus of the lower jaw, including portions of the sockets of the anterior teeth. The first is small and simple, and is situated close to the anterior termination of the dental canal; the second socket shows, by the two prominent vertical ridges on its anterior and posterior walls, that the tooth which it contained had the fluted form characteristic of the genus; the third socket, which is the most complete, differs from the preceding in a slight increase of size, and it shows that the tooth was implanted by an undivided base of considerable length, and of the same size and form as the exposed part or crown."

while the length, measured in a straight line, from the symphysis to the angle of the jaw, is not more than 10·75 inches. The horizontal ramus is very deep and thick, measuring about 3·25 inches vertically by 1·5 inch in thickness, while the ascending ramus is 3·5 inches wide by about 0·9 inch thick at thickest (Plate V. fig. 2).

The anterior end of the mandible is 2·9 inches wide and abruptly truncated, ending in a rugose edge, nowhere more than half an inch thick, which, at its extremities, bends round at a right angle into the upper margins of the rami (Plate VI. fig. 5). These, thick and rounded, ascend somewhat towards the first alveolus, which is 2·25 inches distant from the anterior end of the ramus. The symphysis, 5·7 inches long, appears to be formed by the sutural union, and not by the anchylosis of the rami; but the bone has been so broken that a large aperture occupies the middle of the symphysial space (Plate VI. figs. 4 & 5).

The exit of the inframaxillary canal is nearly half an inch wide, and is situated $1\frac{3}{4}$ inch below the upper margin of the jaw, and directly beneath the anterior boundary of the first alveolus. The anterior, or symphysial, contour of the mandible slopes, with a slight forward concavity, obliquely downwards and backwards to the level of the foramen; and is then continued, almost straight, or with a slight anterior convexity, to a point nearly in the same vertical line as the hinder edge of the third alveolus (Plate V. fig. 2).

The symphysial face is convex from side to side inferiorly,. and gradually widens until, at its hinder end, its breadth amounts to 5·5 inches. Its outer boundary is formed by an obtuse longitudinal convexity, which runs along the middle of the outer face of the horizontal ramus, and dies away, posteriorly, at the commencement of the ascending ramus. From this ridge, or convexity, the summit of which corresponds with the greatest outside breadth of the jaw, the outer surface of the ramus slopes upwards and inwards to its alveolar margin (Plate VI. fig. 4). The inner face of each horizontal ramus is slightly concave from above downwards, passing, in front, into the excavated upper surface of the symphysis.

The general contour of the anterior half of the alveolar margin of the mandible is slightly convex upwards, in correspondence with the concavity of the opposed region of the maxilla (Plate V. fig. 2). The posterior half of the same margin is broken away; but it may be assumed that it was concave upwards, answering to the downward convexity of the hinder part of the maxillary alveolar edge.

The inner edges of the alveolar margins of the two rami are 2 inches apart. In the left ramus the series of alveoli is tolerably well preserved for $5\frac{1}{2}$ inches, or to a point behind the anterior edge of the ascending ramus. From the character of the broken surface behind this point, however, it is obvious that the series of alveoli was continued along the inner surface of the ascending ramus, very nearly to the angle of the jaw, and considerably behind a line let fall perpendicularly from the articular condyle—an arrangement which, so far as I am aware, has no parallel among *Mammalia* (Plate VI. fig. 5).

As the whole length of the series of mandibular alveoli is about 8 inches, it is probable that the number of teeth was the same below as above, or eight on each side.

The external surface of the perpendicular ramus of the mandible is rugose, slightly convex from above downwards and from side to side, while its internal surface exhibits a corresponding concavity, which is exaggerated below by the inward projection of the posterior alveoli, and is divided by an elevation of its surface, which ascends obliquely from the alveolar margin towards the coronoid process, into an anterior and a posterior moiety. The apex of the coronoid process is broken away upon each side, but it seems not to have extended beyond the level of the articular condyle, from which it is separated by only a shallow notch.

The hinder margin of the perpendicular ramus, which is very thin inferiorly, thickens with the rest of the bone superiorly, and ends above in a transversely elongated condyle, which projects further upon the inner than on the outer side of the plane of the ramus (Plate V. fig. 2[a]). Viewed laterally, this condyle has the form of a wedge, the base of which is 0·7 inch broad; its hinder face being slightly concave, while its anterior face, convex from above downwards, and slightly concave from side to side, looks forwards and upwards (Plate V. fig. 2). It is this face which bears the surface for articulation with the squamosal element of the skull, and is indeed coextensive therewith. The surface in question is 1·25 inch wide from side to side, and 0·6 inch broad or from above downwards, and is tolerably smooth, but not very different from the adjacent parts of the condyloid process.

The remains of five successive anterior teeth are observable in the alveoli of the left ramus of the mandible, and the socket of the sixth is clearly defined. Behind it, for a space of 1·8 inch, the inner wall of the ramus is broken away so completely that no trace of any alveolus is left. On the right side, the bone is nearly in the same state, but at a distance of 7·6 inches from the anterior edge of the most anterior alveolus, I observe a smooth vertically grooved surface of bone, which is situated nearly in the same plane as the outer walls of the other alveoli, and which I conceive to be part of the outer wall of the last alveolus.

The teeth of the mandible present the same trilobed form and other general characters of those of the maxilla, but very few are in a sufficiently entire state to furnish materials for description. The first and second, on the left side, and the third, upon the right side, however, have their grinding-surfaces entire, or nearly so (Plate VI. fig. 5).

The grinding-surface of the first tooth (left side) is 0·85 inch long and 0·4 inch wide at widest. It has a very different form from the first tooth of the maxilla, the two posterior ridges of the outer surface being much more developed.

The grinding-surface of the second tooth (left side) measures 0·9 inch by 0·45 inch; its outer ridges and grooves are also the better marked. The posterior surface of the tooth is flat or a little concave, and its plane is directed obliquely outwards and backwards.

The grinding-surface of the third tooth (right side) is 1·05 long, and the isthmuses which unite its prisms are much narrower than in the second tooth. Both the anterior and the posterior faces of the tooth are curved. The grinding-faces of all these teeth

are inclined a little inwards as well as upwards, reversing the direction of the grinding-faces of the upper teeth.

The mandibular teeth seem to have been nearly straight, without either external or internal concavity. Their long axes are inclined rather backwards as well as downwards. The alveolus of the fourth tooth, on the right side, is laid open; and I judge from it that the fourth tooth must have had a length of about $3\frac{1}{2}$ inches; and the others might have had the same dimensions, except the first, which is certainly shorter, probably not exceeding $2\frac{1}{2}$ inches.

A considerable canal traverses the right ascending ramus from behind and below, upwards, forwards, and outwards. Its external aperture, oval, 0·3 inch wide, lies upon the outer face of the ramus, on a level with the alveolar margin, and rather nearer its anterior than its posterior edge (Plate V. fig. 2). The inner end of the canal, which is 1·7 inch long, terminates in the broken cancellous structure, on the outer side of what appears to be the remains of the last alveolus.

I cannot certainly discern any remains of a corresponding canal in the left ascending ramus.

All that remains to be described in this skull is a fragment of the basis cranii, consisting of part of the anchylosed basi- and pre-sphenoid bones. The presphenoid (Plate VI. fig. 2) is remarkable for the strong crest or spine into which the middle of its upper surface is produced, and which was not improbably continued into an ethmoidal *crista galli*. The posterior apertures of the passages for the optic nerves are ellipses, with their long axes directed upwards and outwards; they are about a quarter of an inch in diameter, and are continued into two canals, which are traceable, outwards and upwards, for about an inch in the substance of the orbitosphenoids. On each side, below and external to the optic foramina, are strong grooves which formed the inner portion of the confluent foramen rotundum and sphenorbital fissure. The front face of the presphenoid and the roots of the orbitosphenoids are excavated by deep sphenoidal sinuses.

Comparison of the Skull of the present specimen with that of the typical Glyptodon clavipes.—The principal parts which exist in both skulls, and may therefore serve as terms of comparison, are, 1, the nasofrontal region of the roof of the skull; 2, the descending zygomatic processes; 3, the alveoli; and 4, the basi- and pre-sphenoid.

1. The resemblances in size and general configuration between the nasofrontal regions of the two skulls are so obvious that I need hardly dwell upon them at any length. The present specimen differs from the type in the more rounded contour of the nasal bones, in the persistence of the nasal suture, in the less rugosity and squareness of the supraorbital prominences, and in the far less marked definition of the temporal ridges; but none of these characters appear to me to have more than an individual importance, and I am inclined to suspect that they depend largely on the less advanced age of the present specimen.

2. The zygomatic processes have the same length (measured from the infraorbital foramen) in each case. They are slightly narrower in the type specimen; in other respects

the zygomatic processes of the two specimens do not differ more than those of opposite sides in the same specimen.

3. In the typical specimen the upper ends of the three anterior alveoli, on each side, are preserved; they occupy just the same space as the three anterior alveoli of the present specimen.

4. The presphenoid in the type has the same crest, and the inner ends of the optic foramina are precisely the same distance apart.

When to these correspondences we add that the distance from the front edge of the nasals to the level of the posterior edges of the supraorbital prominences is the same in both skulls, and that the lower jaw of the new specimen would fit very fairly on to the typical skull, it will, I think, be admitted that there is sufficient evidence of the specific identity of the animals to which the two skulls belonged, and that the imperfections of the new specimen may be supplemented by the evidence afforded by the typical example.

Further data as to the Cranial Structure of Glyptodon *furnished by the typical skull.* —Professor Owen ('Catalogue of Fossil Mammalia and Aves,' p. 384) thus describes the fragmentary skull of the typical specimen of *Glyptodon clavipes*:—

"The occipital condyle (*a*) presents a convexity in the vertical direction, which describes more than a semicircle, and is slightly convex transversely, but is narrower in that direction than it is in the *Mylodon*: it is directed in the *Glyptodon* backwards and obliquely outwards. The occipital foramen (*b*) is very large and transversely elliptical; its plane is inclined from below upwards and backwards 20° beyond the vertical line. The anterior condyloid foramen (*c*), though large, is relatively smaller than in the *Mylodon*, and is situated close to the anterior border of the condyle. The depression for the digastric muscle (*d*) is perforated and separated from the condyle by a wider tract of the paroccipital (*e*) than in the *Mylodon*; and the petromastoid (*f*) below the digastric depression presents a rough convexity, bounded posteriorly by a transverse ridge of the paroccipital instead of the hemispherical depression for the articulation of the stylohyoid bone which characterizes the skull of the *Mylodon*. The basioccipital (*g*) presents a median smooth concavity and two lateral rough depressions, which are continued on to the basisphenoid (*h*), and indicate the insertion of very powerful 'recti-capitis antici majores'; the obliterated suture between the basioccipital and basisphenoid forms a rough transverse ridge. The inequalities of this part of the basal region of the skull present a striking contrast to the broad smooth and even tract which the same part forms in the *Mylodon*. The sides of the concave under surface of the basisphenoid are bounded by longitudinal ridges, which have been broken off in the specimen. The petrous bone terminates by a prismatic pointed process in the foramen lacerum (*i*), which here gives passage both to the jugular vein and internal carotid. The foramen ovale (*k*) is circular, and of the same size as the anterior condyloid foramen. The foramen rotundum (*l*) is one inch and a half in advance of the foramen ovale, and opens with the commencement of a deep and long groove, which traverses the base of the

pterygoid processes in the direction towards the antorbital foramen. The base of the zygomatic process supporting the articulation of the lower jaw (*m*) is brought much nearer the occiput than in the *Mylodon*, and is separated from the petromastoid by a deep excavation, perforated by wide apertures that seem to communicate with the tympanic cavity. The articular surface for the lower jaw is well defined, narrow in the axis of the skull, much extended transversely, gently convex in both directions. In the skull of a recent Armadillo (*Dasypus octocinctus*) the articulation for the lower jaw is almost flat, and on a level with the roof of the posterior perforated cavity. In the Prionodon (*Dasypus gigas*, Cuv.) the articular surface is slightly concave, and extends longitudinally forwards from the posterior cavity. The zygomatic process of the malar bone bounds the outer and fore part of the surface, and extends forwards in the form of a laterally compressed plate of bone, and in the *Das. sexcinctus* forms a slight angular projection below the antorbital perforation. In the *Glyptodon*, the articulation for the lower jaw more resembles that in ordinary Pachyderms, and is thus conformable with the deviation from the Edentate structure manifested by the bones of the foot. But the most remarkable characteristic of the skull of the *Glyptodon*, by which it differs from the existing Armadillos and approaches the Megatherioids, is the long and strong process (*n*) which descends from the base or origin of the zygomatic process of the maxillary bone. This process is compressed, but in the opposite direction to that in the *Mylodon*, viz. from before backwards, instead of from side to side; it measures five inches in length from the antorbital perforation, one inch and three-fourths in breadth across the middle: the outer margin is entire, and as if folded back; the lower half of the inner margin is slightly notched, the extremity of the process curves backwards. Both anterior and posterior surfaces bear strong marks of the attachment of muscular fibres.

"The small remaining portion of the maxillary bone on the inner side of this process shows portions of three deep sockets (*o o*) of the same diameter throughout, indicating the implantation of molar teeth by a single excavated base, and showing two longitudinal ridges on both the outer and the inner side, which proves the teeth to have had the same fluted exterior which they present in the lower jaw, and of which the generic name of *Glyptodon* is expressive. The fractured anterior part of the basis cranii shows the large cavities for the olfactory bulbs, and the remains of a very extensive cribriform plate, the organ of smell being very largely developed.

"The posterior, or occipital surface of the skull slopes forward from the plane of the occipital foramen at an angle of 45°; in the small existing Armadillos it is vertical; in the *Glyptodon* it is divided by a strong median vertical ridge, and separated by a sinuous thicker transverse ridge from the upper surface of the skull. The posterior half of this region of the cranium is marked by the ridges bounding the origins of the temporal muscles, which almost meet along the middle or sagittal line. Part of the lambdoidal suture is seen at *p*; the other cranial sutures are obliterated. The temporal fossæ are pierced by numerous large vascular foramina. The anterior parts of the temporal ridges (*q*) diverge to the posterior angle of the supraorbital ridges. The frontal or inter-

orbital part of the upper surface of the cranium is broad and nearly flat, smooth, and slightly concave at its posterior half, slightly convex, rough, and perforated by vascular foramina at its anterior half. The most prominent parts above the orbits are most rugose, and indicate a more intimate adhesion to the superincumbent osseous dermal helmet. The lachrymal foramen (*r*) is pierced immediately in front of the anterior border of the orbit.

"The difference in the development of the temporal muscles manifested by the *Glyptodon* and Mylodon in the position of the ridges in the fossil cranium indicates a corresponding difference in the power of mastication and in the density of the alimentary substances habitually selected by each species; the greater proportion of hard dentine in the teeth of the *Glyptodon*, and the greater number of the teeth, which appear to have been thirty-two, eight on each side of both jaws, coincide with the characters of the cranium, and support the inferences thence deducible."

It is necessary to make certain additions and qualifications to the above description. If we may be guided in the interpretation of the structure of the auditory region by the analogy of the existing *Euphractus*, the part which is there termed "paroccipital" (Plate IV. fig. 5, *h*) includes the true mastoid; the "perforated depression for the digastric muscle" (Plate IV. fig. 5, *f*) is the external auditory meatus; and that which is termed "petromastoid below the digastric depression" (Plate IV. fig. 5, *g*) is part of the tympanic element of the temporal bone. It would appear that, as in *Euphractus*, the tympanic bone sends a process outwards and backwards, the extremity of which comes into contact with the *pars mastoidea*, and so bounds the external auditory meatus externally and below; while it leaves between itself, the proper tympanic *bulla*, and the *pars mastoidea*, an aperture which communicates with the external auditory meatus. The latter is remarkably small for so large an animal. The "bulla," into which it opened, is broken away; but it is probable that a considerable part, if not the whole, of the rugose spaces supposed above to be for the insertion of "recti capitis antici," mark the place where the thick inner walls of the bullæ impinged upon the basioccipital. The *fenestra rotunda* is visible upon the under surface of the *pars petrosa* as an oval aperture 0·15 inch wide, the long axis of which is directed almost transversely to that of the skull. The *fenestra ovalis*, smaller, appears above the *fenestra rotunda*. The proper carotid canal probably traversed the anterior part of the internal wall of the bulla as in the Armadillos; the jugular vein most likely left the skull by a passage between the posterior and internal part of the bulla, the exoccipital, and the periotic.

The large apertures perforating the roof of the cavity which is situated behind the articular facet for the lower jaw, do not communicate with the tympanic chamber. They are probably venous channels, and they communicate internally with the cavity of the skull.

The articular facet for the lower jaw measures 1·8 inch along its greater, and 0·6 inch along its lesser diameter; its edges are well defined, and it has a somewhat kidney-shape, the hilus of the kidney being turned downwards (Plate IV. figs. 4 & 5, *e*). The general

aspect of the facet is backwards and downwards, so that, when viewed laterally, its plane appears inclined more than 45° to a horizontal line. The long axis of the facet is nearly at right angles to the axis of the skull, but its outer half has a slight inclination forwards and outwards. It will be observed that the direction of this facet corresponds very well with that of the articular facet on the condyle of the lower jaw of the new specimen; and the nature of the articulation is such that the lower jaw must have had a purely hinge-like movement in a vertical plane, the doubly curved upper surface of each row of mandibular teeth being brought, with a simply crushing motion, against the correspondingly curved lower surface of the maxillary teeth in each masticatory act.

The "deep and long groove" into which, in the above description, the *foramen rotundum* is said to enter, requires particular notice. The *foramen rotundum* and the sphenoorbital fissure are represented by a rounded aperture 0·5 inch wide, situated immediately in front and to the inner side of the *foramen ovale*, and separated from it by only a narrow bar of bone. The small optic foramen, in like manner, lies immediately in front and to the inner side of this aperture, separated from it only by the lower root of the orbitosphenoid.

The alisphenoid is prolonged forwards as a broad plate, parallel with the orbitosphenoid, for about an inch; and thus the conjoined *foramen rotundum* and *fissura sphenoorbitalis* are continued outwards and forwards by a wide canal of the same length. Anteriorly, the alisphenoid ends in an arcuated free edge, and so forms the hinder part of the outer lip of a groove open inferiorly, the inner wall of which is constituted by the lateral mass of the ethmoid. The front part of the outer lip of the groove, separated from the other by a slight interval, is formed by a strong descending vertical plate of the frontal bone, ending below in a rugose edge, thicker behind than in front, which sweeps upwards and forwards towards the posterior part of the infraorbital prominence. It ceases at about three-quarters of an inch from that part.

The optic foramina are prolonged into canals directed forwards and outwards, each about an inch long, the anterior apertures of which open on the inner wall of the great passage just described, immediately behind the level of the anterior edges of the alisphenoids.

The optic nerves, which could hardly have been more than 0·1 inch in diameter, and were therefore very slender in relation to the size of the animal, must have been continued forwards between the frontal plate and the ethmoid for a distance of at least $3\frac{1}{2}$ inches before they reached the eyeball.

Three other apertures are visible in the roof of the groove—one, about as large as the optic foramen, on its outer side, and three-quarters of an inch in front of the proper anterior end of the optic canal. The two others are smaller and situated close together, and rather on the inner side, half an inch in front of the former. These may be the ends of canals for the oculomotor nerves.

The remains of the expanded upper edge of a *lamina perpendicularis*, similar to that

described in the new specimen, are visible, attached to the under surfaces of the nasal bones.

The inner surface of the right lateral portion of the ethmoid is marked by obliquely diverging ridges of bone, with which the plates of the inferior spongy bone were doubtless connected.

By combining the new specimen with this it is easy to ascertain approximatively the length of the cribriform plate. The former specimen, in fact, is broken through at a distance of six inches from the anterior end of the snout, but its posterior face does not exhibit any notable part of the anterior wall of the cranial cavity. The same distance (6 inches), therefore, measured off upon the roof of the type skull, should give the position of a line beyond which the cribriform plate certainly did not extend anteriorly. From the point thus defined to the anterior edge of the presphenoid is a distance of 1·75 inch, which must therefore represent the maximum length which the cribriform plate could have attained. The distance from the anterior edge of the presphenoid to the level of the posterior margins of the occipital condyles is 4·5 inches. The cribriform plate is rather shorter in proportion to the base of the skull in the *Glyptodon* than in the ordinary Armadillos, and its anterior part is situated far further back in relation to the antorbital processes.

The proper cranial cavity, or brain-case, is small when compared with the whole size of the skull, if the chambers which lodge the olfactory bulbs are left out of consideration. It is in fact only 4·5 inches long, 2·5 inches wide at widest, and about $1\frac{3}{4}$ inch high at highest. Its greatest width is situated beneath the occipital ridge, whence it narrows towards the olfactory outlet, which is about 1·25 inch wide. The immediate side walls and roof of the fore part of the cranial cavity are formed by a very thin inner table of bone, separated by a wide air-chamber from the denser and stouter outer table. This air-chamber does not appear to extend back beyond a transverse line connecting the two glenoidal facets.

Mr. Flower has obtained a cast of the cranial cavity, from which one is enabled to form an idea of the shape and size of the brain. The proportionally large cerebellum exhibits a prominent vermiform process, and is completely uncovered above by the cerebral hemispheres. The latter are quite smooth, and their upper contour is much arched, while their sides are flattened, and approach one another anteriorly. The absence of convolutions in the brain of so large an animal, together with the small absolute mass of the organ, leads one to suspect a great absence of intelligence in the *Glyptodon*.

Measurements of the Skulls.

A. *The new specimen.*

	inches.
Total length of the palate in a straight line	9·50
Width between the inner edges of the alveolar series	1·75
Width between the outer edges of the alveolar series, opposite third tooth	2·95
" " " " last tooth	2·8
" " " " first tooth	2·6
Hinder edge of the last alveolus in front of the posterior nares	0·5
Outer edge of the malar process to the centre of the palate	5·5
The extreme breadth of the skull therefore =	11·0
Vertical height of skull from frontal bones to palate at fourth tooth	6·0
From end of outer edge of orbit to the same point on the opposite side	7·2
Summit of the frontal region to the ends of the malar processes	9·5

Mandible:—

Extreme length from the symphysis to the angle	10·7
Extreme height from the summit of a condyle to a flat surface on which the jaw rests	9·3
Depth of the horizontal ramus at the third tooth	3·2
Width at the symphysis	2·9
Width between the inner edges of the alveoli opposite the first tooth (remains the same throughout)	3·1
Width between the outer edges at the same point	3·1
Width between the outer edges at the third tooth	3·25

B. *The type specimen.*

Extreme length from nasal bones to the level of the occipital condyles	12·7
" " " superior occipital ridge	10·5
Breadth at the front part of the orbits	6·8
" at the interorbital constriction	4·3
" across the occiput, about	5·8
Height of the occiput	2·6
Distance between the inner edges of the articular surfaces for the condyles of lower jaw	4·25

§ 2. *The Vertebral Column.*

The remains of this very interesting part of the organization of *Glyptodon* are, unfortunately, in a somewhat imperfect state, though enough exists to demonstrate its altogether unique character.

The Atlas.—Of this bone the mutilated right half is represented in Plate VII. fig. 1, giving the anterior, and fig. 2 the posterior aspect of the fragment.

The specimen exhibits rather more than the right half of the lower arch, and rather less than the corresponding portion of the upper arch of the bone. The right lateral mass, with its anterior and posterior articular facets, is almost entire, but the transverse process is broken off close to its origin. The inferior arch is a solid bar of bone with a straight upper and a convex lower contour; and somewhat thicker in the middle, both from above downwards and from before backwards, than at the sides. A section taken through the median plane of this part of the bone would have the shape of a spherical triangle; the lower or horizontal face convex, the anterior slightly concave, and the posterior and upper also concave.

The middle of the posterior and upper face of the inferior arch presents an oval articular facet (fig. 2, *a*) for the odontoid process of the axis, which, when entire, must have measured about 1·6 inch in width by 0·8 inch in antero-posterior length. It is slightly concave, both from before backwards and from side to side, and is bounded by a well-defined though narrow ridge. The outer end of this facet is half an inch distant from the inner and lower edge of the articular surface for the odontoid vertebra, upon the lateral mass of the atlas (fig. 2, *b*). This is a reniform surface with its inner and anterior side concave, while the outer and posterior aspect is convex. Its long axis is almost vertical, while the plane of its surface, which is a little concave both from above downwards and from side to side, is directed obliquely inwards and forwards. Lines drawn through the shorter axes of the two articular facets would intersect one another at a point very slightly in front of the anterior margin of the inferior arch. The foramen for the vertebral artery is situated on the outer side of the facet, opposite the junction of its middle and upper thirds, and nearly on the same level as a tubercle for the transverse ligament, situated on the inner side.

The foramen (fig. 2, *c*) leads into a canal which passes directly forwards, widening as it goes, and traverses the root of the transverse process. In front of this it presents a large oblique aperture, by which, however, it does not terminate. Instead of ending, it makes an abrupt turn upwards through the substance of the superior arch of the atlas, parallel with, and equidistant from, the anterior and posterior margins of that part, and ends by an oblique aperture in the outer part of the roof of the cavity of the atlas, and nearer the occipital than the odontoid edge. The upper face of the lateral mass of the atlas presents an elongated, irregular, transverse aperture, which communicates with the canal, and from the anterior and posterior margins of which broad and shallow grooves are continued.

The articular surface for the occipital condyle upon the anterior face of the lateral mass of the atlas (fig. 1) is much more concave from above downwards than that just described; and as it is neither concave nor convex from side to side, the surface may be regarded as a segment of a hollow cylinder, answering to rather less than half the circumference of such a figure. When the inferior arch of this atlas is made horizontal, this articular

surface looks forwards and inwards. The inner and lower edges of the opposite occipital facets of the atlas must have been separated by a distance of about 1·9 inch.

The transverse process of the atlas is, as I have stated, broken off close to its origin; but the cancellated fractured surface, 2 inches long by more than half an inch wide superiorly, proves that the process was flattened from before backwards, and that it arose from the posterior half of the outer surface of the lateral mass of the bone. The surface of attachment of the process is almost perpendicular to that of the axis of the spinal canal, or, at most, has a very slight inclination from above downwards and forwards. The general plane of the process, on the other hand, as exhibited by an upper or an under view, is directed backwards and outwards. There are no means of judging how far the process may have extended outwards.

The Odontoid and immediately-following Cervical Vertebræ.—The fragment of this region of the vertebral column (figured in Plate IX. fig. 5 from without, fig. 6 from within, fig. 7 from behind, and fig. 8 from below) is composed of the right half of the neural arch of the axis, or odontoid, vertebra, anchylosed together with the arches of the third and fourth cervical vertebræ. It formed the right half of the roof and side walls of the neural canal in this region. The front face of the bone, thick and prismatic, is obliquely bevelled off to a rounded edge, which is concave anteriorly. The outer face is produced above into a tuberosity, the anterior part of which is perforated by a canal which traverses the whole thickness of the bone and opens on its inner face, near its upper end (fig. 5, *c*, fig. 6, *c'*). From the tuberosity a small ridge, partly broken away, leads forwards and inwards along the anterior face of the bone. A stouter ridge extends inwards near the posterior margin of the bone, from the same tuberosity. These two ridges were situated upon the proper upper surface of the arch, and probably joined the anchylosed spinous processes.

The lower part of the outer face presents a broken surface, with the outer terminations of three canals (figs. 5 & 8, *d*, *e*, *f*), the inner ends of which are visible on the inner or under surface of the bone (fig. 6, *d*, *e*, *f*) as they traverse its thickness obliquely from within outwards and downwards. The hindermost of these canals (*d*) is wide below, but narrows into a fissure above. The second, or middle, foramen (*e*) is wider, oval, and looks more downwards. The third (*f*) is much smaller than either of the other two. On the inner face of the bone (fig. 6) the aperture of the posterior canal (*d*) is longest. The middle canal opens upon nearly the same level; but the third, or anterior, canal takes a much shorter course through the bone, and thus its inner end is on a level below the others.

The aperture of the middle canal is situated at about the same distance from the anterior margin of the bone as the inner end of that canal (*c*, *c'*) which, I have stated, opens externally upon the tuberosity. A little aperture (*g*) in the same line with these two leads into the substance of the bone, and seems to have no external outlet. Lines drawn through the three apertures referred to, mark off an anterior segment of the bone from a middle segment, which is defined, by a line drawn from the inner end of the posterior canal below to another small aperture (*h*) above, from a hinder segment.

The posterior face of the bone exhibits, below, a large round aperture (fig. 7, *a*), leading into a passage which traverses the posterior canal just described, and debouches into the middle one.

Immediately beneath this foramen is a small concave articular surface, apparently a fragment of a much larger one.

Superiorly and internally the posterior face of the bone presents a deep fossa (fig. 7, *a*), bounded above and internally by a concave articular facet, the long axis of which is directed almost at right angles to the long axis of the bone.

The facet in question I take to correspond with the posterior oblique process or "post-zygapophysis" of the fourth cervical vertebra. The foramen on the posterior face is the aperture of the canal for the vertebral artery. The facet below it is part of an articular surface upon the inferior or "capitular" division of the transverse process, which is characteristic of the cervical vertebræ in Armadillos; and the middle and posterior canals are the intervertebral foramina for the third and fourth cervical nerves. The upper and inner foramina and canals represent the remains of the primitive interspaces between the several arches. The anchylosed spinous processes, and the bodies of the three coalesced vertebræ, are completely broken away, so that nothing can be said regarding their characters.

The fifth and sixth Cervical Vertebræ.—No remains of the fifth and sixth cervical vertebræ have been discovered among the bones sent by Señor TERRERO.

The "Trivertebral bone," or anchylosed seventh Cervical and first and second Dorsal Vertebræ (Plate VII. figs. 3, 4, 5, 6).—The three vertebræ which enter into the composition of this singular bone are very much depressed from above downwards, so that the neural canal is more than twice as wide as it is high; while the greatest depth of the whole bone, leaving the spinous process out of consideration, is hardly a fourth of its width. The inferior face of the bone is deeply concave from side to side; and as the floor of the neural canal is also concave, the part which corresponds with the centra of the anchylosed vertebræ has the form of a broad thin arched plate, thinnest in the middle. The superior arches of the vertebræ, which constitute the roof of the trivertebral bone, follow, in a general way, the contour of its floor; but they are much thicker; and, posteriorly, the roof of the trivertebral bone is produced, upwards and backwards, into a very thick short process, which probably represents the spinous processes of the two anterior dorsal vertebræ. The lateral parts of the trivertebral bone, which represent the anchylosed transverse processes of the vertebræ, are very thick and stout, especially in front. Viewed from above, or laterally, they are seen to be marked out by excavations into three portions, one for each primitive vertebral constituent of the bone. With the lateral excavations the heads of the two anterior ribs articulate.

So much for the general characters of this bone. A front view (Plate VII. fig. 5) exhibits the following features, worthy of more particular description. The lateral mass, which represents the transverse process of the first of the three vertebræ, presents an elongated oval articular facet (*a*), convex from above downwards and looking almost

directly forwards, its long axis being horizontal and at right angles to the axis of the spinal canal. The facet is 1·8 inch long by 0·9 inch maximum height.

This articular facet is separated by a deep groove, into the bottom of which a large canal (*d*) opens, from two other articular surfaces (*b*, *c*), placed one immediately above the other, and also parted by a deep channel, which may be regarded as an internal branch of the groove.

The lower articular face (*c*), almost flat, looks inwards and forwards; and its long axis, which continues the direction of the floor of the neural canal, is inclined from above downwards and outwards.

The upper facet (*b*), also flat, and, elongated transversely, looks directly upwards. Its inner end is nearer the lower facet than its outer end; and a well-marked fossa or depression lies behind it. The upper articular surface certainly answers to the anterior oblique process or "prezygapophysis" of the seventh cervical vertebra. The nature of the lower and of the outer facet will only become obvious when the characters of the cervical vertebræ of recent Armadillos have been explained. The anterior face of the spinous process of the trivertebral bone exhibits two ridges, each convex towards the middle line, which divide the face into a middle and two lateral areæ.

The upper face of the bone (Plate VII. fig. 3) presents three pairs of foramina, terminating internally in canals which lead into the spinal canal, and externally opening into recurved grooves on the surface of the bone. The middle apertures are the largest, and the corresponding grooves more strongly defined and wider. The posterior apertures are smallest, and are situated quite close to the hinder margin. The surface of the bone between these apertures is rough and irregular. The margins of this face of the bone are produced into three processes which alternate with the foramina. The hindermost of these processes is the largest, and ends in a point which is somewhat recurved and bent down.

A side view of the trivertebral bone (Plate VII. fig. 6) shows that these processes are continued into irregular vertical ridges, between which two fossæ are enclosed. Of these, the anterior is much deeper and more capacious than the other. It is an irregular cavity subdivided by a vertical ridge into two, each of which presents a somewhat deeper fossa at its inner and lower end.

The second, shallower, fossa, which lies between the hinder face of the middle process and the front face of the posterior process, presents an elongated irregular articular facet on its anterior wall, and a more rounded articular surface on its posterior wall.

The second rib is received into this fossa, and articulates with both these facets.

The posterior face of the third process presents a small, slightly concave, oval articular face on its lower half, with which the third rib was doubtless connected.

The posterior aspect of the trivertebral bone (Plate VII. fig. 4) presents for notice, besides the features already mentioned, several others. The neural arch of the hindermost vertebra of the three overhangs; and its under face exhibits two oval slightly concave articular faces (*a*, *a*), the posterior oblique, or "postzygapophysial," surfaces of the

second dorsal vertebra. These, however, are not carried upon distinct processes. The great spinous process seems completely to fill up the interval which properly exists between the postzygapophyses. The posterior face of this process is slightly excavated in the middle of its lower half. Its sides are also a little concave, so that the top swells out into a sort of knob with overhanging margins.

The posterior part of the floor of the trivertebral bone is broken away; but the hinder face of each lateral mass exhibits a transversely elongated articular surface (*b*, *b*), concave from above downwards, so as to resemble a segment of a hollow cylinder, the axis of which is directed from within outwards and very slightly backwards.

The inferior face of the trivertebral bone presents the arched surface, flatter behind than in front, of the continuously ossified central portions or bodies of the vertebræ, and, external to these, two pairs of apertures which perforate this face of the bone at its outer margin. The anterior of these apertures is very much larger than the posterior, and corresponds with the inner end of the middle transverse process, opening just behind the inner end of the first rib. Strictly speaking, the foramen seen upon the front face of the bone (Plate VII. fig. 5, *d*) forms one of this series of foramina (all of which are the terminations of short passages leading into the spinal canal); so that, as upon the upper, so on the under surface of the trivertebral bone, there are three pairs of foramina in communication with the spinal canal, and of these the middle pair are, in each series, the largest.

The homologies of the three vertebræ which compose the trivertebral bone are determined by the implantation of the head of the first rib into the great fossa between the lateral processes of the first and second. The vertebra which yields the anterior wall of the fossa is clearly the last cervical, and that which furnishes the posterior wall is the first dorsal. Hence the trivertebral bone is composed of the last, or seventh, cervical and the first and second dorsal vertebræ.

The remaining Dorso-lumbar Vertebræ.—Of these vertebræ thirteen are preserved. The anterior twelve have plainly been immoveably united together into a continuous arched tunnel or tubular bridge of bone, partly by anchylosis and partly by the manner in which their apposed surfaces interlock (Plate VIII. figs. 1–7).

The four anterior vertebræ (figs. 1, *d. l.* 3, 4, 5, 6) are so completely anchylosed together that almost all traces of their original distinctness are lost. Persistent sutures, of a character intermediate between a "harmonia" and a serrated suture, separate the fourth vertebra (*d. l.* 6) from the fifth, and the latter from the sixth; but the sixth and the seventh (*d. l.* 9) are completely fused into one bone. Between the eighth and ninth vertebræ a suture is interposed, and also between the ninth and the tenth, at least on the left side. The tenth and the eleventh (*d. l.* 13) are completely anchylosed above, while the suture seems to have persisted below*.

* It is convenient to speak of the first, second, &c. of the thirteen vertebræ which succeed the trivertebral bone; but it must be recollected that the first of these is the third of the dorso-lumbar series, the second the fourth dorso-lumbar, and so on, the number of any one of these vertebræ in the dorso-lumbar series being

Thus far, no trace of distinct articular processes is visible upon these vertebræ; but the hinder face of the eleventh vertebra (*d. l.* 13) presents certain irregular elevations and depressions, which interlock with corresponding ridges and cavities of the anterior face of the twelfth vertebra. The hinder face of the twelfth (*d. l.* 14) and the front face of the thirteenth vertebra (*d. l.* 15) are in like case. I shall return to the consideration of the character of these irregular articular elevations and depressions after describing the general form of the vertebræ.

In all but the first, second, third, eleventh, and thirteenth vertebræ, the parts representing the vertebral centra are broken away, but, when they remain, they are so similar to one another that their form was, doubtless, essentially the same throughout. Each centrum is a comparatively thin bony plate, bent so as to be convex downwards and concave upwards, and presenting a much flatter curve in the anterior than in the posterior part of the column. In front, the central plate is not more than 0·1 inch thick in the middle, but it becomes thicker posteriorly, so that the centrum of the eleventh vertebra is 0·45 inch thick; that of the thirteenth vertebra is 0·1 inch thinner. At the sides and above, the curved central part of the vertebra passes into the lateral processes and upper arches, which last are slightly concave downwards in the first vertebra, flat in the middle vertebræ, and somewhat arched again in the thirteenth. The contour of a transverse section of the spinal canal is a transversely elongated oval in the first vertebra (fig. 3), is more nearly round, but flattened at the top, in the middle vertebræ (*d. l.* 12), and is a vertically elongated oval in the thirteenth vertebra (*d. l.* 15).

The spinous and transverse processes of the vertebræ are represented by three crests or ridges of bone. One of these (Plate VIII. fig. 2, *a*, *b*), vertical, and situated in the middle line of the dorsal surfaces of the arches of the vertebræ, represents the spinous processes; while the lateral crests (*c*, *c*), directed obliquely upward and downwards, answer to transverse, accessory, and mammillary processes. As the latter ridges become directed more upwards towards the hinder part of the dorsal region, the total width of the column lessens, and the grooves between the middle and the outer ridges become deeper in the same direction. Thus, anteriorly, the column is fully six inches broad, while at the eleventh vertebra the distance from one external ridge to another is hardly half this amount.

The first vertebra (*d. l.* 3) is as broad and depressed as the trivertebral bone. Viewed in front (Plate VIII. fig. 3), the neural canal is seen not to take up more than one-fourth of the face of the bone, the rest of which is occupied by two broad expanded transverse processes, directed very slightly upwards as well as outwards. The under half of each of these processes presents an elongated articular facet (*a*, *a'*), convex from above downwards, slightly concave from side to side, which corresponds with, and is received into, the concave articular surfaces upon the hinder face of the trivertebral bone.

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always greater by two than its number reckoned as one of the thirteen. In order to avoid confusion in describing each vertebra, I shall occasionally give after it its number in the dorsal lumbar series, *e. g.* (*d. l.* 3), (*d. l.* 6), by which it is indicated in the figures.

Seated upon the upper face of the neural arch are two other oval articular surfaces (*b*, *b'*), which answer to the postzygapophysial surfaces upon the under surfaces of the hinder part of the neural arch of the trivertebral bone.

The inner part of each of these articular faces is convex in all directions; the outer is concave from side to side, convex from before backwards; behind each lies a transverse fossa.

The outer ends of the transverse processes are obliquely truncated, and each presents two articular facets, an anterior and inferior, larger, and a posterior and superior smaller, which articulate with corresponding facets upon the capitulum and tuberculum of the attached rib. A well-marked notch separates the hinder face of the transverse process of the first from that of the second vertebra; and the intervertebral foramen is situated on the same level as this notch, on the one hand, and the anterior inferior facet, on the other, or about halfway between the upper and lower faces of the bone.

The transverse process of the second vertebra (*d. l.* 4) presents two oval articular facets for the head of a rib, more nearly equal and more nearly on a level than those of the first vertebra. The transverse process of the third vertebra is broken on the left side; but on the right side, traces of an elongated costal facet are visible.

The ends of the lateral ridges representing the transverse processes of the fourth, fifth, sixth, and seventh vertebræ are broken away.

In the eighth, ninth, tenth, and eleventh vertebræ (Plate VIII. fig. 7, *d. l.* 10, 11, 12) they are preserved on the left side, broken away on the right; on the twelfth vertebra the corresponding ridges are broken on both sides.

I find no trace of articular surfaces for ribs on the lateral ridge continued along the eighth, ninth, tenth, and eleventh vertebræ, which, as I have stated, is entire on the left side; but the upper and inner surface of the ridge is rounded and marked by longitudinal striations (fig. 7). The outer surface is rough and irregular, opposite the anterior part of each vertebra, and raised into an irregular tubercle posteriorly.

The spinous processes of all the vertebræ are broken short off; that of the first is almost obsolete, being a mere ridge sloping back towards the second, into which it is continued. The anterior edge of the process is so much inclined backwards and upwards as to afford free play to the knobbed head of the spinous process of the trivertebral bone (fig. 2).

The spinous process of the second vertebra (*d. l.* 4) is 0·4 inch thick where it is broken through, and had probably a considerable height. A distinct interval separates it posteriorly from the thin anterior edge of the spinous process of the third vertebra, which is much thinner, and is anchylosed with its successors, as far as the eleventh inclusive, into a long continuous crest; slight traces of the original separation of the several spinous processes, however, are visible at the base of the crest, and they may have been distinct at their apices. The crest gradually increases in thickness to the sixth vertebra (*d. l.* 8) (where it attains 0·75 inch), and then gradually diminishes. The spinous process of the twelfth vertebra (*d. l.* 14) may have been distinct down to its

base; and the posterior edge of the thin ridge, which is all that is left of the process, appears to incline upwards and forwards.

The foramina for the exit of the spinal nerves are not intervertebral in the ten anterior vertebræ, but perforate the bony substance of each vertebra nearer its posterior than its anterior boundary. Of these foramina there are two, on each side, for the five anterior vertebræ; one, larger, below the lateral apophysial ridge; and one, smaller, above, or upon, this ridge at the posterior boundary of each vertebra.

The larger foramen approaches the outer margin of the apophysial ridge, or seems to be situated higher up, in each successive vertebra from the first to the seventh. Beyond this point the level of the foramen descends somewhat. The eleventh vertebra (*d. l.* 13) appears to have possessed a simple intervertebral notch posteriorly, on the left side; but, on the right, a bar of bone is preserved, separating an anterior foramen from the rest of the notch, which receives a process of the twelfth vertebra. The arrangement appears to be the same in the twelfth vertebra (*d. l.* 14); that is to say, the apparent notch has been divided by a bar of bone into an anterior nervous foramen, and a posterior articular fossa.

I have briefly referred, above, to the articular surfaces of the eleventh and twelfth vertebræ, which are exceedingly irregular and distorted, apparently from partial anchylosis and filling up with osseous matter. A notion of their general character may best be obtained by the study of the posterior face of the twelfth vertebra (*d. l.* 14). On the upper part of the neural arch, on each side of the spine of this vertebra, irregular and partially obliterated posterior oblique processes, or postzygapophyses, are discernible. The zygapophysis is separated by a depression, or groove, directed from without obliquely downwards and inwards, from a wedge of bone which terminates the apophysial ridge. Inferiorly and externally, this wedge presents a slightly concave articular facet, separated by a deep fossa from a tuberosity with a rounded surface, which passes down into the body of the vertebra. On the same level as this fossa, there projects from the front surface of the vertebra a triangular process, which fits into a corresponding fossa of the eleventh vertebra. The front face of the thirteenth vertebra (*d. l.* 15), again, presents, on each side of the neural spine, pits, the floors of which answer to the anterior oblique processes, or prezygapophyses; outside of these are ridges, which fit into the fossæ between the postzygapophysis of the twelfth vertebra and the wedge-shaped process; external to the ridges are fossæ which receive those wedge-shaped processes; and external to and below these, again, are the remains of processes which were received into the deep fossæ mentioned above.

Except in the region of these articular processes, neither the anterior nor the posterior ends of the thirteenth vertebra (Plate VIII. figs. 6 & 7, *d. l.* 15) are entire. Of the spinous process, only the base is left; it thins off anteriorly to a natural edge, which is inclined upwards and backwards, and seems to have been quite free. Posteriorly, it becomes rapidly thicker; but its mode of termination cannot be ascertained. The large nervous foramen perforates the wall of the vertebra, on a level with the articular pro-

cesses, and bifurcates externally, so that one of its apertures ends above, and the other below, a stout bar of bone (Plate VIII. fig. 6, *a*), nearly an inch thick, which ends posteriorly in a raised curved ridge, forming the anterior boundary of a semicircular groove.

The spinal canal in the thirteenth vertebra is, as I have said, oval in shape, the long diameter of the oval (1·5 inch in length) being vertical, the short diameter (1·1 inch) transverse.

As, in the anterior part of the lumbo-sacral region, this canal has a very different shape, it is probable that two or three vertebræ are wanting in this portion of the spinal column.

The Sacrum and Coccygeal Vertebræ.—The "sacrum," composed of anchylosed lumbar, proper sacral, and coccygeal vertebræ, contains at fewest twelve, and perhaps thirteen vertebræ. The centra of the two hindermost lumbar vertebræ and of the two proper sacral vertebræ, which follow them (Plate IX. fig. 2), are thin and broad bony plates, flat above, and slightly concave from side to side below, exhibiting a most marked contrast to the semicylindrical form of the same part in the hindermost of the thirteen vertebræ described above. The plane of the plate formed by the centra of the anchylosed lumbar vertebræ is inclined, upwards and forwards, to pass into the general curve of the dorso-lumbar region. The plane of the centra of the two succeeding sacral vertebræ, on the other hand, is horizontal; and it is obvious, from the characters of the rest of the sacrum, that the centra of the following vertebræ, to the end of the sacral region, were arranged in an almost semicircular curve, the chord of which is about 18 inches long (Plate IX. fig. 3). The posterior face of the hindermost coccygeal vertebra (Plate IX. fig. 1, *a*) is broad, oval, and very slightly concave, like the face of an ordinary vertebral centrum; but the centrum of the penultimate coccygeal vertebra is much flatter and narrower; and this flattening and narrowing become still more marked in the centrum of the antepenultimate vertebra and of that which precedes it, or the fourth from the end. From this point to the two anterior sacral vertebræ the floor of the sacral canal is completely broken away, but there can be little doubt that the missing centra were represented by a broad and flat bony plate.

The neural arches are but imperfectly preserved, except in the lumbar region and the anterior part of the sacrum. They are thin, and are separated by large intervertebral foramina. In the lumbar vertebræ these foramina pass downwards and backwards into grooves which mark the sides of the central plate. Well-defined depressions upon the sides of the sacral crest lead upwards and backwards to the canals which pass between that crest and the ilia.

The four last coccygeal intervertebral foramina are still larger, and indicate the passage of large nerves to the muscles moving the tail.

The spinous processes of all the vertebræ which enter into the sacrum, up to the fourth from the end inclusively, are anchylosed together into a long and strong osseous crest (Plate IX. figs. 3 & 4), which expands above, so as to present a broad and very rugged superior face. This crest is 8 inches high in front, but slowly diminishes as it follows

the curve of the centra posteriorly, to 5 inches. The spinous process of the penultimate coccygeal vertebra is very thick, but it is broken short off. It was probably not less than 4 inches high, and afforded a middle point of support for the dermal shield between the ischial protuberances (Plate IX. fig. 1).

The sides of the two anterior sacral vertebræ and the corresponding part of the sacral crest are anchylosed with the inner edges of the iliac bones, so that only a narrow oval space, left between these parts, near the upper edge of the crest, and the small canals above mentioned, allow of any communication between the region in front of, and that behind the ilia.

Behind this point the vertebræ are devoid of transverse processes as far as the fourth from the end. But the antepenultimate had a long and slender transverse process on each side; the penultimate possesses an equally long but much stouter process, and the last coccygeal vertebra has extremely thick processes of the same length. The enlarged distal ends of these processes unite with one another and with the inner surfaces of the ischia (Plate IX. figs. 1, 2, 4).

Caudal Vertebræ.—No caudal vertebræ existed among the remains of this specimen of *Glyptodon*.

Of the Vertebral Column as a whole.—It appears from the foregoing description that the atlas of the *Glyptodon* was moveable upon the odontoid vertebra; but that the latter was anchylosed with the third and fourth cervical vertebræ into one short bone, moveable upon the fifth cervical; of the fifth and sixth cervical vertebræ no remains exist. The seventh cervical is anchylosed with the first and second dorsal into a single "trivertebral bone," upon the front part of which the sixth cervical was certainly moveable; while the hinder part of it freely articulates with the third dorsal, so that the bone was capable of motion through a certain vertical arc.

Beyond this point, as far as the fourteenth dorso-lumbar vertebra, the vertebræ are so connected by complete, or partial, anchylosis, that it is impossible any motion should have taken place between them; and it is probable, though not so certain, that the fifteenth dorso-lumbar vertebra was similarly fixed.

Between this and the two hindermost lumbar vertebræ, which are completely anchylosed together and with the sacral vertebræ, there is a hiatus, but the condition of the two latter is not such as to lead to the supposition that the intermediate vertebræ were less firmly united than they.

The free cervical portion of the vertebral column must have been remarkably short, probably not exceeding 8 inches in length, and the cervical vertebræ were most likely arranged in a nearly straight line.

The trivertebral bone and the thirteen following dorso-lumbar vertebræ, when articulated together, form one great curve, concave downwards or towards the visceral cavity, the curve being much sharper in the anterior than in the posterior part of the column. Measured along its curvature, this part of the vertebral column is about 35 inches long.

At the anterior part of the sacral region the lumbar curve passes into the straight

line of the two anterior sacral vertebræ, behind which commences the great sacro-coccygeal curve, concave towards the cavity of the pelvis. The lumbo-sacral is very nearly as long as the dorso-lumbar region, so that the vertebral column, from the last cervical to the last coccygeal, may be said to form two subequal arches with a common pier, formed by the proper sacral vertebræ.

Description of the Plates.

PLATE IV.

Figs. 1 & 3. Upper and under views of the skull of the "new specimen" of *Glyptodon clavipes*.

Figs. 2, 4, & 5. Upper, under, and side views of the hinder part of the skull of the "typical specimen" of *Glyptodon clavipes*.

All reduced to one-half the natural size.

PLATE V.

Fig. 1. Side view of the skull of the new specimen of *Glyptodon clavipes*.

Fig. 2. The left half of the mandible of the same, one-half the natural size.

Fig. 2^a. The ascending ramus of the mandible, viewed from behind.

Figs. 3 & 4. Grinding-surfaces of the teeth, of the natural size.

PLATE VI.

Fig. 1. Front view, and

Fig. 2. Back view of the skull of the new specimen of *Glyptodon clavipes*.

Fig. 3. View of the occipital face of the skull of the typical specimen.

Fig. 4. Front view, and

Fig. 5. Upper view of the mandible of the new specimen.

All reduced to one-half the natural size.

PLATE VII.

Figs. 1 & 2. Front and back views of the fragment of the atlas.

*** The artist has inadvertently inverted each figure, so that the lower side of the bone is turned upwards, and *vice versâ*.

Fig. 3. The trivertebral bone, seen from above.

Fig. 4. The trivertebral bone, from behind; *d*, the first rib, in place.

Fig. 5. The trivertebral bone, from in front.

Fig. 6. The trivertebral bone, viewed from the right side.

Fig. 7. The fragment of the first rib of the right side, viewed from without.
Figs. 8, 9, 10. Front, inner, and outer views of the fragment of the third left rib.

PLATE VIII.

Fig. 1. The third to the ninth dorso-lumbar vertebræ, viewed laterally.
Fig. 2. The same, viewed from above.
Fig. 3. The anterior face of the third dorso-lumbar vertebra.
Fig. 4. The posterior face of the sixth dorso-lumbar vertebra.
Fig. 5. The anterior face of the twelfth and thirteenth dorso-lumbar vertebræ. It is much mutilated, especially below and on the left side, none of the centrum of the twelfth vertebra remaining.
Fig. 6. The tenth to the fifteenth dorso-lumbar vertebræ, viewed laterally.
Fig. 7. The same, from above.

All reduced to one-half the natural size.

PLATE IX.

Fig. 1. Back view of the pelvis of *Glyptodon clavipes.*
Fig. 2. Front view of the same.
Fig. 3. Side view of the same.
Fig. 4. Upper view of the same.

All these figures are reduced to one-sixth the natural size.

Figs. 5–8. Outer, inner, back and under views of the fragment of the anchylosed odontoid, third, and fourth cervical vertebræ, one-half the natural size.

a the upper, and *b* the lower end of the bone in each figure, which is reduced to one-half the natural size.

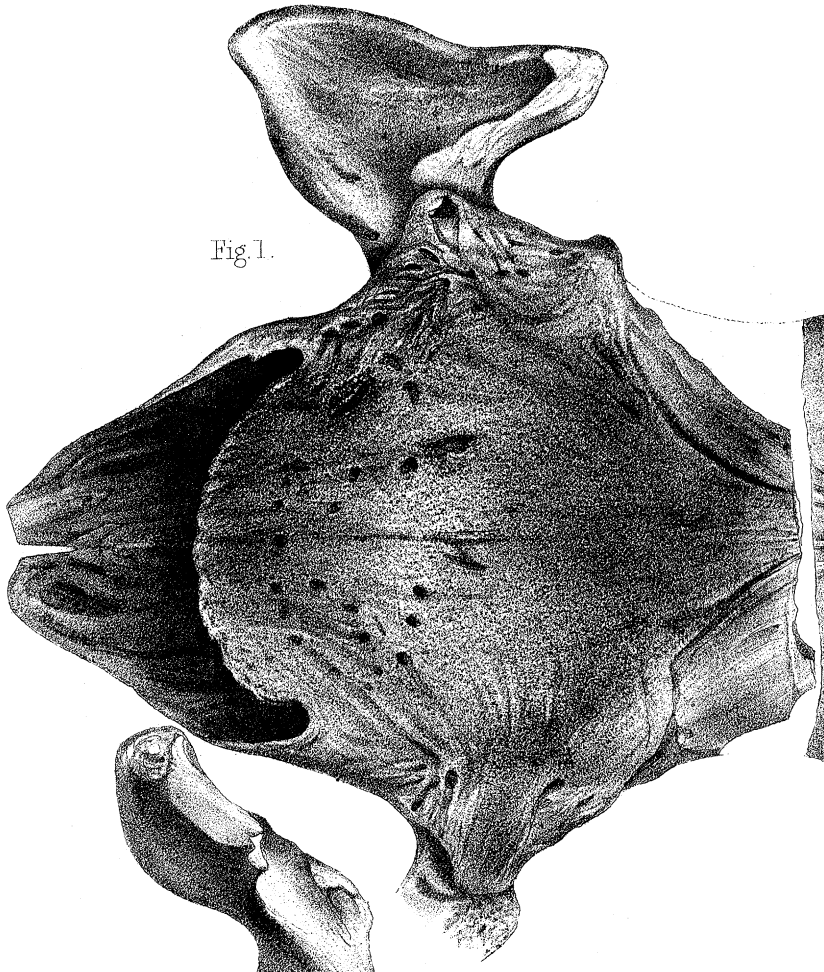


Fig. 1.

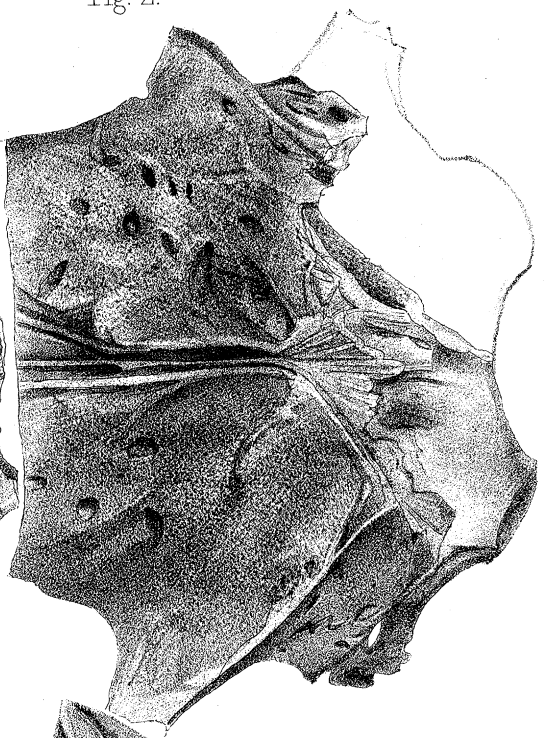


Fig. 2.

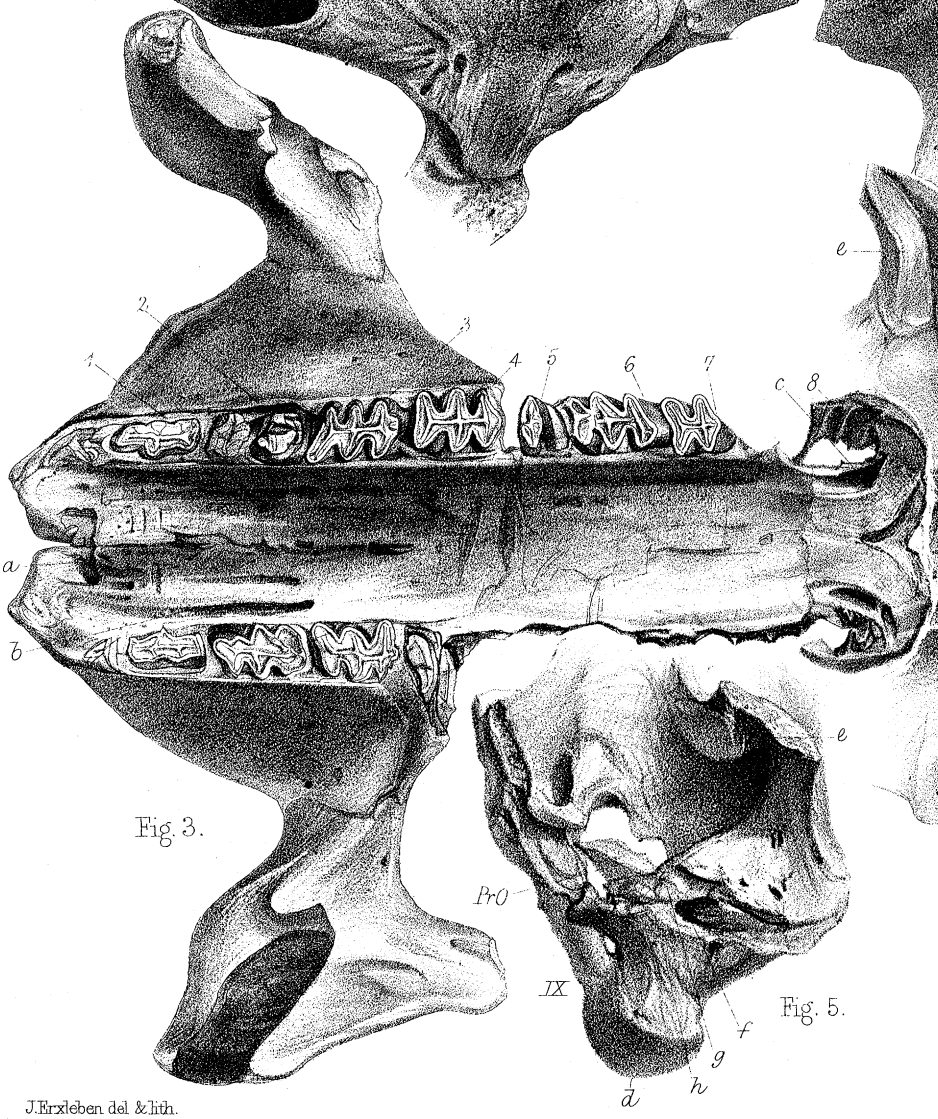


Fig. 3.

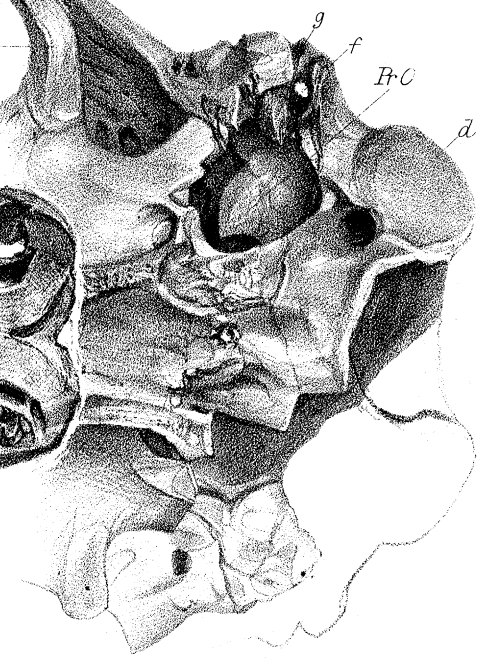


Fig. 4.

Fig. 5.

Fig. 1.

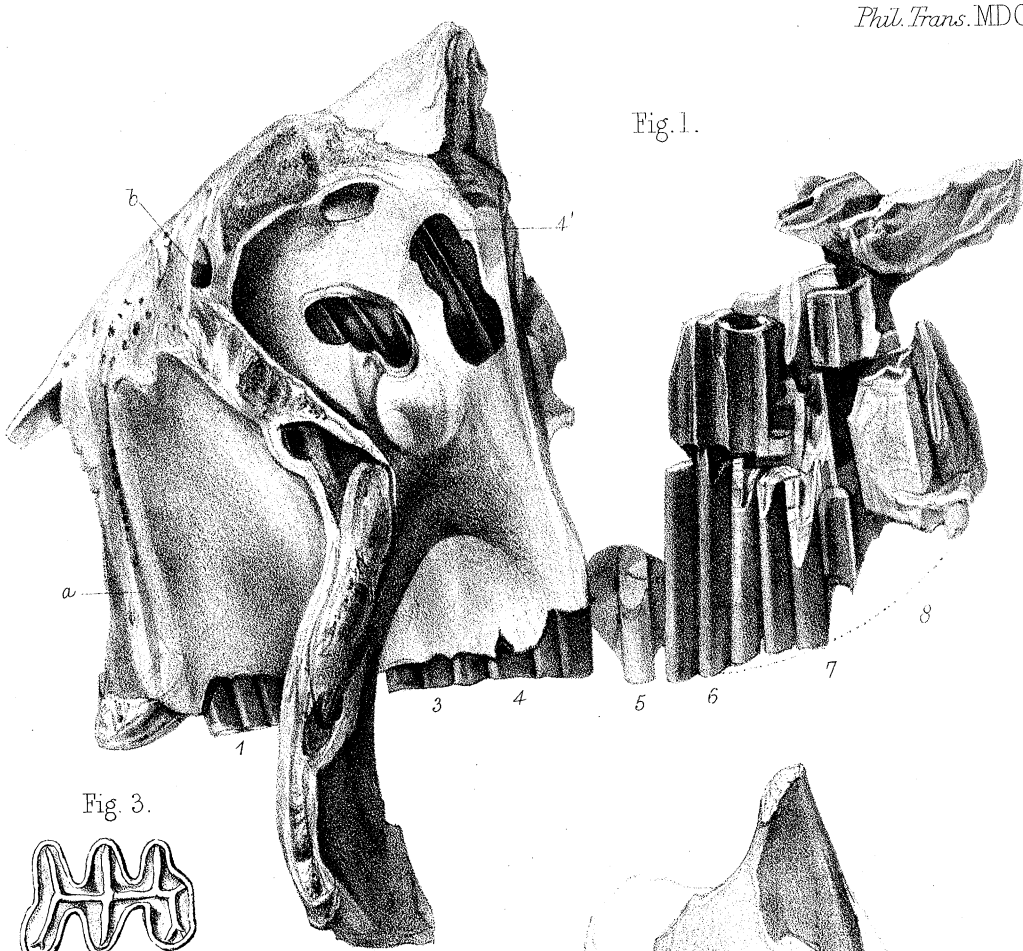


Fig. 3.

Fig. 4.

Fig. 2ª

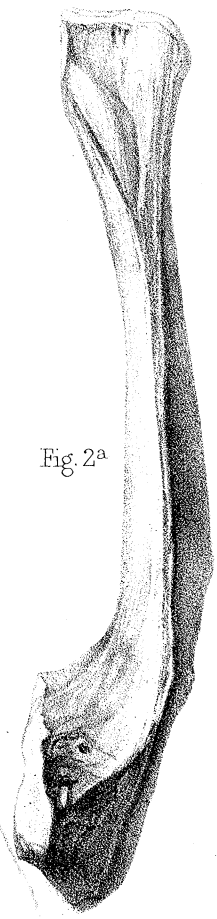


Fig. 2.

J. Erxleben del. & lith.

W. West. imp.

Fig. 2.

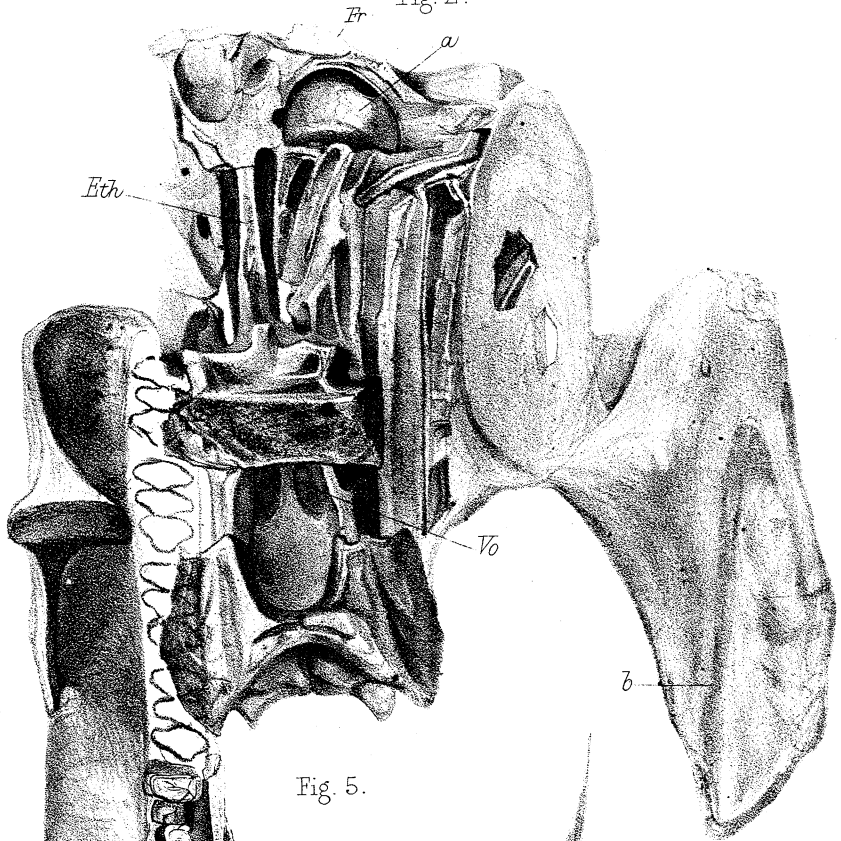


Fig. 1.

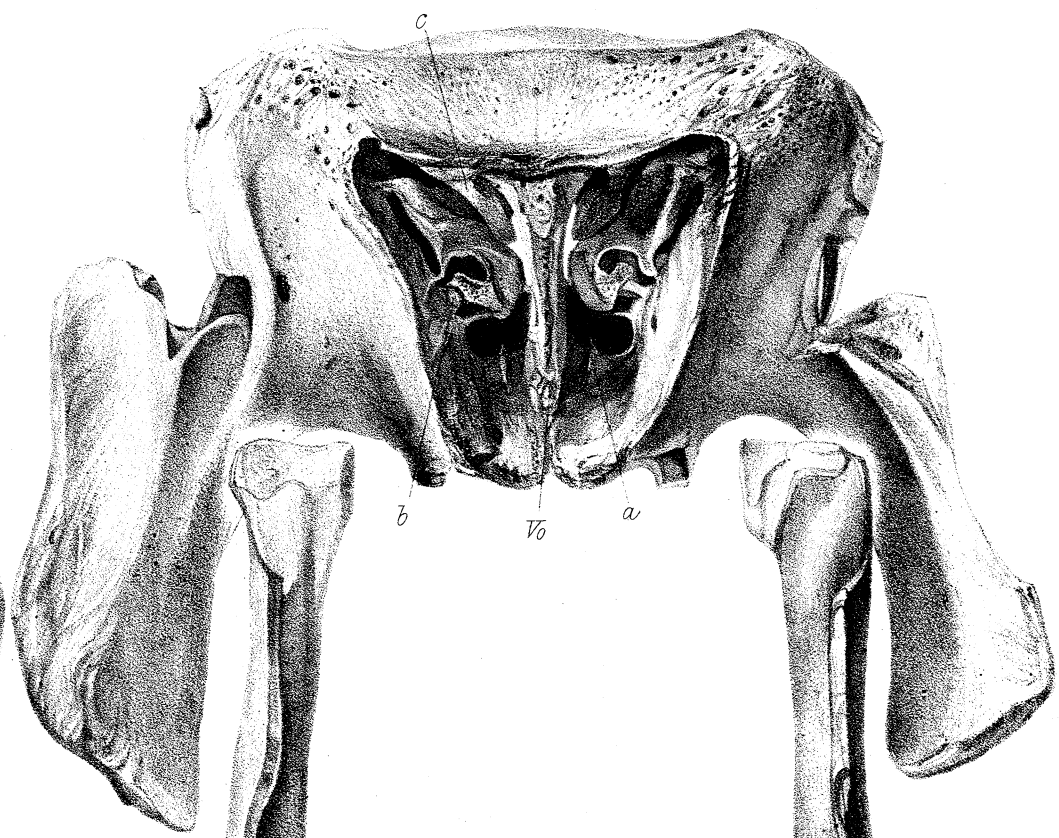


Fig. 5.

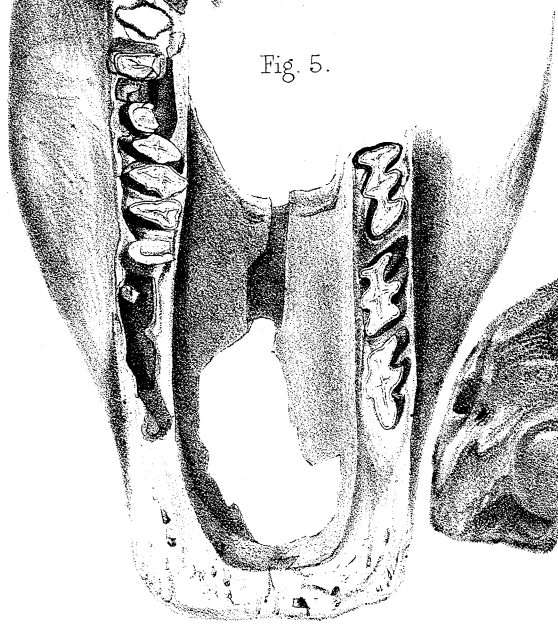
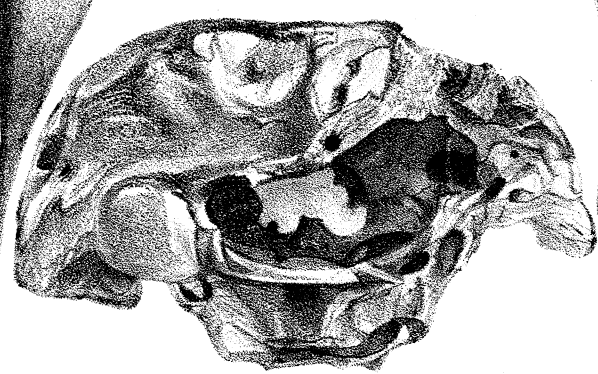


Fig. 3.



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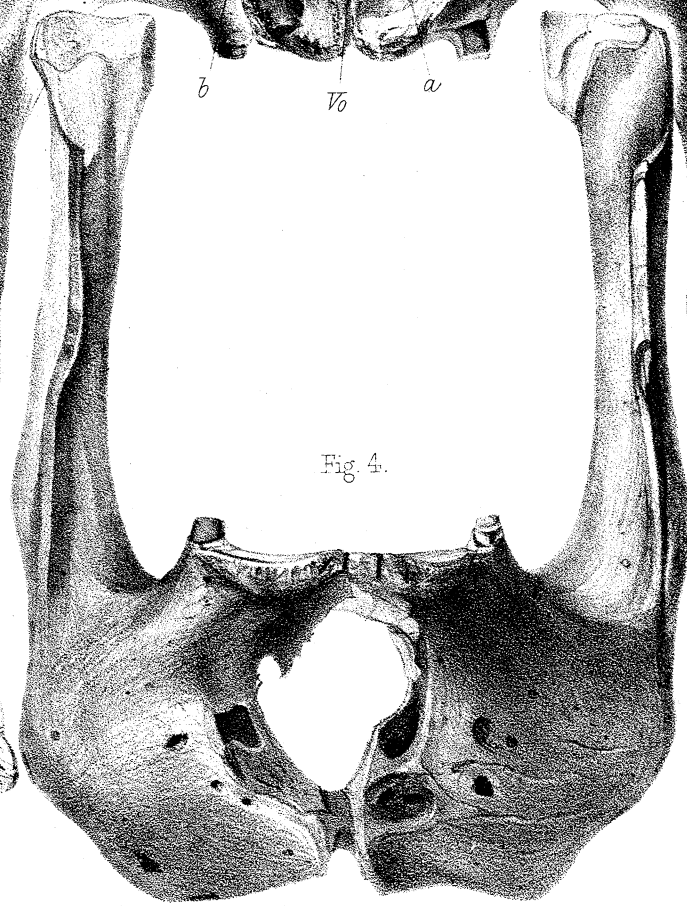


J. Erxleben del. & lith.

W. West imp.

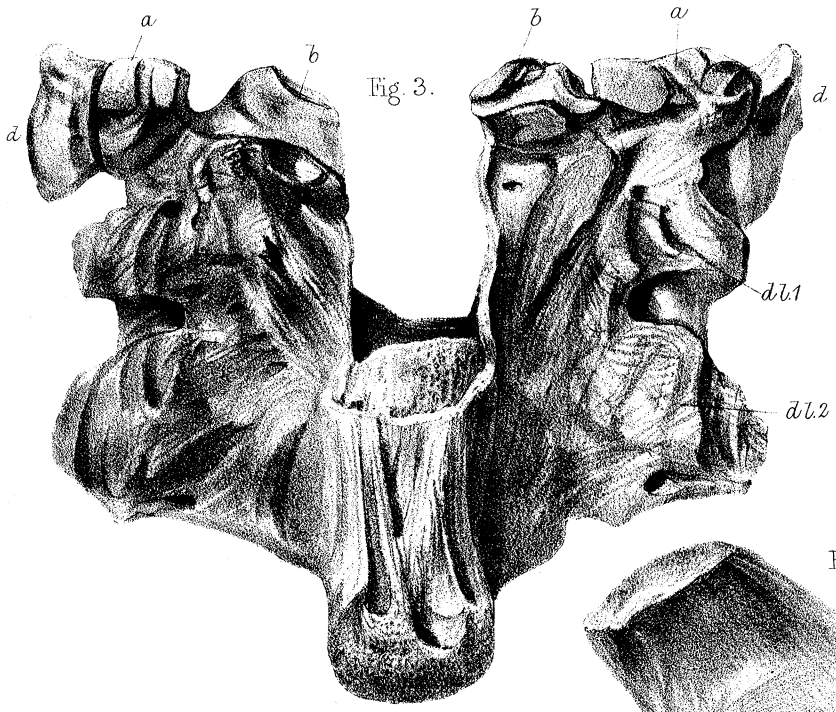


Fig. 3.

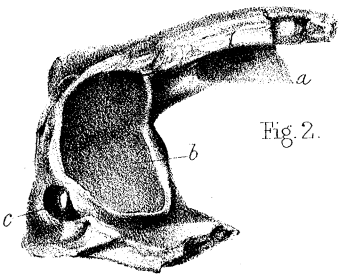


Fig. 2.

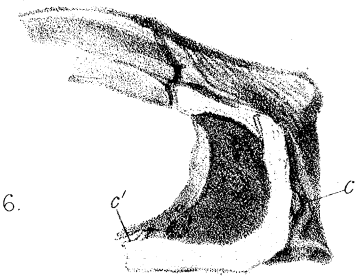
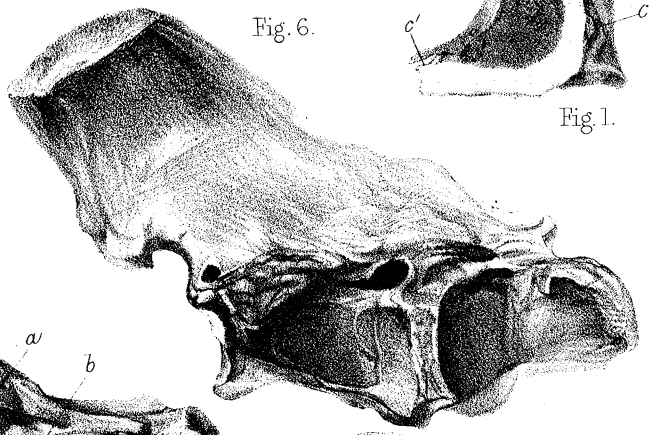
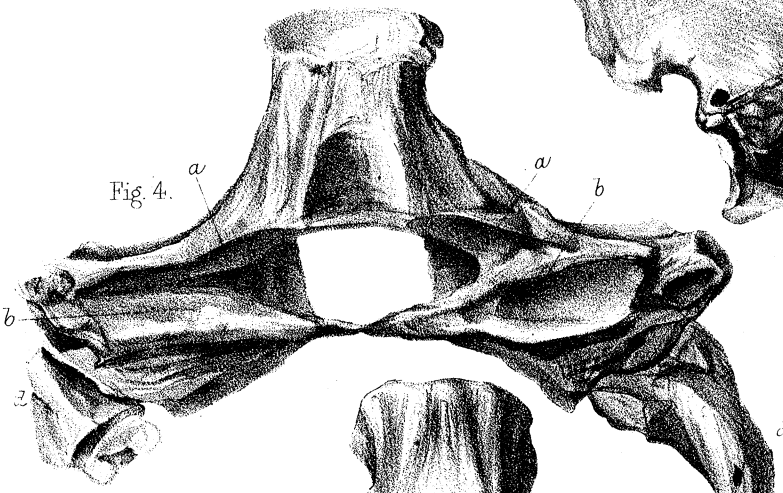


Fig. 6.

Fig. 1.





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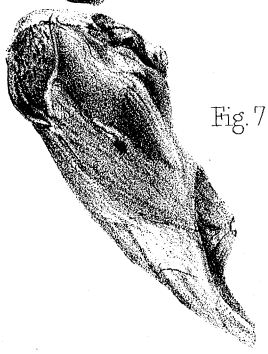

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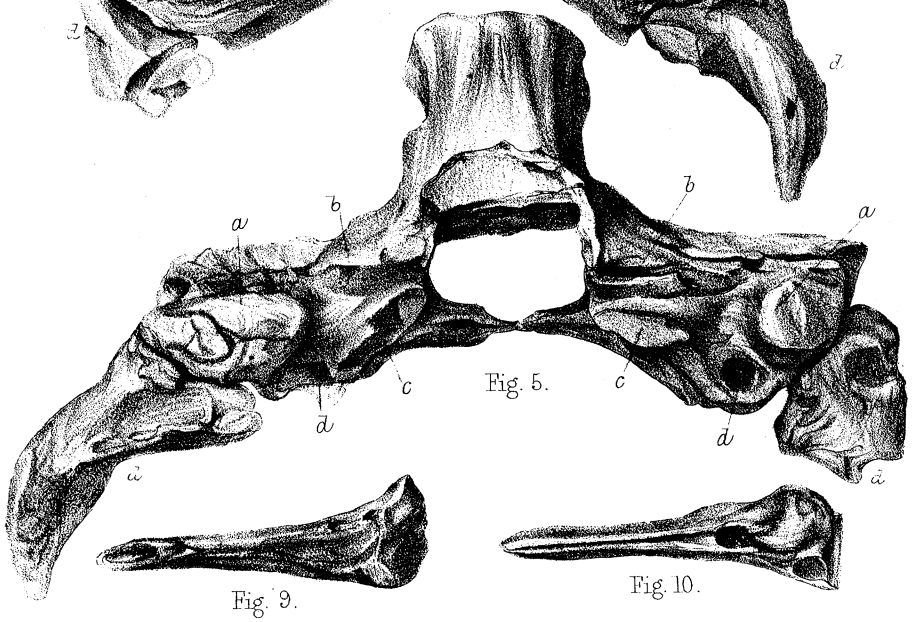

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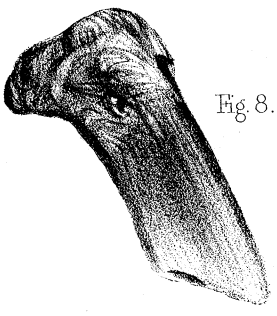


Fig. 8.

Fig. 9.

Fig. 10.

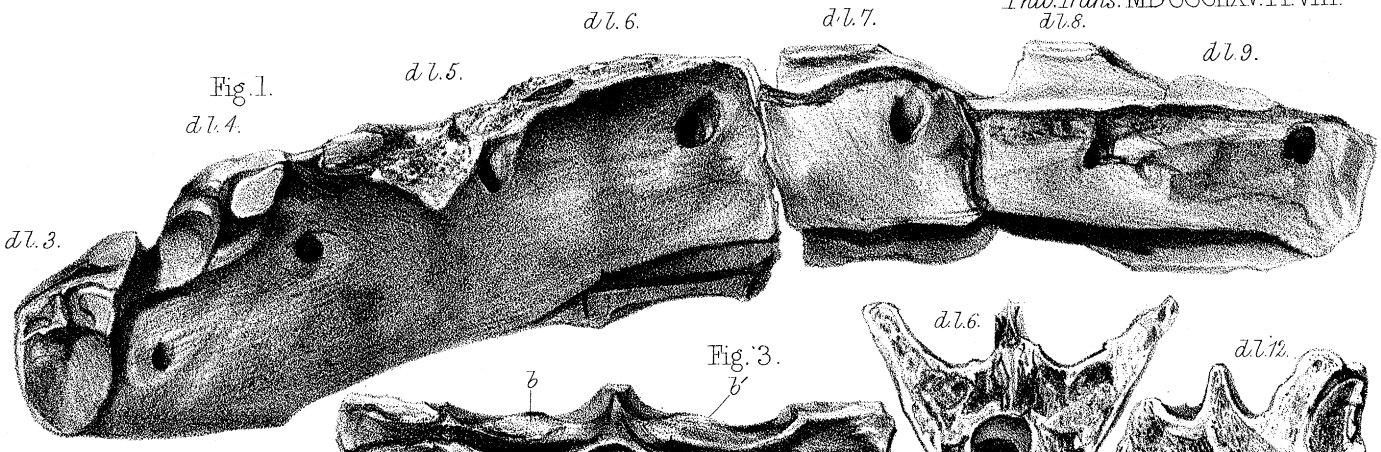


Fig. 1.

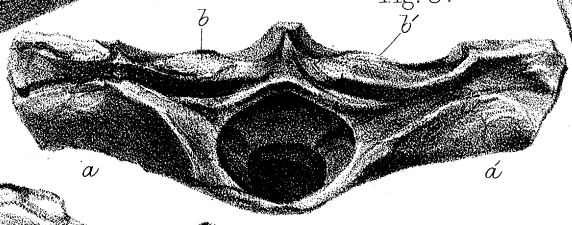
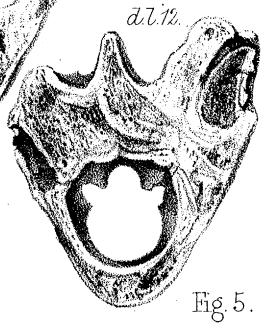


Fig. 3.

Fig. 4.



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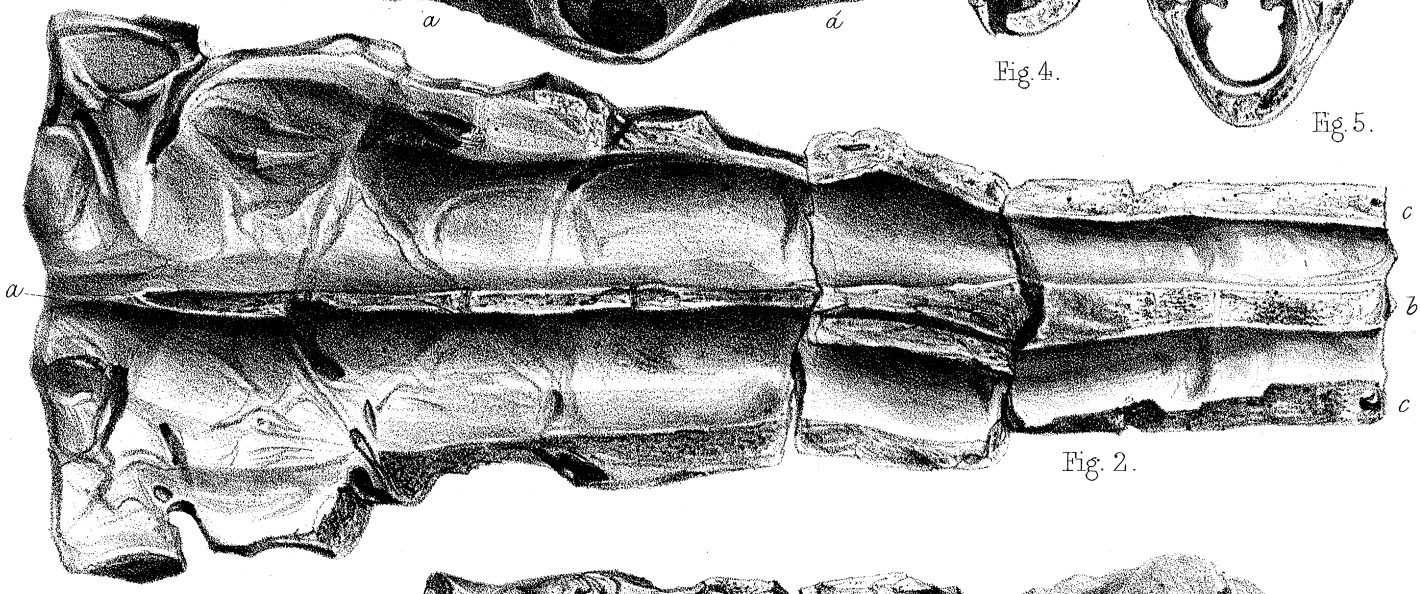

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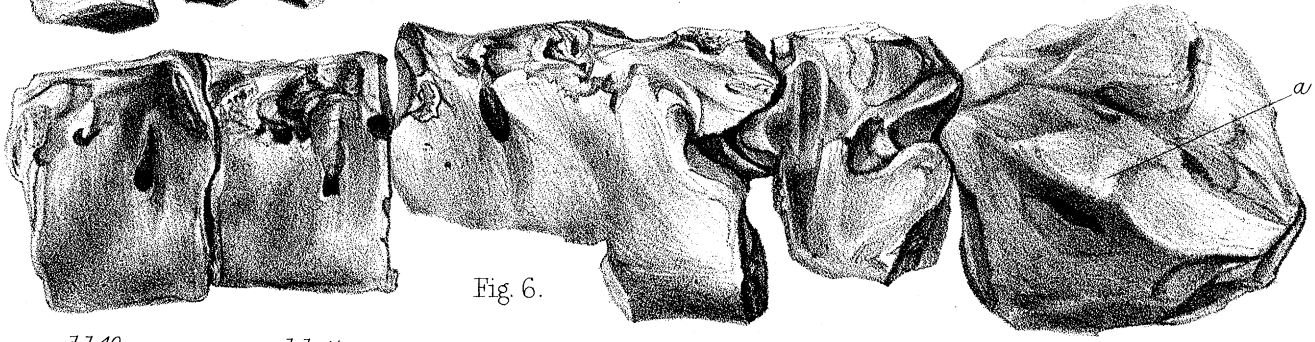

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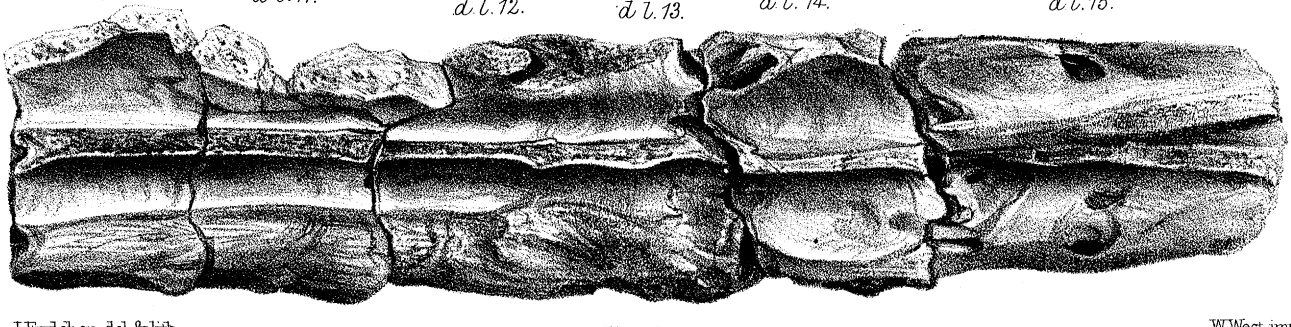


Fig. 7.

J. Erxleben del. & lith.
W. West imp.

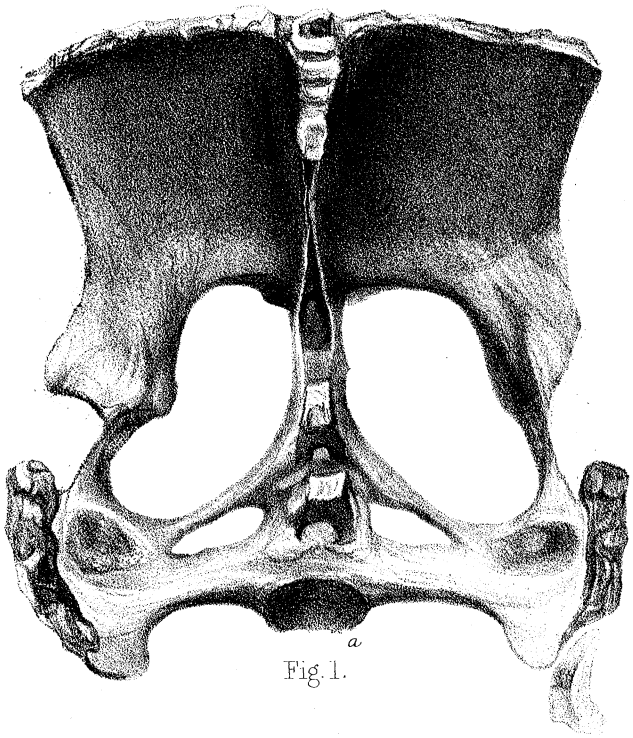


Fig. 1.

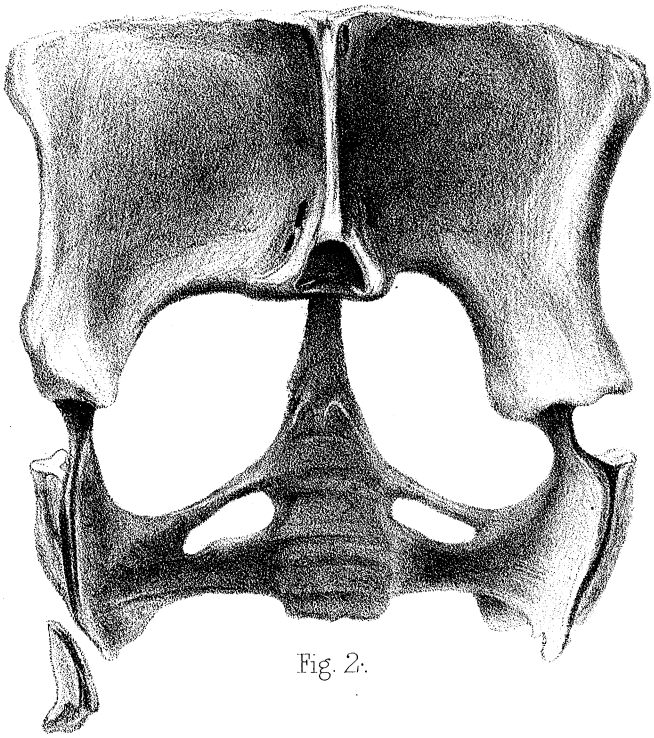
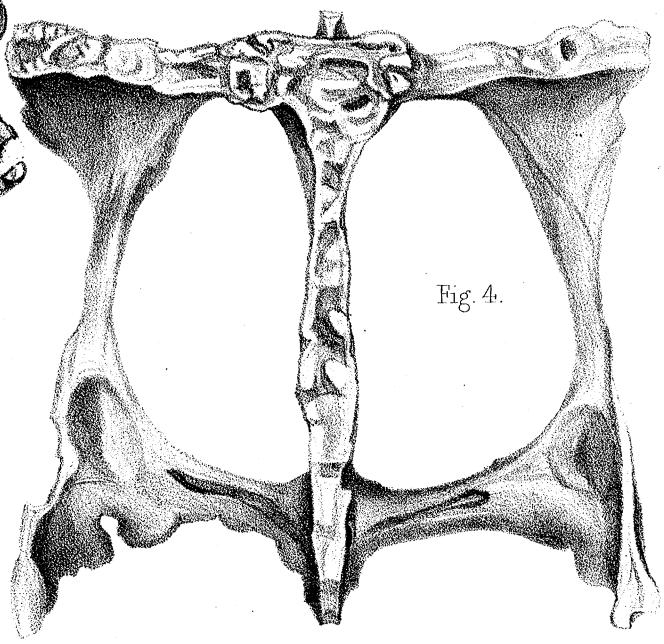


Fig. 2.

Fig. 3.



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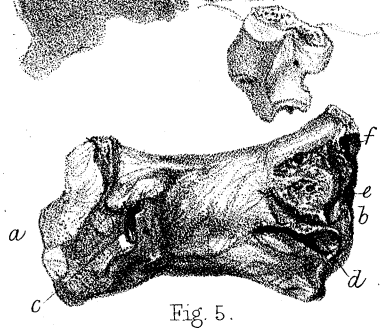

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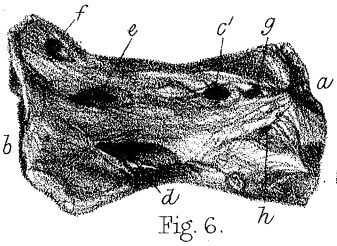

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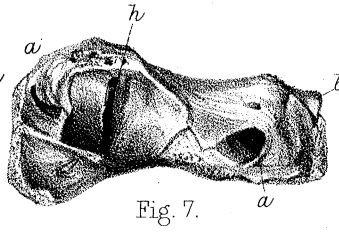

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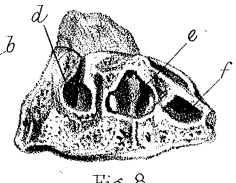

Fig. 8.

J. Erxleben del. & lith.

W. West imp.