XVI. *On the* MEGATHERIUM (Megatherium Americanum, CUVIER *and* BLUMENBACH). Part II.—*Vertebræ of the Trunk.* *By Professor* OWEN, *F.R.S. &c.*

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IN commencing the description of the skeleton of the Megatherium, now in London, Plate XVII., which is the most complete that has yet reached Europe, a brief statement may be premised of the chief steps which have led to the restoration of the species to which it belongs.

CUVIER, in communicating to the 'Annales du Muséum' (t. v. 1804) a translation of the first memoir on this subject—that, viz. by GARRIGA and BRU, published at Madrid in 1796,—gives all the requisite details respecting the discovery of the skeleton therein described, and adds his own more important deductions as to its affinities from an examination and comparison of the plates of the Spanish work.

It appears that proofs of these plates were transmitted in 1795 to the Institute of France, and that CUVIER, having been called upon by the 'Class of Sciences' at that period to give a report upon them, developed his views of the affinity of the animal to the *Sloths* and other *Edentates**, and proposed for it the name 'Megatherium†.'

M. ROUME, the correspondent of the French Institute to whom that distinguished scientific body were indebted for the proof impressions of GARRIGA's work, and who had an opportunity of examining the skeleton itself at Madrid (which CUVIER never enjoyed), inserted a brief notice of it in the 'Bulletin de la Société Philomathique' of the Republican year IV. (1795); in which, after particularly noticing that the pelvis was open towards the abdomen, the pubis being absent, without any indication of its having ever existed‡, concludes that the animal was intermediate, as to form, between the Cape Anteater (*Orycteropus*) and the Great Anteater of America (*Myrmecophaga jubata*). But he adds, that M. CUVIER, from an examination of the engravings of the skeleton, had recognized that the species was much more nearly allied to the Sloths than to the Anteaters.

* "Je développai dès-lors l'affinité de cet animal avec les *paresseux* et les autres *édentés*."—Annales du Muséum, t. v. p. 377.

† *μέγας great, θηρίον beast.*

‡ "Son bassin est composé des os sacrum, iléum et ischium, mais il n'y a point de pubis ni d'indication qu'il ait existé. Ce bassin est ouvert du côté de l'abdomen."—p. 97. It will be shown in this memoir that the supposed want of pubic bones was due to accidental mutilation of the pelvis of the skeleton at Madrid: the true profile of the pelvis is given at 62, 63, 64, Plate XVII.

M. Abildgaard, a professor at Copenhagen, having had the opportunity of studying the skeleton of the Megatherium at Madrid in 1793, published a short notice of it in Danish, illustrated by a rude figure of the skull and of the hind limbs, and referred the species to the *Bruta* of Linnæus, an order afterwards modified to form the *Edentés* of Cuvier: this notice, though published the year after Cuvier's Report, appears to have been independent of it, and the conclusions to be the result of the author's own observations and reflections. It is, therefore, to be regarded as an additional testimony to the true affinities of the species.

Cuvier's comments on the figures in the engravings for Garriga's memoir are accompanied by reduced copies of them, given in the above-cited volume of the 'Annales du Muséum,' and afterwards in the fourth volume of the first edition of the 'Recherches sur les Ossemens Fossiles,' 4to, 1812. In both works Cuvier sums up his conclusions as to the habits and food of the Megatherium, as follows:—"Its teeth prove that it lived on vegetables, and its robust fore-feet armed with sharp claws, make us believe that it was principally their roots which it attacked. Its magnitude and its talons must have given it sufficient means of defence. It was not of swift course, nor was this requisite, the animal needing neither to pursue nor to escape*."

In the year 1821 Drs. Pander and D'Alton published their beautiful Monograph on the Megatherium, the result of personal examination and depiction of the then unique skeleton at Madrid; they represent the bones more artistically and in more natural juxtaposition than in the plates of Bru's memoir, but the subject being the same, the same deficiencies, to be presently specified, were unavoidable.

As the accomplished and learned authors of the German work reasoned, like Abildgaard, from actual inspection of the fossil skeleton, their conclusions as to the nature, affinities and habits of the animal to which it belonged merit a respectful consideration. In it they recognize, with Cuvier, all the important points of resemblance to the skeletons of the existing species of Sloth, of which they append excellent figures. But, imbued with the principles of the transcendental and transmutative hypotheses, then prevalent in the schools of Germany, they regard the great Megatherium and Megalonyx as being not merely predecessors but progenitors of those still lingering remnants of the tardigrade race, into which such ancestral giants are supposed to have dwindled down by gradual degeneration and alteration of characters. But they deem the living habits of the Megatherium to have been far different from those of its puny scansorial progeny: it was, in their opinion, a fossorial animal; and not merely an occasional digger of the soil, as Cuvier concluded, but altogether

* "Ses dents prouvent qu'il vivoit de végétaux, et ses pieds de devant, robustes et armées d'ongles tranchans, nous fait croire que c'étoit principalement leurs racines qu'il attaquoit. Sa grandeur et ses griffes devoient lui fournir assez de moyens de défense. Il n'étoit pas prompt à la course, mais cela ne lui étoit pas nécessaire, n'ayant besoin ni de poursuivre ni de fuir." *Tom. cit.* 'Sur le Mégatherium,' p. 29. See also the posthumous edition of the 'Ossemens Fossiles,' 8vo, 1836, tom. viii. p. 363.

a creature of subterranean habits; some earth-whale, as it were, or colossal mole. PANDER and D'ALTON nevertheless give to this animal, which they truly characterized as one of the most extraordinary of its class, the name of 'Riesen-faulthier,' *Bradypus giganteus*, or Gigantic Sloth*.

CUVIER, in preparing his new and enlarged edition of the famous 'Recherches sur les Ossemens Fossiles,' availed himself, in the fifth volume, published in 1823, of the labours of the German anatomists and draughtsmen, just cited, and substituted copies of their figures for those which he had previously borrowed from BRU.

The teeth of the Megatherium are still described as being implanted by two roots, and as being sixteen in number, formulized as $m, \frac{4-4}{4-4}$: there is the same deficiency of the sternal ribs, pubic bones and tail; the manubrium sterni continues to be represented in a reversed position: but, with regard to the bones of the fore-foot, the organization of which was involved in obscurity, owing to the faulty manner in which CUVIER believed them to have been articulated, he endeavours to throw some new light on their arrangement. After a comparison of the figures given by PANDER and D'ALTON with the bones of the fore-foot in existing Edentata, CUVIER concludes that the fore-feet in the Madrid skeleton are transposed, the right being on the left, and the left on the right side; that the index, medius and annular digits were the only ones provided with claws; that the thumb was clawless, and the little finger rudimental and concealed, in the living Megatherium, under the skin; the hand being thereby specially formed for cleaving the soil and digging, like that of the *Dasypus gigas*. On this hypothesis, names are applied by CUVIER to certain bones of the carpus, none of which had before been determined†. CUVIER, however, adds, that "in order to verify his conjectures it must be necessary to have access to the skeleton itself, and to compare separately each bone of the fore-foot with their homologues in that species of Armadillo‡." His ideas of the affinities of the Megatherium have now undergone some modification: the following paragraph is added to the summary on this head given in the earlier edition of the great work:—"Its analogies approximate it to different genera of the Edentate family. It has the head and the shoulder of a Sloth, whilst the legs and the feet offer a singular mixture of characters peculiar to the Anteaters and Armadillos§." CUVIER concludes his account of the Megatherium in the second edition of the 'Ossemens Fossiles,' by appending a note communicated to him by

* Das Riesen-Faulthier, &c. fol. 1821, p. 16.

† Recherches sur les Ossemens Fossiles, 4to. t. v. pt. 1. 1823, p. 185. pl. 16. fig. 13. The letters indicative of the carpal bones have been omitted, by oversight, in the plates, but there is no difficulty in adding them according to the description given by CUVIER in the text.

‡ "Mais on sent que, pour vérifier ces conjectures, il faudroit être auprès du squelette, et en comparer séparément tous les os avec leurs analogues dans ce tatou, ce que j'espère que quelque anatomiste espagnol ne tardera pas à faire."—*Ib.* p. 185.

§ "Ses analogies le rapprochent des divers genres de la famille des édentés. Il a la tête et l'épaule d'un paresseux, et ses jambes et ses pieds offrent un singulier mélange de caractères propres aux fourmilliers et aux tatous."—*Ib.* p. 189.

M. AUGUSTE ST. HILAIRE, "which announces," he says, "that the Megatherium had pushed its affinity to the Armadillos so far as to be covered like them with a scaly cuirass."

This opinion derived apparent confirmation from the description by Professor WEISS of portions of an osseous tessellated dermal armour of some gigantic quadruped, sent to Berlin by the traveller SELLOW, which armour he figures, and attributes to the Megatherium, in a "Geological memoir on the Provinces of S. Pedro do Sal and the Banda Oriental," published in 1827*.

In the year 1832, a highly valuable and important collection of the bones of the Megatherium, discovered in the Rio Salado, with a portion of a bony tessellated dermal covering of an animal, found in Lake Averias, province of Buenos Ayres, indicative of a frame as great as that of the skeleton from the Rio Salado, was transmitted from Buenos Ayres by Sir WOODBINE PARISH, K.H., and presented by him to the Royal College of Surgeons. These specimens formed the subject of a memoir communicated by WILLIAM CLIFT, Esq., F.R.S., to the Geological Society, June 13, 1832†, in which, although, with the characteristic caution of the author, the armour is not directly affirmed to belong to the Megatherium, nothing is stated to prevent the inference that it formed part of the 'Remains' of that animal which it is the object of the memoir to describe: and, in the description of the map engraved in pl. 43, the specimen figured in pl. 46, with other portions of the bony armour, are comprehended amongst "those Remains of the Megatherium which have hitherto been sent to Europe‡." Further countenance to the later opinion of CUVIER as to the affinities of the Megatherium to the Armadillo, was afforded by a few remarks in the text of Mr. CLIFT's memoir: thus, in noticing the "bony or pseudo-cartilaginous pieces which unite the true ribs to the sternum," Mr. CLIFT adds, "as is also the case in the Armadillo §." And in the description of the caudal vertebræ, he remarks, "they have the inferior spines (*i. e.* the chevron or V-shaped bones), manifesting in this their relation to other Edentata, as the *Myrmecophagæ* and *Dasypodæ*‖."

The additional parts of the Megatherium, supplied by Sir WOODBINE PARISH, and deficient in the skeleton at Madrid, were two of the ossified cartilages of the ribs, two of the smaller bones of the sternum, twelve caudal vertebræ, and ten of the separate 'chevron bones,' partly belonging to them and partly indicating other caudal vertebræ: they also included a part of the os hyoides. Mr. CLIFT, with his accustomed ingenuity and artistic ability, gives at one view an idea of "all the parts hitherto known, or supposed to be known," of the Megatherium, by taking as his basis the outline of the view of the skeleton given by PANDER and D'ALTON in the first plate of their work; leaving in simple outline those parts which are present in

* Abhandlungen der Kön. Akad. der Wissenschaften zu Berlin, 1827.

† Geological Transactions, 2nd series, vol. iii. p. 437.

‡ *Ibid.* Description of the Plates. § *Ibid.* p. 439. ‖ *Ibid.* p. 444.

the Madrid skeleton, but not in Sir WOODBINE PARISH's collection; expressing by a pale tint the parts in that collection which also exist in the Madrid skeleton; and indicating by a dark tint the additional parts which are deficient in the Madrid skeleton, and had not before been figured.

Besides the important elements thus added towards the completion of our knowledge of the skeleton, Mr. CLIFT was enabled to correct an error into which CUVIER had been led by a figure of a mutilated tooth in tab. 4. fig. 5, F, of GARRIGA's memoir, which seemed to show that it had been implanted, as CUVIER describes it to have been, by two fangs. PANDER and D'ALTON give a similar figure of one of the teeth in their tab. 2. fig. 15. The figure of the natural size of one of the teeth of the Megatherium transmitted by Sir WOODBINE PARISH, given in the third plate (pl. 45. fig. 2.) of Mr. CLIFT's memoir, is the first accurate representation of these characteristic parts, and shows that the implanted base is widely excavated for a persistent matrix, as in the Sloths and Armadillos.

The prevalent belief among Comparative Anatomists and Naturalists at this period, founded upon the additional observations by WEISS and CLIFT to those contained in the second edition of the 'Ossemens Fossiles' of CUVIER, may be gathered from such notices as were then published of the opinions expressed by the eminent professors of those sciences on the subject. Thus Dr. ROBERT GRANT, treating of the Armadillos, in his Lectures on Comparative Anatomy, says, "The Megatherium itself appears to have been such a digging loricated animal, and in many of its bones resembles the Armadillos *."

The Very Rev. Dr. BUCKLAND, in his Bridgewater Treatise published in 1836, admitting the probability, from the evidence at that time adduced, that the Megatherium had been defended by a bony tessellated armour, argues that—"A covering of such enormous weight would have been consistent with the general structure of the Megatherium: its columnar hind legs and colossal tail were calculated to give it due support; and the strength of the loins and ribs, being very much greater than in the Elephant, seems to have been necessary for carrying so ponderous a cuirass as that which we suppose to have covered the body." He next calls attention to the broad and rough flattened surface of a part of the crest of the ileum, to the broad summits of the spines of many vertebræ, and also to the superior convex portion of certain ribs, on which the armour could rest, as affording "evidence of pressure, similar to that we find on the analogous parts of the skeleton of the Armadillo, from which,"

* Lecture, reported in the 'Lancet,' March 29, 1834: and again, in 1839, the Megatherium is described by Dr. GRANT as being "allied in structure to the *Bradypus*, and shielded with cutaneous plates like the *Dasypus*." —THOMSON's 'British Annual' for 1839, p. 274. M. DESMAREST, in the art. *Megathere* of the 'Dictionnaire des Sciences Naturelles,' 1823, writes as follows:—"Leurs membres étaient robustes et terminés par cinq gros doigts. Des observations récentes paroissent prouver que sa peau, épaissée et comme ossifiée, était partagée en une foule d'écussons polygones et rapprochés les uns des autres comme les pièces qui entrent dans la composition d'une mosaïque."—"La forme des molaires et la taille de ces animaux semblent indiquer qu'ils se nourrissoient de végétaux et sans doute de racines."

he remarks, "we might have inferred that the Megatherium also was covered with heavy armour, even had no such armour been discovered near bones of this animal in other parts of the same level district of Paraguay*."

The estimable and justly celebrated author of the 'Bridgewater Treatise,' notwithstanding his bias for the hypothesis of the affinities of the Megatherium to the Armadillos, enunciates his conclusion with philosophic caution, and affirms that the other "remarkable character of the Megatherium, in which it approaches most nearly to the Armadillo and Chlamyphorus, consists in its hide having probably been covered with a bony coat of armour, varying from three-fourths of an inch to an inch and a half in thickness†." In the same work is given an original figure of the pelvis and hind limb of the Megatherium, from a front view of those specimens in the Museum of the College of Surgeons.

M. Laurillard, in the posthumous edition of the 'Ossemens Fossiles' of Cuvier, published in 1836, whilst admitting it to be very possible for the Megatherium to have been covered by a cuirass, appends a note of warning against too hastily attributing to that animal the fragments of the gigantic osseous armour that had been found in the same formations of South America; because, in the casts of some of the bones which were transmitted with that armour by Sir Woodbine Parish, M. Laurillard had recognized a calcaneum, an astragalus and a scaphoid, differing from those of the living Armadillos only by their size and by some merely specific modifications‡.

But that which Baron Cuvier and M. Laurillard had ventured to regard as very possible, and Dr. Buckland as probable, M. de Blainville a few years later announced to be a positive fact. He communicated, in 1839, to the Academy of Sciences of the French Institute, a statement that bones of the Megatherium had recently been discovered, accompanied with fragments of a carapace belonging indubitably to the same animal; and he adds that the association of a bony armour with the internal skeleton of the Megatherium can be demonstrated as surely by *à priori* reasoning as by the *à posteriori* fact; but he adduces no observations or arguments from the skeleton in addition to those of which Dr. Buckland had previously availed himself, simply affirming that "the Megatherium is proved to have been certainly covered by an osteo-dermal carapace, by the disposition of the spinous processes of the vertebræ, by the angles of the ribs, by the articulation of the pelvis with the vertebral column," &c.; and he concludes by announcing "that the Megatherium was a gigantic species of Armadillo, most nearly allied to the diminutive *Chlamyphorus* §."

* Geology and Mineralogy considered with reference to Natural Theology, vol. i. pp. 160 and 161.

† *Ibid.* p. 159.

‡ Recherches sur les Ossemens Fossiles, 8vo, 1836, tom. viii. p. 354.

§ "Recherches sur l'ancienneté des Edentés terrestres à la surface de la terre," Comptes Rendus de l'Acad. des Sciences, 1839, p. 65.

With regard to the fossils from South America, unequivocally referable to the Armadillo family, I had myself pointed out the generic distinction of that large quadruped, some bones of which had been transmitted along with the gigantic dermal armour by Sir WOODBINE PARISH, and proposed for it the name of 'Glyptodon' in Sir WOODBINE PARISH's work on Buenos Ayres *; and afterwards, stimulated by the general tendency of anatomists and palæontologists to regard the Megatherium as being, likewise, a gigantic Armadillo, I entered upon a critical review of all the facts of the case which at that time had been obtained, and communicated the result in a memoir to the Geological Society, read March 23, 1839 †. The general conclusions from this memoir were:—

1. The opinions of CUVIER and WEISS, in favour of the Megatherium being so armed, rest on no better ground than the mere fact of bony armour of some gigantic quadruped and the skeleton of the Megatherium having been discovered in the same continent.

2. The skeleton, or its parts, which have been actually associated with the bony armour above mentioned, belongs to a quadruped distinct from and less than the Megatherium.

3. No part of the skeleton of the Megatherium presents those modifications which are related to the support of a dermal covering.

4. The proportions of the component tesseræ of the bony armour in question to the skeleton of the Glyptodon are the same as those between the dermal tesseræ and skeleton of existing Armadillos, but are much smaller as compared with the bones of the Megatherium.

5. No bony armour composed of tesseræ having the same relative size to the bones of the Megatherium as in the Glyptodon and existing Armadillos, has yet been discovered.

In 1837 I had been put in possession of an additional test of the affinities of the Megatherium, by portions of teeth, obtained by Mr. CHARLES DARWIN at Punta Alta in Northern Patagonia, from which specimens I was kindly permitted to take the requisite sections for microscopical examination. Previous researches by Professor RETZIUS and myself into the structure of the teeth of the Mammalia generally, had made me acquainted with the marked difference between the teeth of the Armadillos and those of the Sloths in internal structure, and I now found that the Megatherium presented the same remarkable compound structure of the teeth as in the Sloths, but with additional complexity, by which they still further departed from the comparatively simple structure of the teeth of the Armadillos: the examination at the same time proved that there was no true enamel in the teeth of the Megatherium ‡.

* P. 178 *b*, frontispiece, 8vo, 1838.

† "On the *Glyptodon clavipes*," Transactions of the Geological Society, second series, vol. vi. p. 98.

‡ Zoology of the Voyage of Her Majesty's Ship 'Beagle,' Fossil Mammalia, 4to, 1838–40, p. 103, pls. 31 and 32. fig. 1.

Another important evidence of the affinity of the Megatherium to the Sloths was brought to light by a fragment of the skull from Punta Alta, which demonstrated a fifth small molar tooth on each side of the upper jaw, thus showing that in the number as well as in the structure and the kind of teeth the Megatherium agreed with the *Bradypodidæ*, and especially with the Ai or Three-toed Sloth; the anterior pair of molars not manifesting the excess of size and laniary form which characterize them in the Unau or Two-toed species*.

These additional evidences of the concordance of structure between the Megatherium and the Sloths, manifested by the hard and enduring parts which are most intimately related to the food of the animal, induced me to reconsider the conclusions of CUVIER, PANDER and D'ALTON, and Dr. BUCKLAND relative to the sources of its nutriment and its habits of life; and ultimately to arrive at a conviction of the correspondence of the food of the Megatherium with that of the Sloths, and of the relation of the modified form of the Megatherium to its peculiar mode of obtaining such food, the grounds for which conviction are given in my memoir on the *Mylodon robustus*, published in 1842.

By the analogy of this smaller species of the great extinct terrestrial Sloths of South America, I endeavoured to dissipate some of the doubt and obscurity which shrouded the true structure of the fore and hind feet of the Megatherium†; but the light so obtained served rather to increase the desire to inspect the skeleton itself at Madrid, and obtain, *ex visu*, a conviction of the accuracy of my views; for I participated entirely in the doubts expressed by my experienced colleague Mr. CLIFT‡ relative to that skeleton, then unique in Europe, viz. as to "whether it had been properly or improperly mounted, *i. e.* whether all the parts were of one or more individuals, whether they belong to the situation or position in which they are placed, whether all the parts are genuine or partly modelled, or whether parts are eked out by bones that do not belong to the part or situation in which they are collected:" concurring at the same time with Mr. CLIFT, that "no blame was attributable to the articulator, who, probably, had little or no guide in such a difficult task."

Year after year, however, passed away without bringing with it the requisite liberty from official duties for a visit to Madrid. I availed myself of the rare opportunities afforded by journeys of scientific friends to that city to endeavour to obtain information on some of the discrepant or doubtful points, and more especially relative to the exact number of teeth or sockets of teeth in the skull; but usually without any satisfactory result, owing chiefly to the difficulty which the mode of preserving the famous skeleton presents to any close inspection. Dr. DAUBENY, the accomplished Professor of Botany at Oxford, in reply to one of my requests, wrote to me from Madrid:—"I have examined the Megatherium and can discern only four teeth in

* Zoology of the Voyage of Her Majesty's Ship 'Beagle,' Fossil Mammalia, 4to, 1838–40, p. 102.

† Description of the Skeleton of the *Mylodon robustus*, 4to, pp. 102, 131–136.

‡ "Notice on the Megatherium," Geol. Trans. Second Series, vol. iii., description of plate 44.

either jaw, which are all perfect and double, but whether or not there be the rudiment of a tooth behind cannot be distinctly ascertained, unless the glass case which covers the specimen be removed; for there is no door or any way of getting close to the skeleton. I should advise a memorial to be drawn up stating the reasons for wishing the point to be determined, in which case, perhaps, the authorities might consent to allow a pane of glass to be removed."

Fortunately the necessity of the endeavour to overcome these obstacles was in great measure obviated by the arrival in 1845, in this country, of a very important and remarkable accession of remains of the Megatherium, discovered in 1837, near Luxan, Buenos Ayres, which, with other fossils of large extinct South American animals, were purchased by the Trustees of the British Museum. This collection included an entire cranium and lower jaw of the Megatherium; the entire tail; complete series of the bones of both fore- and hind-feet:—in short, parts which, in combination with those previously deposited in the Museum of the Royal College of Surgeons, by Sir Woodbine Parish and Mr. Darwin, completed the entire skeleton of the animal, including the hyoid and sesamoid bones, which are too often wanting in the skeletons of our recent and common quadrupeds.

Accurate plaster casts of the huge pelvis and most of the other bones of the Megatherium in the College Museum had been prepared at the expense of the College and presented to the British Museum: and, after an examination and comparison of the whole series of the remains of the Megatherium in both collections, and a consultation with the ingenious articulator of the Mylodon, Mr. Flower, I suggested to the able keeper of the Mineralogical Department in the British Museum, Charles König, K.H., F.R.S., the advantage which would arise, if similar plaster casts should be taken of all the other bones of the skeleton, and if such casts, coloured to match the original bones, should be mounted; the originals being preserved separate, for the greater facility of their comparison and for the advantage of examining their articular surfaces.

The Trustees of the British Museum having taken the proposition under mature consideration, the Council of the Royal College of Surgeons having liberally sanctioned the moulding of all the requisite bones in their Museum, and my own consent to superintend the co-adjustment and attitude of the skeleton having been given, the models and plaster casts were ordered by the Trustees to be made, and their articulation was confided to Mr. Flower.

The result is the exhibition in our National Museum of the entire skeleton of the Megatherium, Plate XVII., in a much more complete state, and, I believe I may add, more natural attitude, than that of the same extraordinary quadruped, which previously had been unique and the glory of the Royal Museum of Natural History at Madrid.

For the full fruition by comparative anatomists and palæontologists of so rich an accession to our evidences of one of the strangest animals of a former world, there still remained one condition,—viz. the power to employ a competent artist to depict the skeleton and its several parts. There could be no question that the opportunity of supplying the omissions, correcting the errors, and clearing up the doubts, in the descriptions founded on the Madrid skeleton, ought to be embraced without loss of time. The enlightened and liberal grant of £1000, placed by Lord John Russell, then Prime Minister, at the disposal of the Council of the Royal Society, in aid of the labours of men of science, seemed to me to afford the means of removing the only difficulty that stood in the way of completing the object of my wishes. I therefore submitted the case to the "Committee of Recommendations for the application of the Government Grant," and the Council of the Royal Society has been pleased to approve the recommendation of the Committee, viz. "that £100 be granted to Professor Owen, to be applied to the procurement of drawings of the undescribed and unfigured or inaccurately figured parts of the skeleton of the Megatherium, on the understanding that Professor Owen undertakes to select the subjects, direct the artists, and communicate his descriptions to the Royal Society; and that Mr. Darwin, Mr. Bell, and Dr. Sharpey, be a Committee to ascertain the proper application of the funds."

The memoir, and its illustrations from the accurate pencil of Mr. Joseph Dinkel, herewith communicated to the Society, are the result of that recommendation; and I have only to add, that the descriptions and figures of the several parts of the skeleton of the Megatherium, now in London, have been taken from the actual bones; and the views of the entire skeleton from the articulated casts, which are so beautifully exact, as, for all the essential purposes of science, to be of the same value and utility as the bones themselves would be if so articulated together.

Of the Spinal Column.

The skeleton of the Megatherium, like that of all other vertebrate animals, being composed of a series of segments, similar in their composition, and referable under all their modifications to a common type, answering to that which is figured as the 'typical vertebra' in my work on the Vertebrate Skeleton*, I shall commence its description by one of those segments which deviate least from the archetypal character; and such segments we find to constitute the major part of the trunk, where they form what, in human anatomy, would be termed 'dorsal vertebræ,' 'ribs,' 'cartilages of ribs' and 'sternal bones.'

Plate XVIII. fig. 1, gives a front view of the fifth segment of the dorsal or thoracic region of the trunk: it deviates from the archetype inasmuch as the neurapophyses, *n*, *n*, have coalesced, as in other mammals, with the centrum, *c*, below, and are connate with the neural spine, *ns*, above: the hæmal arch is also vastly expanded in relation to the greatly developed vascular centres which it was destined to encompass; the

* On the Archetype and Homologies of the Vertebrate Skeleton, 8vo, 1848, p. 81, fig. 16, and p. 82, fig. 15.

pleurapophyses, *pl, pl,* being elongated and bent down, and the hæmapophyses, *h.h,* removed from the centrum and articulated to the ends of the pleurapophyses, and, by a double synovial joint, *s's'*, to the hæmal spine or sternal bone *h.s.*

The coalesced centrum and neural arch constitute the so-called 'dorsal vertebra,' and the one selected is the fifth of that series counting backwards.

The centrum, *c*, or body of the vertebra, is wedge-shaped, with its base upwards, forming the floor of the capacious neural canal, and the sides—slightly concave lengthwise, almost flattened vertically—converge to the inferior surface, which is formed by an obtuse ridge: the centrum expands slightly at its articular ends, and so that the contour of the anterior one is rather oval than trihedral; this surface is slightly depressed at its middle, slightly convex in the rest of its extent; the posterior articular surface is larger than the anterior one and flatter, but is also a little depressed at the middle: the two upper angles of the hinder end, probably contributed by the neurapophyses in the development of the vertebra, are slightly produced and truncate, offering each a smooth, flat, small subcircular surface, *c'*, for the head of the rib of the preceding vertebra; the corresponding part of the rib of the present segment is marked *c''*. The neurapophyses, *n, n,* rise each by a slender base which has coalesced with the anterior half of the upper and outer angle of the centrum: they diverge from each other and expand as they rise; then, developing some articular surfaces and exogenous processes from their outer surface, arch towards each other, increasing rapidly in antero-posterior extent, and coalesce above the neural canal; where they support the zygapophyses, *z, z,* and the thick and strong neural spine *ns.* The roof of the neural arch, thus formed, projects some way beyond the anterior surface of the centrum, and extends almost to the posterior surface. The inner surface of the neural arch is as remarkable for its even smoothness, as the outer surface is for its various prominences and depressions. The outer side of the basal half of the neurapophysis supports a large elliptical articular surface (*n'*), concave from above downwards and backwards: the overhanging fore-part of the arch supports the two flat oval anterior zygapophyses, *z, z,* the articular surfaces of which look almost directly upwards; on the under surface of the back part of the arch are the two posterior zygapophyses looking almost downwards, and between these is a rough longitudinal prominent ridge. The neural spine is moderately long, subcompressed and subtrihedral, with a sharp anterior margin, smooth sides, and a rough thick posterior surface, developing a median longitudinal ridge: the summit expands into a rough triangular almost flattened surface.

For the convenience of describing and comparing the different exogenous processes developed from the neural arch in the class *Mammalia,* I have indicated them by single-worded names; having found that, although they varied much in size and a little in relative position, when traced through the series, they could be identified from species to species.

The most common and constant of these processes is that which usually stands out, or transversely, from the base of the neural arch, and affords a joint or a surface of confluence for the rib; this I have proposed to call '*diapophysis**': the second process has a range of variety in its position from the upper part of the diapophysis to that of the anterior zygapophysis, but, as it is commonly somewhere between these two, I have called it '*metapophysis*†'; the third process projects most commonly more or less backwards, from the base of the diapophysis, and I have termed it '*anapophysis*‡'. As each of the above processes developes in some species an articular surface, and as each is usually more or less oblique in position, I have called those processes which more constantly support such surfaces '*zygapophyses*§'. The comparative anatomy of these and other 'exogenous' processes has been the subject of a previous part of this memoir, because their extreme degree of variety in the Order *Edentata*, and extraordinary development in the Armadillos and true Anteaters, render them of unusual importance in the question of the affinities of the Megatherium.

The narrow compressed base of the neurapophysis of the fifth dorsal vertebra in that animal having risen above the centrum, developes on its outer surface a large vertically oval articular surface, n', concave in the direction of its long axis, almost flat transversely; to which surface a corresponding convex articular surface, n'', on the upper part of the neck of the rib near the head, is adapted. Above the surface, n', the diapophysis, d, stands out, short, thick, subdepressed, expanded at its extremity, which is slightly produced backwards and supports on its outer surface an elliptical articular concavity, d', with the long axis directed from above downwards and backwards, and articulated to a corresponding convexity, d'', upon the tubercle of the rib. A rugged tuberosity, m, on the upper and fore-part of the diapophysis represents in rudiment the metapophysis. A smaller tuberosity is interposed between the anterior zygapophysis, z, and the neurapophysial surface, n', for the rib. Thus the neural arch of the vertebra in question presents ten distinct articulations besides the two sutural ones now obliterated by its anchylosis to the centrum, which part has its two large terminal articulations distinct from those for the head of the rib, c', which I reckon among the neurapophysial ones. The rib, which term I confine to the pleurapophysis, or 'vertebral rib' of comparative anatomists, 'pars ossea costæ' of anthropotomy, presents a small flat subcircular surface, c'', for articulation with that on the base of the neurapophysis forming the upper angle of the body of the vertebra in advance of the segment to which the rib belongs. The neck of the rib rapidly expands as it quits the head, developes the convex oval surface, n'', on its upper part

* Lectures on the Comparative Anatomy of the Vertebrate Animals, 8vo, Longmans, 1846, vol. i. p. 42; from διὰ *trans*, and ἀπόφυσις *processus*.

† On the Anatomy of the Male Aurochs, Proceedings of the Zoological Society, November 14, 1848, p. 131, from μετὰ *inter*, and ἀπόφυσις.

‡ On the Anatomy of the Aurochs, *ut supra*, p. 131; from ἀνὰ *retro*, and ἀπόφυσις.

§ Lectures on the Comparative Anatomy of the Vertebrate Animals, p. 43; from ζυγὸν *junctura*, and ἀπόφυσις; these are called the "oblique or articular processes" in Human Anatomy.

for the concavity on the neurapophysis of its own vertebra; and is indented behind where it joins the tubercle. The oval convex articular surface, d'', for that on the diapophysis, is situated on the upper and towards the back part of the tubercle. The body of the rib is moderately convex on its outer side, more convex transversely on its inner side, where the convexity is bounded by a groove on each side, extending half-way down the rib, near its rather sharp margins: in its lower half the rib becomes a little broader and less thick. The outer surface of the rib is well marked by grooves and ridges for muscular attachment; the best-developed eminence being at a short distance from the tubercle; and the largest and deepest groove being behind the tubercle.

The hæmapophysis, or 'sternal rib,' *h*, is a straight subcompressed bone, with a very irregular surface, which is somewhat convex on the inner side, but is traversed by strong oblique ridges with intervening deep and wide channels on part of the outer side. The surface of junction with the pleurapophysis is a very rough and irregular one for ligamentous union: the opposite end of the hæmapophysis divides into two convex condyles, $s'\,s'$, separated by an oblique, deep and rather narrow groove; the outer condyle projects further than the other; on the shorter one the articular surface passes continuously from one side to the other, describing a semicircle; on the longer condyle the articulation is divided by a median constriction into two oval convex surfaces. One half of each of the condyles articulates with a corresponding concavity on the 'sternal bone' (*h s*) of its own segment, the other half of each condyle with the contiguous sternal bone.

The sterneber or sternal bone, completing, as 'hæmal spine,' *h s*, the typical segment in question, is a cuboid piece, divided into an outer or peripheral, and an inner or central portion. The outer portion is subpentagonal, having its four corners excavated by as many concavities for the hæmapophysis; the two upper concavities, $s''\,s''$, being divided by a flat rough tract, the two lower concavities by a rough tuberosity. The outer surface is flat and rough. The inner portion, or that next the cavity of the chest, is larger than the other and has a hexagonal contour; the four angular concave articular surfaces, s'', s'', for the hæmapophyses being separated, at the sides of the bone, by rough tracts; and, above and below, by a flat articular surface, *hs*, by which the bone articulates with contiguous sternal bones. The inner surface of this portion is flat and rough, having been apparently covered by a strong aponeurosis in the living animal. Thus the whole bone presents not fewer than ten articular surfaces, viz. a flat semicircular one above or in front of, and a similar one behind, the posterior division; and two concave articulations, s'', s'', on each side of both divisions for the double condyles of two pairs of hæmapophyses.

The chief modification in the sixth segment of the chest is the development of a third articular surface at the back part of the base of the spine, between the two posterior zygapophyses; and the somewhat greater production of the ridge which stands out from the fore-part of the base of the spine between the anterior zygapophyses. The inferior or hæmal arch is also augmented by increased length of the ribs. The key-bone of that arch, sterneber or hæmal spine, Plate XXVII. figs. 4–7, repeats the characters of that of the previous segment, save that the sternal articulation, *s*, and the hæmapophysial ones, *hp*, *hp*, of the central division of the bone are more continuous, as shown in fig. 6. Fig. 5 shows the surface which was presented towards the integument; fig. 4 that which was turned towards the cavity of the chest; fig. 7 is a side view showing the four articular cavities for the double condyles of the sixth and seventh hæmapophyses; fig. 6 shows the under surface of this remarkable type of sternal bone.

In the seventh dorsal vertebra (Plate XIX. figs. 1, 2, 3), a third articular surface, *mz*, fig. 1, is developed between the two anterior zygapophyses, *z*, *z*, to join that upon the back part of the sixth vertebra; so that there are three zygapophyses, a median and two lateral, on both the fore and the back part (*mz'*, fig. 2) of the arch of this vertebra, making, with the three articular surfaces on each side (fig. 3, *c'*, *n'*, *d'*) for the ribs, and with the anterior and posterior surfaces of the centrum, not fewer than fourteen joints. In this and the two following segments of the back (D_8 and $_9$, Plate XVII.), the ribs attain their greatest length. In the tenth segment the hæmapophyses cease to articulate below directly with a hæmal spine. The median zygapophyses continue to be developed both before and behind to the twelfth dorsal vertebra inclusive. In the thirteenth (Plate XXVI. fig. 4) this supplementary articulation is suppressed behind; and the costal articulations have disappeared from the diapophyses *d*. Those on the neurapophyses are almost circular, *n'*, and those on the upper and posterior angles of the centrum, *c'*, have increased in size. The metapophysis (*m*), which was indicated by a protuberance above the diapophysis in the preceding dorsals, begins to assume the form of a rugged thick vertical ridge. The fourteenth dorsal vertebra shows the progressive increase of size of the centrum, and the absence of the median zygapophysis before as well as behind; and in it the costal articulation on the centrum for the penultimate rib is lost, as well as that on the diapophysis for the antepenultimate one, and only the subcircular concave neural surface for the rib remains. In the fifteenth dorsal vertebra the posterior zygapophyses are convex transversely at their inner border, slightly concave in the rest of their extent; the back part of the neural spine between these processes is deeply grooved; the metapophysial ridge increases in height and length; a short and thick anapophysis is developed from the back part of the base of the diapophysis, and on the under part of the anapophysis there is a distinct, nearly flat, articular surface. The sixteenth dorsal vertebra (Plate XIX. figs. 4 and 5, Plate XXVI. fig. 5) offers a corresponding modification at the fore-part of each neurapophysis, in the development of a short, strong, wedge-shaped process, *p*, fig. 5, answering to the parapophysis in *Myrmecophaga** and *Dasypus*, with an articular surface, *pa* (Plate XIX. fig. 4), on its upper part for junction with the anapophysis of the preceding vertebra.

* Philosophical Transactions, 1851, Plate L. fig. 22, *p*, *pa*.

The metapophysis, *m*, projects forward above the zygapophysis, the articular surface of which (*z*, fig. 5) is continued upward upon the metapophysis (*mz*, fig. 4). The anapophysis, *a a*, fig. 5, Plate XXVI., forms a strong thick square plate of bone projecting upward, outward and backward from the diapophysis. The anapophysial articular surface, *a'*, *a'*, fig. 5, Plate XIX., is on the under and back part of this plate, nearly parallel with the posterior zygapophysis, *z'*, the convex inner border of which has increased in thickness. The body of the vertebra assumes, with its larger size, a more decided trihedral or wedge-shaped figure at this part of the spine.

The rib of the thirteenth segment loses the convex articular surface on the tubercle, which is attached by ligaments to the diapophysis. The rib of the fourteenth segment loses the small flat surface at the extremity of the head; and only the large convex surface on the upper part of that end of the neck remains, which surface, extending to the free end of the neck, reduces that part to an edge: the tubercle exists in this rib, and is rough for ligamentous insertions as in the preceding. In the fifteenth (Plate XIX. figs. 1 and 3) and sixteenth (*ib.* fig. 2) ribs the tubercle subsides; the neck of the rib is defined by the rugosity of its whole upper surface, save that part where the articular convexity, *n''*, remains for articulating with the neural arch, as shown at *n'*, fig. 5, Plate XIX.

The hæmal spine ('sterneber') of the eighth segment, Plate XXVII. figs. 8–12, may be the last of the so-called bones of the sternum. It is divided, like those in advance, into a peripheral and a central portion. The peripheral portion (fig. 9) is of a subquadrate form, the four corresponding articular surfaces (*ha*, *ha'*) for the hæmapophyses almost touching each other at their margins; the outer roughened surface is convex; the anterior hæmapophysial articular surface is suppressed on the left side of this division of the bone, fig. 10, to which the corresponding hæmapophysis seems to have been united by ligament. The central division of the bone (fig. 8) presents the median flat surface (*s*, fig. 10) on its upper or fore-part for the antecedent sterneber, and the concave hæmapophysial surface, *hp*, *hp*, on each side of its anterior half; but posteriorly the hæmapophysial surface on each side is confluent with that of the same side belonging to the peripheral division of the bone, which thus presents at its lower or hinder part only two long oval concave articular surfaces (*hp a*, figs. 11 & 12) for the pair of hæmapophyses of the ninth segment of the chest, and the concavities almost meet at the under surface of the sterneber, which there presents no articular surface for a succeeding one. The number of articular surfaces, therefore, of this bone is reduced to six; one, *s*, for the antecedent sterneber, two on the anterior half of the right side, *hp*, *ha*, fig. 12, for the bifid condyle of the eighth hæmapophysis, one on the anterior half of the left side, *ha*, fig. 10, for one of the condyles of the opposite hæmapophysis; and a pair of surfaces on the posterior and lateral parts, *hp a*, for the ninth pair of hæmapophyses which terminate each by a single convex condyle. It is possible that a more simplified sterneber may have intervened between the hæmapophyses of the tenth segment.

In the three segments of the trunk, Plate XVII. *L* 1, 2, 3, succeeding the last of the dorsal series, both pleurapophyses and hæmapophyses are wanting as distinct ossified parts, and those segments are reduced to the coalesced elements, constituting the 'lumbar vertebræ' of Human Anatomy. The accessory articulations between the parapophyses and anapophyses are continued in these vertebræ, which do not become anchylosed together in the Megatherium as in the Mylodon.

I next proceed to trace the modifications of the segments as they recede from the typical one in the opposite direction or towards the head.

The fourth dorsal segment much resembles the fifth, which has been taken as the type; the pleurapophyses are shorter, especially at their cervix; but the complex articulations of these and of the hæmapophyses are repeated.

In the third segment the pleurapophysis, *pl*, fig. 3, Plate XXV., and hæmapophysis, ib. *h*, are anchylosed together: both are shortened, but the pleurapophysis in a greater degree; this retains its three articular surfaces, c'', n'', d'', on the head, neck and tubercle; and the hæmapophysis, *h*, has its double condyle, s', s'', at the sternal end, fig. 3 *b*, the inner one being single, the outer one divided by a narrow groove into an anterior and a posterior convexity. The concave border of the rib is less produced than in the fifth segment.

In the second dorsal segment (Plate XVII. *D* 2) the neural spine is increased in height, and the metapophysial tubercle is diminished in size. The vertebral, *pl*, and sternal, *h*, parts of the rib (Plate XXV. fig. 2) are anchylosed, and both are shortened: the former retains its three articular surfaces on the head, c'', neck, n'', and tubercle, d'', that on the tubercle being the largest, and being partially divided into two convexities (fig. 2*a*, *d*). The pleurapophysis (*pl*, fig. 2) is diminished in length, but increases in breadth to its place of coalescence with the hæmapophysis (*h*); the convex articular surface (fig. 2*b*, s'') on the outer condyle of the hæmapophysis is not divided: the inner condyle, s', is much reduced and has only a small articular surface.

The first dorsal segment (Plate XVII. *D* 1) is remarkable for the superior height and antero-posterior extent of the neural spine, the summit of which expands into a broad flat subtriangular rough surface, Plate XX. fig. 5. *D* 1, *ns*. The anterior margin of the spine is sharp and produced. The anterior zygapophyses are not so near each other as in the succeeding vertebræ; and they are continued outwardly upon the base of the metapophysis, which is here more distinct from the diapophysis than in the succeeding vertebræ; and the articular surfaces of the zygapophyses are slightly concave transversely. The costal concavity below the diapophysis is continuous with the smaller articular surface upon the side of the neurapophysis.

The pleurapophysis (Plate XXV. *pl*, fig. 1) is much reduced in length, and is confluent below with a short, thick, broad, subquadrate hæmapophysis, *h*. The short neck of the rib terminates in a small obtuse end without any distinct articular surface: this end seems to have been imbedded in the ligamentous mass between the seventh cervical and first dorsal vertebræ: the short neck quickly expands into the shaft of the rib: a small elliptical surface, fig. 1 *a*, n'', on the upper part of the neck, is continued at its outer end into the larger convex surface upon the upper part of the tubercle, d'': from the middle of the anterior border of this surface a strong ridge is continued down the outer surface of the rib to its hinder border. The sternal end of the hæmapophysis, fig. 1 *b*, presents a large subtriangular surface, slightly concave in one direction, slightly convex in the other, adapted to a similar single concavo-convex surface on the side of the much developed and modified hæmal spine called 'manubrium sterni.'

This bone (Plate XXVII. figs. 1, 2, 3) is of an oval or cordiform figure, with a prominence on each side near its inferior truncated apex, below the lateral articulations, *hp*, for the first pair of sternal ribs. The outer surface is principally concave lengthwise, and is sculptured by the impressions of the coarse aponeurotic structures which have been adherent to it in the living animal: a short median longitudinal ridge projects from its lower part. The inner surface is chiefly convex, but is very irregular. At its upper half a strong median prominence divides the shallow rough depressions, *cl*, for the attachment of the clavicular ligaments: these depressions are deepest above the costal articulations which are supported on well-marked triangular prominences. Between these prominences the bone is rather concave. A strong rough tuberosity projects below the lower angle of the costal surface. The contracted inferior end of the manubrium terminates in an oval convex articular surface, s', for the second sternal bone. There are no articular surfaces for the hæmapophyses of the second dorsal segment.

The skeletal segment (Plates XVII. C_7; XX. fig. 7) in advance of the first of the dorsal series is reduced to its centrum and neural arch; both pleurapophysis, hæmapophysis and hæmal spine are absent; and its remaining anchylosed elements constitute the 'seventh cervical vertebra' of Descriptive Anatomy. This is most remarkable for the great development of the neural spine (Plate XX. fig. 7, *ns*), which exceeds that of the first dorsal vertebra: the summit is similarly expanded and flattened above (Plate XX. fig. 5, *ns* 7); but the anterior margin is still more produced, forming a low angle about half-way down the spine (fig. 7, *ns*). The anterior zygapophyses are more remote from each other than in the first dorsal, and their articular surfaces are chiefly supported by the inner side of the base of the metapophyses, figs. 5, 7 *m*, which are here well developed and more distinct from the diapophyses, *d*, fig. 7, than in the dorsal region. The diapophyses, figs. 5 & 7, *d*, are strong, rugged, stand out from the sides of the neural arch, and terminate in rough truncate ends. The posterior zygapophyses (figs. 6 & 7, z') are slightly convex.

In the sixth cervical vertebra (Plates XVII. C_6; XXI. figs. 5 & 6) the spine, *ns*, is much shortened, though still long and large in proportion to the neural arch. The metapophyses, *m*, *m*, stand out from the upper part of the side of the neural arch behind the anterior zygapophyses, *z*. The diapophyses, *d*, *d*, are developed from the base of the neural arch, which has descended lower upon the sides of the centrum; and now we find another element—the pleurapophysis, *pl*—restored to the segment, but reduced to rudimental proportions and anchylosed at two points. Its vertebral end is bifid; one portion, answering to the head of the rib, has coalesced with the side of the centrum (at *p*, fig. 5); the other, answering to the tubercle, has united with the under part of the diapophysis, *d*: what may be termed the body of the rib is a short but broad rhomboidal plate (fig. 6, *pl*), projecting outward, downward and a little backward. The space intercepted between the pleurapophysis and diapophysis forms the canal, *v*, for the vertebral artery.

The fifth cervical (Plate XVII. C_5) differs from the sixth by its smaller dimensions, especially by its shorter spine, and by the diminution in the breadth of the pleurapophysis, which terminates by a thick obtuse end: it sends out, however, a thin plate forwards from its vertebral end. The metapophysis is a large obtuse tubercle, Plate XX. fig. 5, m_5.

In the fourth and third cervicals (Plate XXI. figs. 3 & 4) the neural spine is still more reduced, and, contracting from its base, assumes a triangular shape, fig. 4, *ns*. The anterior zygapophyses, fig. 3, *z*, are concave transversely, and look upward and inward; the posterior ones, fig. 4, z', are convex, with the reverse aspect: the metapophysis, *m*, continues to be developed as a distinct tuberosity, external and posterior to the prozygapophyses; and the pleurapophysis continues to send forward the pointed plate from its fore-part, fig. 4, pl', its outer end, *pl*, being thick and tuberous, like the diapophysis, *d*, above.

The dentata (Plate XXI. figs. 1 & 2) has its spine extended in the antero-posterior direction, and of great strength, though low; with a thick angular ridge projecting from its fore-part and overhanging the neural canal; it is broad, flattened and almost vertical behind, and has a subbifid summit (Plate XX. fig. $5,_2$, and Plate XXI. fig. 1, *ns*). There are no metapophyses and no anterior zygapophyses, but the analogous articular surfaces (figs. 41 & 42, *zn*) have descended upon the antero-lateral parts of the coalesced centrum of the atlas or 'odontoid process,' and are adapted to corresponding surfaces of the bases of the neural arch of the atlas. The posterior zygapophyses, z', are wide apart, and are convex. The diapophysis, *d*, is short and obtuse; the pleurapophysis, *pl*, still developes its anterior angle, Plate XXI. fig. 2, pl'. The fore-part of the odontoid process, *o*, is a rounded tuberosity, on the under surface of which is the oval, slightly convex surface for articulating with the hypapophysis (Plate XX. fig. 3, *o*, *hy*), which has coalesced with the neural arch, *ns*, of the atlas, and is commonly called the 'body of the atlas.' The under surface of the centrum of the dentata developes a hypapophysial ridge.

The atlas, viewed from behind, as in Plate XX. fig. 3, is a large, transversely oblong, subdepressed, shuttle-shaped bone, perforated by a large aperture, quadrate below for its detached centrum the 'odontoid process,' arched above for the spinal cord.

The thinnest and smallest part of the ring of the atlas is formed by the hypapophysis, *hy*, which has coalesced with part of the bases of the neural arch, *nn*, and has supplanted, as it were, the proper centrum, *o*, Plate XXI. figs. 1 & 2, which has remained anchylosed to that of the axis. The upper surface of the hypapophysis presents a shallow articular surface, *o*, Plate XX. fig. 3, for that centrum to rest and turn upon. The hinder half of the base of the neurapophysis developes, on each side, a slightly concave, subcircular, articular surface, *z′*, for a moveable articulation with that on the side of the odontoid, *zn*, fig. 1, Plate XXI. The atlas is perforated anterior and external to this by a foramen, Plate XX. fig. 1, *s*, answering to that called 'foramen alare posterius' in the Horse, in which it gives passage to the posterior branch of the occipital artery; in the Megatherium the foramen or canal is bridged over by a narrow oblique bar of bone, dividing its external outlet into two, *r* & *s*, and through the hinder, *s*, of the divisions it is probable that a branch of the second spinal nerve may have passed.

The diapophysis, *d*, is a broad, depressed, rounded aliform process, with a protuberance from its under and back part, like the rudiment of a pleurapophysis, *pl*. Anterior to this process the under surface of the diapophysis is deeply and widely excavated and perforated by the vertebral artery, the canal for which, opening upon the upper surface of the diapophysis, is then continued obliquely inward, perforating at *q*, fig. 4, Plate XX. the upper part of the neural arch, just within the upper part of the condyloid concavities. A large part of the canal for the first spinal nerve, fig. 1, *v*, opens into the outer commencement of the vertebral canal, and answers to that called 'foramen alare anterius' in the Horse, which transmits the inferior branch of the first spinal nerve as well as the anterior branch of the occipital artery. The condyloid concavities, fig. 2, *nz*, are semioval, large and deep, and occupy nearly the whole of the anterior surface of the neural arch, being separated above by a rough tract of three inches' extent, upon which the vertebral canals open. There is a triangular rough surface at the back and inner part of each condyloid concavity.

Such are the modifications of the different cervical vertebræ of the Megatherium. With regard to the dorsal vertebræ, their chief characteristics may be briefly recapitulated as follows:—

The first dorsal vertebra is distinguished by the confluence of the neuro-costal and dia-costal surfaces, and by the superior height of the spine.

The second to the fifth dorsals inclusive, like the first, have only the ordinary pair of zygapophyses before and behind, but have the neural and diapophysial surfaces for the rib distinct.

The sixth dorsal is recognizable by having a third median zygapophysis behind, but not in front. The seventh to the twelfth dorsals inclusive have the three zygapophyses both before and behind. The thirteenth dorsal has the median zygapophysis in front but not behind: the costal surface has disappeared from the diapophysis. The fourteenth dorsal has only the ordinary pair of zygapophyses before and behind, but may be distinguished from the second, third, fourth and fifth dorsals by the absence of the costal articulation on the diapophysis, and of that on the upper and hinder angle of the centrum. The fifteenth dorsal has an anapophysis on each side with an articular surface, and has only the costal articulation on the neurapophysis. The sixteenth dorsal has on each side, at the fore part of the neural arch, a parapophysis with a superior articular surface, and behind, an anapophysis with an inferior articular surface. But it differs from the lumbar vertebræ by the costal surface on the neurapophysis.

Having now described the principal characters of those segments of the skeleton, the centrums and neural arches of which are comprehended in Anthropotomy under the term of 'true vertebræ,' on account of their freedom of motion on each other, I next proceed to the description of the 'false vertebræ;' and first, of those that, being anchylosed together, form the 'sacrum.'

This part of the skeleton includes five vertebræ (Plate XXIII. $_{1-5}$), which are not only anchylosed to each other, but to both the iliac and ischial bones: the length of the sacrum is 22 inches, its extreme breadth across the fifth vertebra, fig. 1, d_5, is 20 inches. The centrum of the first vertebra (Plate XXII. *c*) presents a transversely oblong, subquadrate, flattened, articular surface for that of the last lumbar vertebra, with its margin a little produced forwards, and developed below into a pair of rough ridges, *. *. The neural arch overhangs this surface, and developes a metapophysis from the fore part of each side of its base, with a broad articular surface on its under part, and a similar surface above (Plate XXIII. fig. 1, *z*), representing the anterior zygapophysis; the two surfaces meeting at a right angle at their inner borders. The broad diapophysis of the first sacral, $_1$, is perforated by a small subvertical canal, d', at its confluence with the ilium, and is separated from the corresponding part of the next diapophysis by a larger orifice, o_1, which is the first of the four superior or posterior sacral outlets. The neural arch of the first sacral vertebra, n_1, is separated from that of the second, n_2, by a narrow transversely elongated elliptical vacuity. The neural arches of the three succeeding vertebræ are completely confluent: a pair of triangular closely approximated apertures, n_4, divides the base of the neural spine of the fourth, ns_4, from that, ns_5, of the fifth sacral vertebra. The neural spines of the first four sacral vertebræ have coalesced into a strong vertical ridge, *ns*, ns_4, increasing in thickness as it extends backwards, and being there from two-thirds of an inch to one inch and a half thick across the broken summit. The second posterior sacral canal, o_2, intervenes between the diapophysis of the second and that of the third vertebra. The metapophysis, m_4, of the fourth appears as a low angular tubercle above and a little behind the diapophysis of the third sacral, $_3$. The diapophysis of the fourth sacral, d_4, extends outwards beyond the ilium, as a subdepressed broad process with a rough free extremity; the back part of the process coalesces with a similar but stronger and longer diapophysis of the fifth sacral, d_5, from the fore-part of the base of which a tuberous metapophysis, m_5, projects upward and forward. The third, o_3, and fourth, o_4, upper sacral outlets are wider apart than the second and first; the sacrum expanding posteriorly. The back and under part of the diapophysis of both the fourth and fifth vertebræ coalesce with the ischium and with the thick and strong parapophysis extended from the side of the centrums. The neural arch of the fifth sacral developes a pair of posterior zygapophyses, Plate XXIII. z', z', with a flat surface looking outward and a little downward, and with the lower angle continued upon a small rough subarticular surface. The posterior surface of the last sacral vertebra, Plate XXIII. fig. 2, is on the same vertical parallel as the posterior zygapophyses; it is nearly flat and transversely elliptic. The neural canal of the sacrum, the anterior aperture of which is 3 inches in vertical and 4 inches in transverse diameter, expands in the sacrum, and opens below by three wide foramina on each side: of these the first and second are of great size: into the second foramen the third upper sacral canal leads: the third lower sacral foramen, which is the smallest, corresponds with the fourth upper one: the fifth canal for the fifth pair of sacral nerves broadly grooves the back part of the parapophysis and side of the centrum. The posterior aperture of the neural canal is 2 inches in vertical and 4 inches 3 lines in transverse diameter. Both diapophyses and parapophyses of the first three sacral vertebræ coalesce with the ilia. The sacrum is concave below both transversely and lengthwise.

The tail of the Megatherium was of great strength: it is so long as to touch the ground when the trunk is raised at an angle of forty-five degrees from the horizontal position: it includes eighteen vertebræ, which progressively diminish in size from the first to the last, Plate XVII. Cd, $_{1-18}$.

The first vertebra, Plate XVIII. fig. 2, is remarkable for the length and strength of its diapophyses, *d*, which are expanded at both ends, and, like those of the sacral vertebræ, are probably lengthened out by connate or coalesced pleurapophyses, *pl*. The base of the process, *dp*, extends from the side of the centrum to the base of the neural arch, is widely excavated behind for the passage of the first pair of caudal nerves, and is subcompressed before it expands into its rugged free termination. These processes are shorter than those of the last sacral vertebra. The neural canal, *n*, is triangular, 3 inches in vertical and 3 inches 9 lines in transverse diameter. The neural arch developes two posterior zygapophyses, z', with their articular surfaces looking downwards and outwards: two anterior zygapophyses, *z*, with their articular surfaces looking upwards and inwards, these being strengthened by a strong tuberous metapophysis, *m*, on their outer side: the spine, *ns*, is of moderate length, carinate behind, obtuse and slightly expanded above. From the under part of the transversely elliptical centrum are developed two hypapophyses, *hy*, each with an oblong articular surface, Plate XXVI. fig. 6, *hy*, to which is joined a hæmapophysis, Plate XVIII. *h*. Each hæmapophysis is a long slender conical bone, with an articular surface at each angle of the base, hy', hy'', and an obtuse slightly inflected apex: the inner side of the bone is slightly concave, the outer one convex transversely: a rough tuberosity dividing it from the inflected apex. The essential differences between the first caudal segment and the dorsal one delineated on the same Plate are, that the pleurapophysis, *pl*, is short and anchylosed to the diapophysis, the hæmopophyses, *h*, articulate with the centrum, and the hæmal spine is absent, in fig. 2.

The second caudal vertebra (Plate XXIV. figs. 1 and 2) differs from the first in having an anterior, fig. 2, *hy*, as well as a posterior, ib. *hy'*, pair of hypapophyses; and in the confluence of the hæmapophyses, fig. 1, *h*, at their apices forming the so-called 'chevron bone' (*os en chevron*, CUVIER). This vertebra is smaller than the first caudal in all its parts except the hæmapophyses, and in all its dimensions except the vertical diameter, which is due to the development of the coalesced parts of those elements into a long and strong hæmal spine, *hs*. The anterior hypapophyses, fig. 2, *hy*, which are the smallest, articulate with the surface on the back part of the base of the hæmapophyses of the first caudal vertebra: the posterior hypapophyses, *hy'*, which are more oblong and closer together, articulate with the anterior and larger pair of surfaces, *hy'*, of their own hæmapophyses, fig. 1, *h*. There is a strong rough tuberosity projecting backwards external to each of the anterior hypapophyses. The posterior articular surface is, in the present instance, developed only on the right hæmapophysis, fig. 1, *hy''*; on the left it is represented by a rough tubercle.

From the third to the fifth caudal vertebræ inclusive, the proximal end of each hæmapophysis has both the large anterior transversely oblong surface for its own centrum, and the smaller subcircular posterior surface for the next centrum: the spine, or coalesced portions, of the third pair is the longest in the caudal series; beyond this it progressively diminishes. In the sixth caudal vertebra the hæmapophyses have a rough protuberance instead of the posterior articular surface. After the eighth the protuberance subsides to a rough ridge. In the eleventh caudal (Plate XXIV. figs. 3–6) the distal end of the coalesced and shortened hæmapophyses, *hy*, is truncate, and as broad as the divided bases. The under surface of the corresponding centrums of the sixth to the eleventh caudal offers the articular surface on the anterior pair of hypapophyses, fig. 6, *hy'*; the posterior pair, ib. *hy*, are rough tuberosities. The posterior zygapophyses (figs. 3, 4, 5, *z' z'*) retain their articular surfaces to the tenth caudal: in the eleventh they are mere angular projections. The metapophyses, *m m*, are continued to the fourteenth caudal. The neural spine is reduced to a low tuberosity on the thirteenth caudal (fig. 7, *ns*): the neural arch continues complete to the sixteenth, fig. 8, *n*: in the seventeenth, fig. 10, the neurapophyses, *n*, are mere exogenous ridges, bounding the sides of an open neural groove. The hæmapophyses are continued to the fourteenth vertebra: two pair of rough low hypapophysial tubercles, *hy*, *hy*, fig. 9, continue to be developed to the sixteenth: they subside on the penultimate caudal, fig. 11, in which the diapophyses are represented by an obtuse ridge on each side of the centrum. In the last centrum, figs. 12, 13, all the processes have disappeared, and it presents the form of a low rounded cone, with a smooth concave pentangular base, fig. 13, and a rough tuberous summit, fig. 12. This simplified modification of the central element terminates the vertebral series.

Comparison of the Vertebral Column.

In the number of the true vertebræ, as well as of their kinds, the *Myrmecophaga jubata*, amongst the *Edentata*, agrees with the Megatherium. The Ai, or Three-toed Sloth, *Bradypus tridactylus*, has the same number of dorsal and lumbar vertebræ, but has two more in the cervical region; the Unau, or Two-toed Sloth, *Cholæpus didactylus*, has the same number of cervical and lumbar, but has eight additional dorsal vertebræ, being the greatest number known in any mammalian quadruped. The Short-tailed Manis (*Manis brevicaudata*) has seven cervical and sixteen dorsal vertebræ, but it differs from the Megatherium in having five lumbar vertebræ. The Armadillo tribe (*Dasypodidæ*) differ most from the Megatherium in the inferior number of the dorsal vertebræ, which do not exceed eleven in some species, nor twelve in any. The Orycterope, *Orycteropus capensis*, shows its affinity to the Armadillos in having but thirteen dorsal vertebræ: and, like them, it has five lumbar vertebræ. With regard to the structure of the vertebræ, the Anteaters, both hairy (*Myrmecophaga*) and scaled (*Manis*) most resemble the Megatherium in the length and the uniform backward inclination of the spinous processes; but these processes are not so long in proportion to their antero-posterior extent. The spinous processes of the dorsal vertebræ are short and, in the hinder ones, obsolete in the Sloths: the Unau shows the nearest affinity to the Megatherium by having a few of the anterior dorsal spines better developed than in the Ai. In the Orycterope the last dorsal spine is vertical, indicating a centre of motion in the trunk, those behind and those before slightly converging towards this centre.

In the development of the accessory articular surfaces upon both anapophysis and parapophysis of the last dorsal and lumbar vertebræ, the Megatherium manifests a more direct departure from the Sloths and a proportionate affinity to the Anteaters. The Armadillos, which likewise possess these accessory joints, have superadded peculiarities of the posterior dorsal and lumbar vertebræ, in relation to the support of their peculiar bony armour, of which the Megatherium offers as little trace as do the *Myrmecophagæ*: I allude to the progressively and rapidly increasing length of the metapophysis *. These, in the lumbar region, equal in length the spinous process itself; to which the metapophyses bear the same relation in the support of the over-arched carapace that the tie-bearers do to the king-post in the architecture of a roof. From the fact of the metapophyses in the dorsal and lumbar vertebræ of the Megatherium, Plate XVII. and Plate XIX. figs. 4 and 5, *m*, not being developed beyond the state of a tubercle, I long ago drew the inference that, like the Sloths and Anteaters, it was not covered by a bony armour †.

* See Plate XLIX. figs. 18 & 19, *m*, of Part I. of this memoir, Philosophical Transactions, 1851.

† Geological Transactions, 2nd Series, vol. vi. p. 101 (1839).

With regard to the cervical vertebræ, the fact of the Megatherium having the normal number in the Mammalian class, seven—if it were not sufficiently established by the well-adjusted articulations of those in the skeleton here described, rendering any supplemental vertebræ inadmissible,—would have been made most probable by the same number being present in the skeleton of the Megatherium at Madrid, and in the more complete skeleton of the *Mylodon* in the Museum of the Royal College of Surgeons in London. Moreover, that one of the Megatherioids had seven cervical vertebræ and no more is certain: the skeleton of the *Scelidotherium*, discovered and deposited by Mr. Darwin in the Museum of the Royal College of Surgeons, having been imbedded, without disturbance of the true vertebræ, and those of the neck being exposed in the ordinary number, and in their natural juxtaposition, on the removal of the stony matrix*.

The atlas in both the Ai and Unau presents but two perforations on each side upon the upper surface; one in front, the other behind the base of the transverse process, and this is less produced and is of a quadrate rather than a triangular form.

The dentata of the Unau resembles more that of the Megatherium in the size of the spinous process than that of the Ai does; but the spine in the Unau is pointed behind, not bifurcate. In the forms and proportions of the spines of the succeeding cervical vertebræ the Unau approaches nearer to the Megatherium than does any other existing Edentate species; but the spine of the seventh cervical is by no means proportionally so developed, and metapophyses are not present in any. The Armadillos are distinguished from all other *Bruta* by the great breadth, the shortness and the anchylosis of the middle cervical vertebræ. In the Anteaters (*Myrmecophaga*) the spine of the dentata is low and is extended more forwards than backwards; the spines of the other cervical vertebræ are still less elevated. In the long-tailed Manis very similar proportions of the cervical spines prevail.

The closest correspondence with the Megatherium in the form and structure of the cervical vertebræ is presented as might be expected by its extinct congeners, the *Mylodon* and *Scelidotherium*.

A resemblance of the Armadillos to the Megatherium has been pointed out in the ossification of the sternal ribs, but this is a character common to the order Edentata, and is consequently equally manifested by the Sloths. The Anteaters most resemble the Megatherium in the double joints by which the sternal ribs articulate with the sternum. There is, however, a character by which the Sloths peculiarly resemble the Megatherium, viz. in the anchylosis of the sternal with the vertebral portion of the rib in those of the first three dorsal segments. The Unau most resembles the Megatherium in the form of the manubrium sterni, having the same prolongation of that bone in advance of the expanded part giving articulation to the first rib. This prolongation, which is not present in the *Bradypus tridactylus*, relates to the complete

* Description of the Fossil Mammalia collected during the Voyage of the Beagle, 4to. 1838–40. pl. 20. p. 84.

development of the clavicles in the *Cholœpus didactylus*, and serves, as in the Megatherium, for their ligamentous attachment. In other existing *Bruta* the manubrium sterni has a broader and shorter figure, and is generally emarginate anteriorly. The succeeding sternal bones present the nearest resemblance to those of the Megatherium in the genus *Myrmecophaga*, in which they are divided into two parts, each having articular surfaces for those on the bifurcate ends of the ossified sternal ribs; but here the broad depressed portion of the sternal bone is external, the stumpy cylindrical part internal or toward the thoracic cavity. The small subcubical sternebers of the Sloths represent the peripheral divisions only of the more complex bones in the Megatherium. Only the Sloths and Anteaters resemble the Megatherium in the small number of the lumbar vertebræ, and the Megatherium most resembles the *Myrmecophaga* in the number and complexity of the articulations between these. The genera *Manis*, *Dasypus* and *Orycteropus* have five lumbar vertebræ.

Both the *Mylodon* and *Scelidotherium* have three lumbar vertebræ; but these had coalesced with each other and with the sacrum in the skeleton of the *Mylodon robustus* described by me*.

The *Myrmecophagœ* have five sacral vertebræ as in the Megatherium: the Orycteropus has six: so likewise has the *Bradypus tridactylus*: the *Bradypus didactylus* has seven sacral vertebræ; the Armadillos depart furthest from the Megatherium in the unusual number of vertebræ which coalesce to form the sacrum, these ranging from eight to ten in the different species.

It would be unsafe, however, to infer that the Megatherioids were more nearly allied to the Anteaters than to the Sloths in respect of the structure of the sacrum of the Megatherium, for the *Mylodon robustus* has seven sacral vertebræ, like the *Bradypus didactylus*. The posterior expansion of the sacrum and its junction with the ischia, so as to circumscribe the great ischiatic notch, is a character common to the Order *Bruta*. The sacrum early anchyloses with the iliac bones in the Sloths; and the broad and expanded ilia of these animals, with the long and slender anterior parts of the ischia and pubes, circumscribing a large obturator foramen, and bounding a capacious pelvis in front by a narrow symphysis, are characters by which the Sloths, of all existing *Edentata*, offer most resemblance in their pelvis to the Megatherium.

The part of the skeleton in which the Sloths differ most from the Megatherium is the tail, which is so short as to be hardly visible in the entire animal; whilst the Anteaters and Armadillos present the extensive and complex development of caudal vertebræ which characterizes the Megatherioid skeletons. In all the existing species of the ground-dwelling Edentate families the tail is relatively longer and more slender than in the Megatherium; it is even prehensile in the *Manis longicaudatus* and in the *Myrmecophaga didactyla*; but of the modifications of the terminal vertebræ on which

* Description of the Skeleton of the *Mylodon robustus*, 4to. 1842.

that power depends there is no trace in the Megatherium any more than in the Mylodon.

The hæmapophyses are distinct, but short and stumpy, in the first caudal vertebra of the *Dasypus longicaudatus*, Pr. Max.: in the *Myrmecophaga jubata* they present proportions much more nearly resembling those in the first caudal vertebra of the Megatherium, and they are equally disjoined at their distal ends *.

The Mylodon in the number, as well as the proportions and structure of the caudal vertebræ, makes the nearest approach to the Megatherium; the hæmapophyses are equally distinct from each other in the first caudal †.

Upon the whole, our deductions from the characters of the parts of the skeleton described in the present section of this memoir, would lead to an inference that *Megatherium* was nearer akin to *Myrmecophaga* than to *Bradypus*; nevertheless the cervical vertebræ, the condition of the anterior ribs, the form of the manubrium sterni, and the pelvis, illustrate the intermediate nature of the giant's affinities, and afford an additional instance to many others which I have had occasion to point out, of a closer adherence to a common type in extinct animals than in the existing species to which they may be most nearly allied.

Description of the Plates.

PLATE XVII.

Skeleton of the Megatherium, on the scale of one inch to a foot. (The vertebræ concealed by the scapula are added in outline.)

C 1–7. Cervical vertebræ.
D 1–16. Dorsal vertebræ.
L 1–3. Lumbar vertebræ.
S. Sacrum.
Cd 1–18. Caudal vertebræ.
38. Stylohyal.
51. Scapula.
53. Humerus.
54. Ulna.
55. Radius.
s. Scaphoid part } of Scaphotrapezium.
t. Trapezial part }
l. Lunare.
c. Cuneiforme.
p. Pisiforme.
d. Trapezoides.
m. Magnum.
u. Unciforme.
I. Rudimentary metacarpal of first digit or pollex.
II. Second digit, or index.
III. Third digit, or medius.
IV. Fourth digit, or annularis.
V. Fifth digit, or minimus.
62. Ilium.
63. Ischium.

* See Philosophical Transactions, 1851, Plate LIII. fig. 60.

† Memoir on the Mylodon, 4to. p. 69, pl. 8, fig. 5, *b*, *b*.

64. Pubis.
65. Femur.
66. Tibia.
66′. Patella.
67. Fibula.
67′. Fabella.
a. Astragalus.
cl. Calcaneum.
s. Scaphoides.
ce. Ectocuneiform.
b. Cuboides.
II. Rudimentary metatarsal of second digit.
III. Third digit.
IV. Fourth digit.
V. Fifth digit. (There is no rudiment of the first or innermost toe of the hind foot in the Megatherium.)

PLATE XVIII.

Typical vertebræ in the Megatherium. One-fourth natural size.

Fig. 1. Fifth dorsal vertebra, or natural segment of the skeleton. *c.* Centrum, *c′.* articular tubercle for head rib; *n,* neurapophysis, *n′,* neurapophysial surface for neck of rib; *d,* diapophysis, *d′,* diapophysial surface for tubercle of rib; *z,* anterior zygapophysis; *m,* metapophysis; *ns,* neural spine; *pl,* pleurapophysis or 'vertebral rib'; *c″,* head; *n″,* articular surface on upper part of the neck; *d″,* articular surface on tubercle; *h,* hæmapophysis or 'sternal rib,' *s′, s′,* its condyles; *hs,* hæmal spine, or 'sternal bone;' *s″, s″,* articular surfaces for hæmapophysial condyles.

Fig. 2. First caudal vertebra. *n.* Neural arch; *p,* parapophysial part, *d,* diapophysial part, *pl,* pleurapophysial part, of compound transverse process; *hy,* hypapophyses; *h,* hæmapophysis, *hy′,* articular surface for its own vertebra, which is in advance; *hy″,* articular surface for succeeding vertebra.

PLATE XIX.

Fig. 1. Seventh dorsal vertebra, front view.
Fig. 2. Seventh dorsal vertebra, back view.
Fig. 3. Seventh dorsal vertebra, side view.
Fig. 4. Sixteenth dorsal vertebra, front view.
Fig. 5. Sixteenth dorsal vertebra, back view.

All the figures are drawn, minus the hæmal arch, one-fourth natural size.

c′. Articular tubercle for the head of the rib; *n′,* neurapophysial articular surface for the neck of the rib; *d,* diapophysis, *d′,* diapophysial articular surface for tubercle of rib; *m,* metapophysis, *mz′,* metapophysial articular surface; *a,* anapophysis, *a′,* anapophysial articular surface; *p,* parapophysis, *pa,* parapophysial articular surface; *z,* anterior, *z′,* posterior, *mz,* mid-anterior, *mz′,* mid-posterior, zygapophyses; *ns,* neural spine.

PLATE XX.

Fig. 1. The atlas, upper view.
Fig. 2. The atlas, under view.
Fig. 3. The atlas, back view.
Fig. 4. The atlas, side view.
Fig. 5. The seven cervical and first dorsal vertebræ, upper view.
Fig. 6. The seventh cervical vertebra, back view.
Fig. 7. The seventh cervical vertebra, side view.

One-fourth natural size; *c*, centrum; *n*, neurapophysis; *ns*, neural spine; *d*, diapophysis, d_3–d_7, of the third to the seventh cervicals inclusive; *pl*, pleurapophysis; *pl'*, (fig. 7) articular surface for head of first dorsal rib; *m*, metapophysis; *nz* (fig. 2), anterior articular surface; *z'*, posterior zygapophysis; *hy*, hypapophysis; *o*, (figs. 1 & 3) its articular surface for the odontoid or true body of the atlas; *r*, division of the foramen alare posterius, for the passage of the posterior branch of the occipital artery; *s*, division of the same foramen for the passage of a branch of the second spinal nerve; *v*, foramen alare anterius, communicating with *q* the canal for the vertebral artery.

PLATE XXI.

Fig. 1. The axis, or vertebra dentata, front view.
Fig. 2. The axis, or vertebra dentata, side view.
Fig. 3. The third cervical vertebra, front view.
Fig. 4. The third cervical vertebra, side view.
Fig. 5. The sixth cervical vertebra, front view.
Fig. 6. The sixth cervical vertebra, side view.

One-fourth natural size; *o*, odontoid process (centrum of atlas); *zn*, analogues of anterior zygapophyses, in the dentata; *z*, anterior zygapophysis; *z'*, posterior zygapophysis; *d*, diapophysis; *p*, parapophysis; *pl*, pleurapophysis, *pl'*, its anterior production; *m*, metapophysis; *ns*, neural spine.

PLATE XXII.

First sacral vertebra, with part of its hæmal arch (ilium and pubis).

One-fourth natural size; *c*, centrum; ** exogenous growths; *ma*, metapophysial process and articular surface.

PLATE XXIII.

Fig. 1. The five sacral vertebræ, upper view.
Fig. 2. The five sacral vertebræ, back view.

One-fourth natural size; *c*, centrum; n_1, n_4, coalesced neurapophyses; ns_1, ns_4, coalesced neural spines, of the four anterior vertebræ; ns_5, neural spine of fifth vertebra; $d_{1, 2, 3, 4, 5}$, diapophyses; m_2–m_5, metapophyses; o_1–o_5, posterior outlets of nerve-canals; *z*, anterior, *z'*, posterior, zygapophyses.

PLATE XXIV.

Fig. 1. The second caudal vertebra, back view.
Fig. 2. The second caudal vertebra, under view, minus the hæmal arch.
Fig. 3. The eleventh caudal vertebra, back view.
Fig. 4. The eleventh caudal vertebra, side view.
Fig. 5. The eleventh caudal vertebra, upper view.
Fig. 6. The eleventh caudal vertebra, under view, minus the hæmal arch.
Fig. 7. The thirteenth caudal vertebra, upper view.
Fig. 8. The sixteenth caudal vertebra, upper view.
Fig. 9. The sixteenth caudal vertebra, under view.
Fig. 10. The seventeenth caudal vertebra, upper view.
Fig. 11. The seventeenth caudal vertebra, under view.
Fig. 12. The eighteenth caudal vertebra, back view.
Fig. 13. The eighteenth caudal vertebra, front view.

One-fourth natural size; *c*, centrum; *hy*, anterior, *hy'*, posterior hypapophyses; *h'*, their hæmal articular surface; *n*, neural arch and neurapophyses; *ns*, neural spine; *d*, diapophysis; *pl*, pleurapophysis; *m*, metapophysis; *z*, anterior, *z'*, posterior zygapophysis; *h*, hæmal arch, *hy'*, (fig. 1) its anterior hypapophysial articular surface, *hy''*, its posterior hypapophysial surface; *hs*, hæmal spine.

PLATE XXV.

Fig. 1. First dorsal rib.
Fig. 2. Second dorsal rib.
Fig. 3. Third dorsal rib; one-fourth natural size.
Figs. 1*a*, 2*a*, 3*a*, their upper articulations.
Figs. 1*b*, 2*b*, 3*b*, their lower articulations; one-half natural size.

c'', articular surface on the head for the centrum; *n''*, articular surface on the neck for the neurapophysis; *d''*, articular surface on the tubercle for the diapophysis; *s'*, anterior condyle for sternum, *s''*, posterior condyle for sternum; *pl*, pleurapophysial part, *h*, hæmapophysial part, of rib.

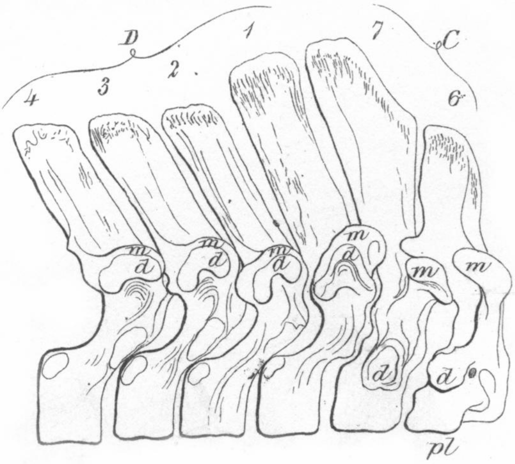
PLATE XXVI.

Fig. 1. Head and neck of the fifteenth dorsal rib, upper view.
Fig. 2. Head and neck of the sixteenth dorsal rib, upper view.
Fig. 3. Head and neck of the fifteenth dorsal rib, side view.
One-half natural size; *n''*, neurapophysial articular surface.
Fig. 4. The thirteenth dorsal vertebra.
Fig. 5. The sixteenth dorsal vertebra.
Fig. 6. The first caudal vertebra, under view, minus the hæmal arch.
Fig. 7. The clavicle.
One-fourth natural size; *c'*, articular surface for the head of the rib; *n'*, neurapophysial surface for the neck of the rib; *p*, parapophysis; *d*, diapophysis; *a*, anapophysis, *a'*, its articular surface; *pl*, pleurapophysis; *hy'*, hypapophysis; *z*, anterior, *z'*, posterior zygapophysis; *ns*, neural spine.

PLATE XXVII.

Hæmapophyses of dorsal vertebræ or bones of the sternum.

Fig. 1. Manubrium sterni, outer or under view.
Fig. 2. Manubrium sterni, inner or upper view.
Fig. 3. Manubrium sterni, side view.
Fig. 4. Sixth sternal bone, inner or central surface.
Fig. 5. Sixth sternal bone, outer or peripheral surface.
Fig. 6. Sixth sternal bone, upper or anterior surface.
Fig. 7. Sixth sternal bone, side view.
Fig. 8. Eighth sternal bone, inner surface.
Fig. 9. Eighth sternal bone, outer surface.
Fig. 10. Eighth sternal bone, upper surface.
Fig. 11. Eighth sternal bone, under surface.
One-fourth natural size; *cl*, surface for the clavicle; *hp*, articular surface for hæmapophysis, or sternal portion of rib; *s* and *s'*, articular surface for contiguous sternal bone; *ha*, anterior outer hæmapophysial surface, *ha'*, posterior outer hæmapophysial surface; *hp*, anterior inner, *hp'*, posterior inner hæmapophysial surface.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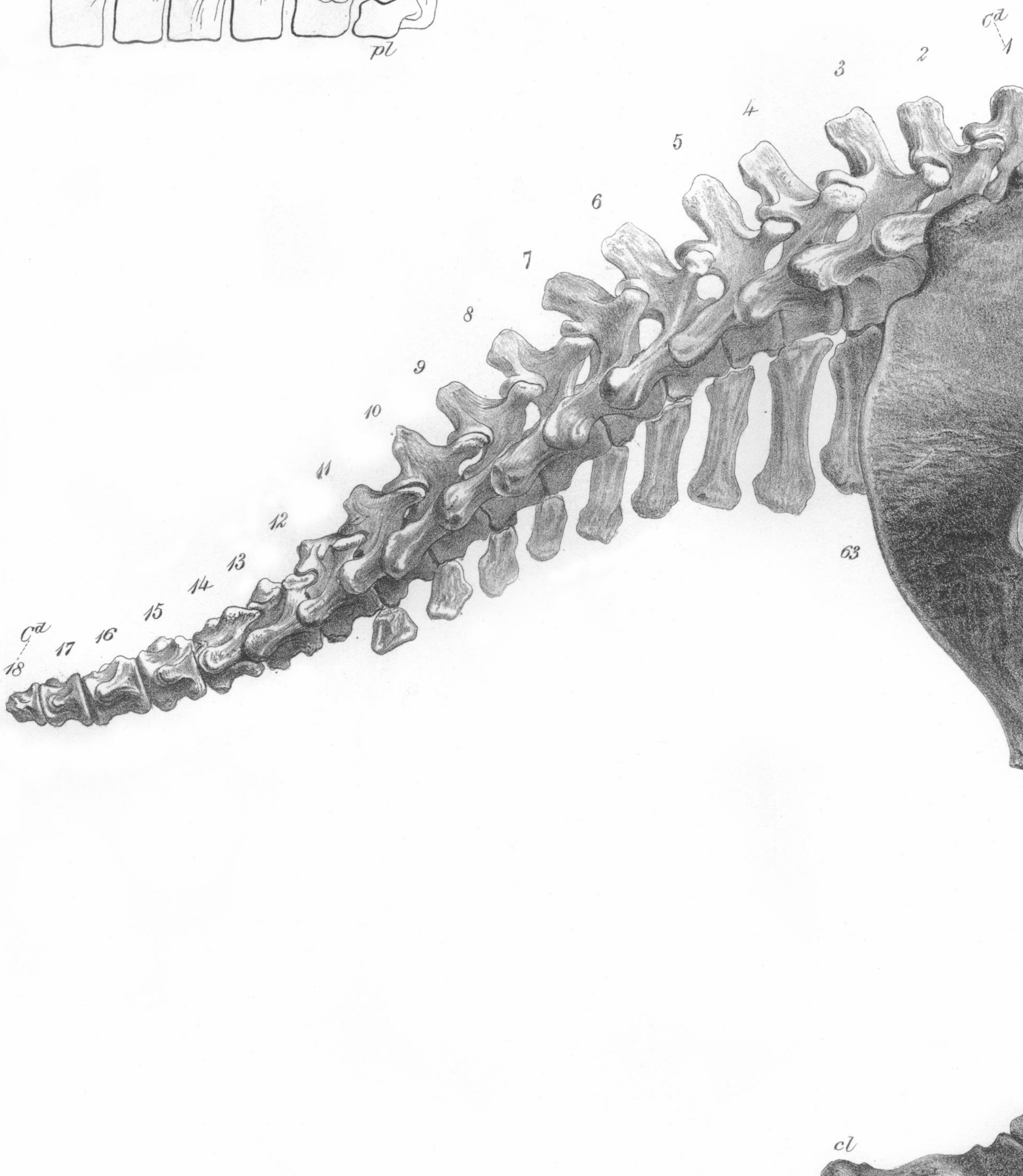
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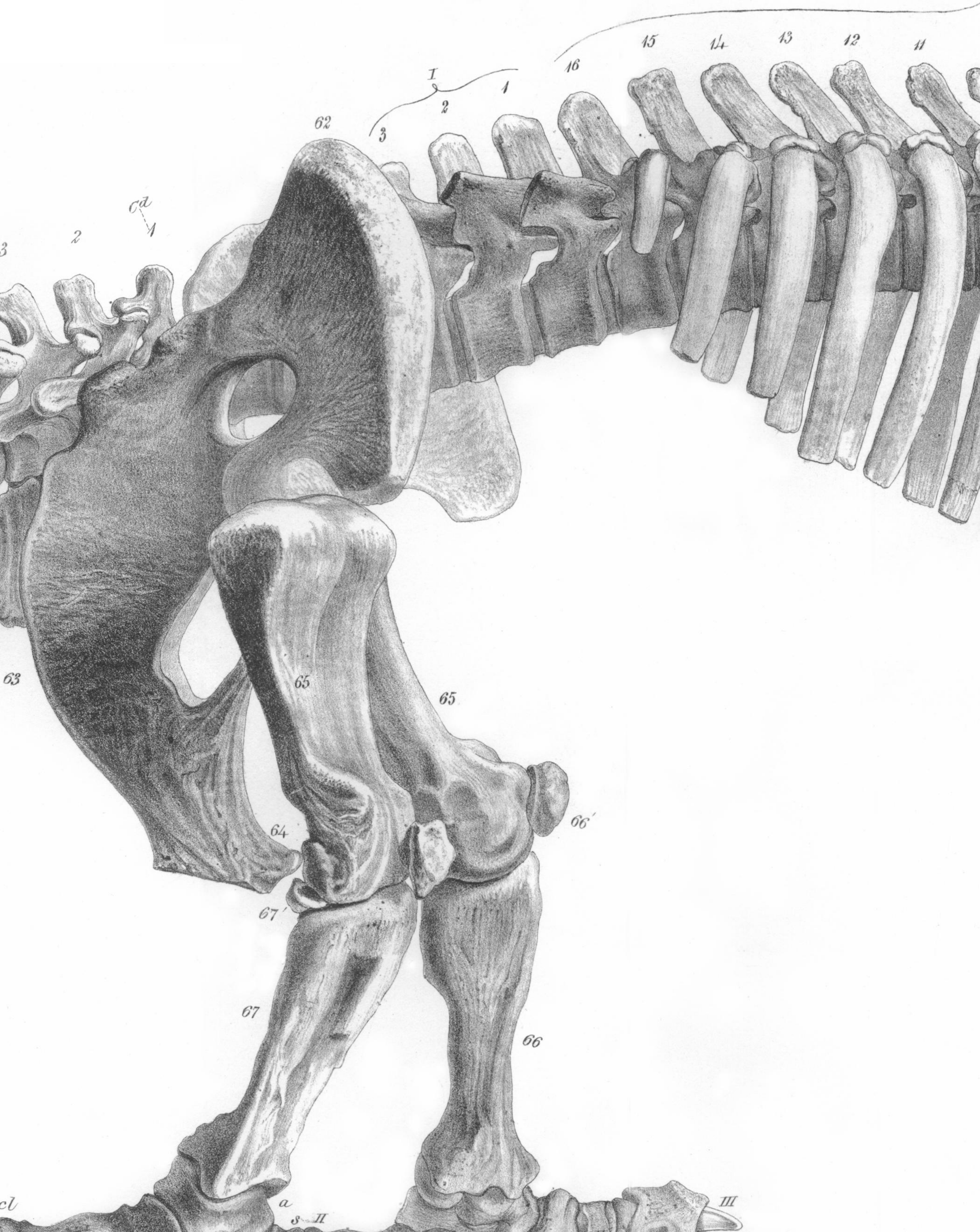

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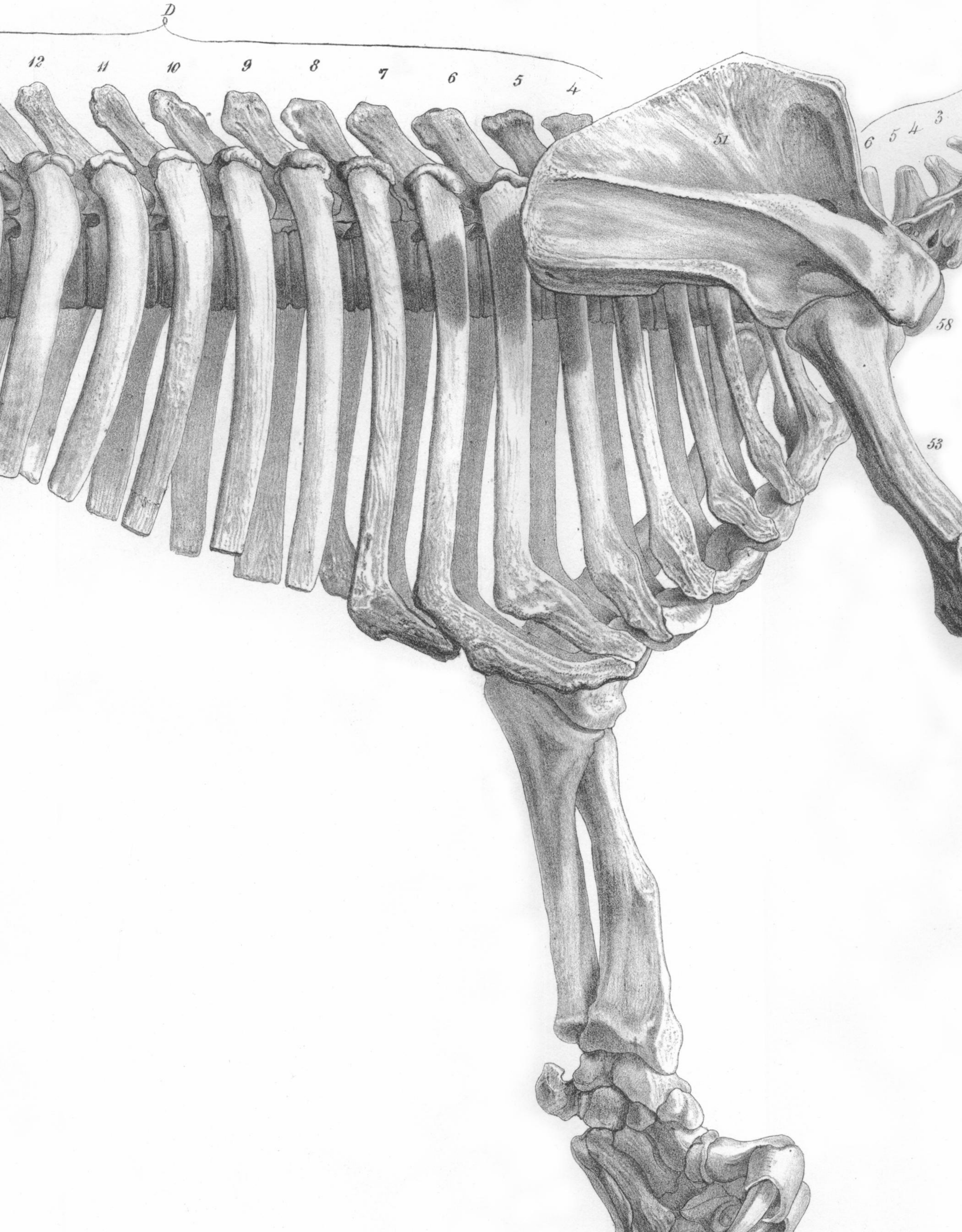
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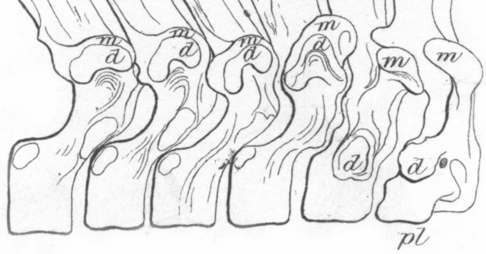

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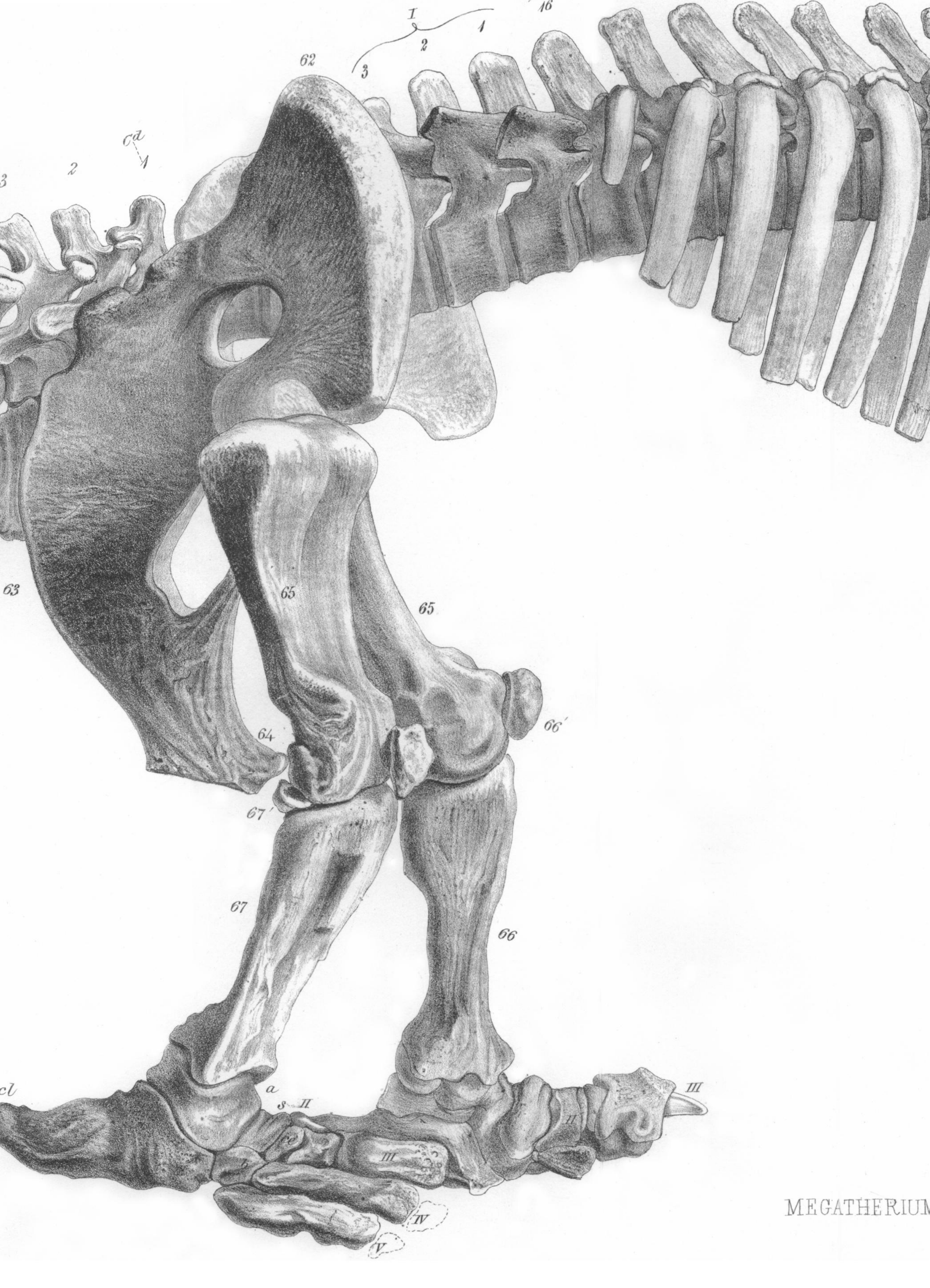
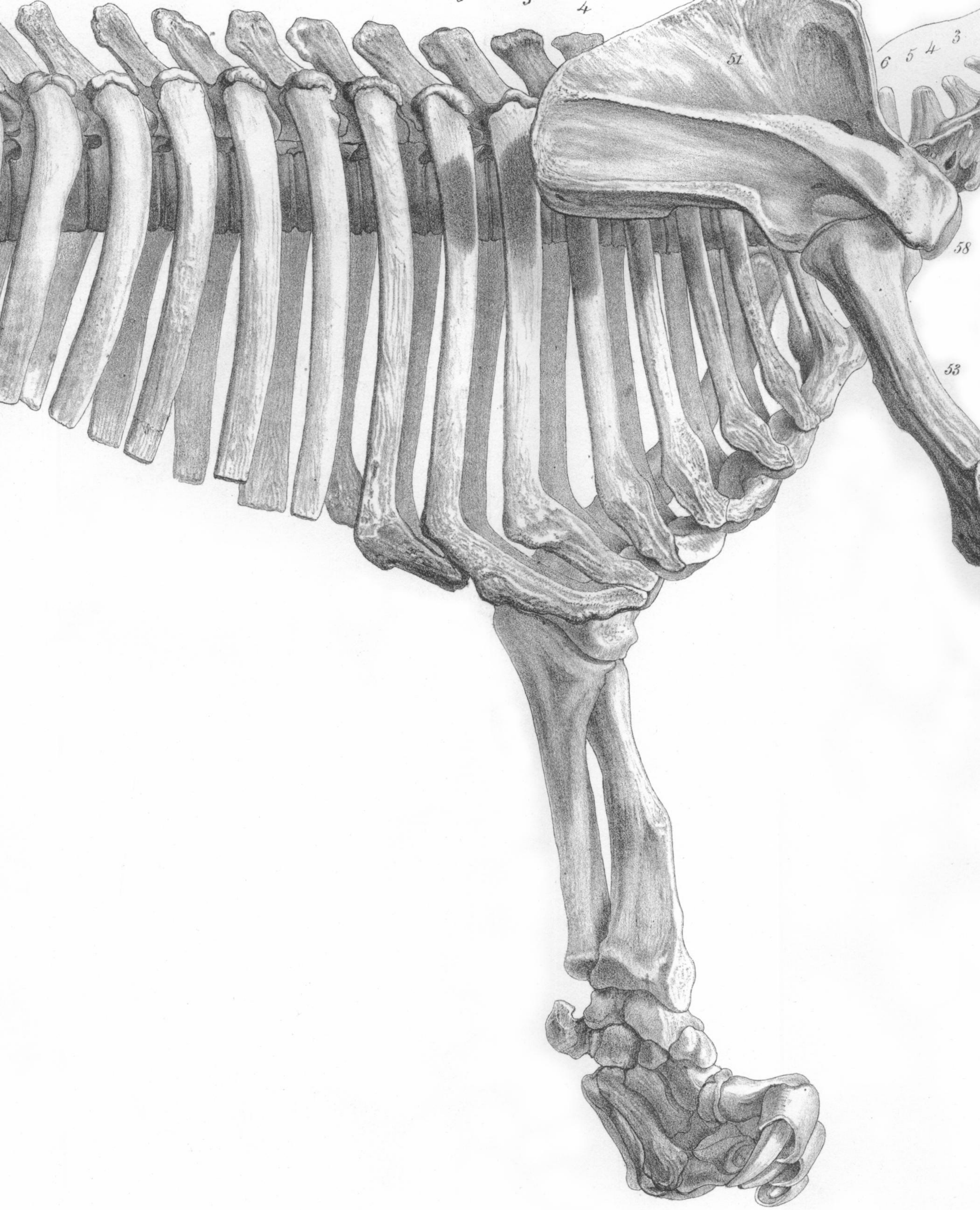


MEGATHERIUM



MEGATHERIUM AMERICANUM.

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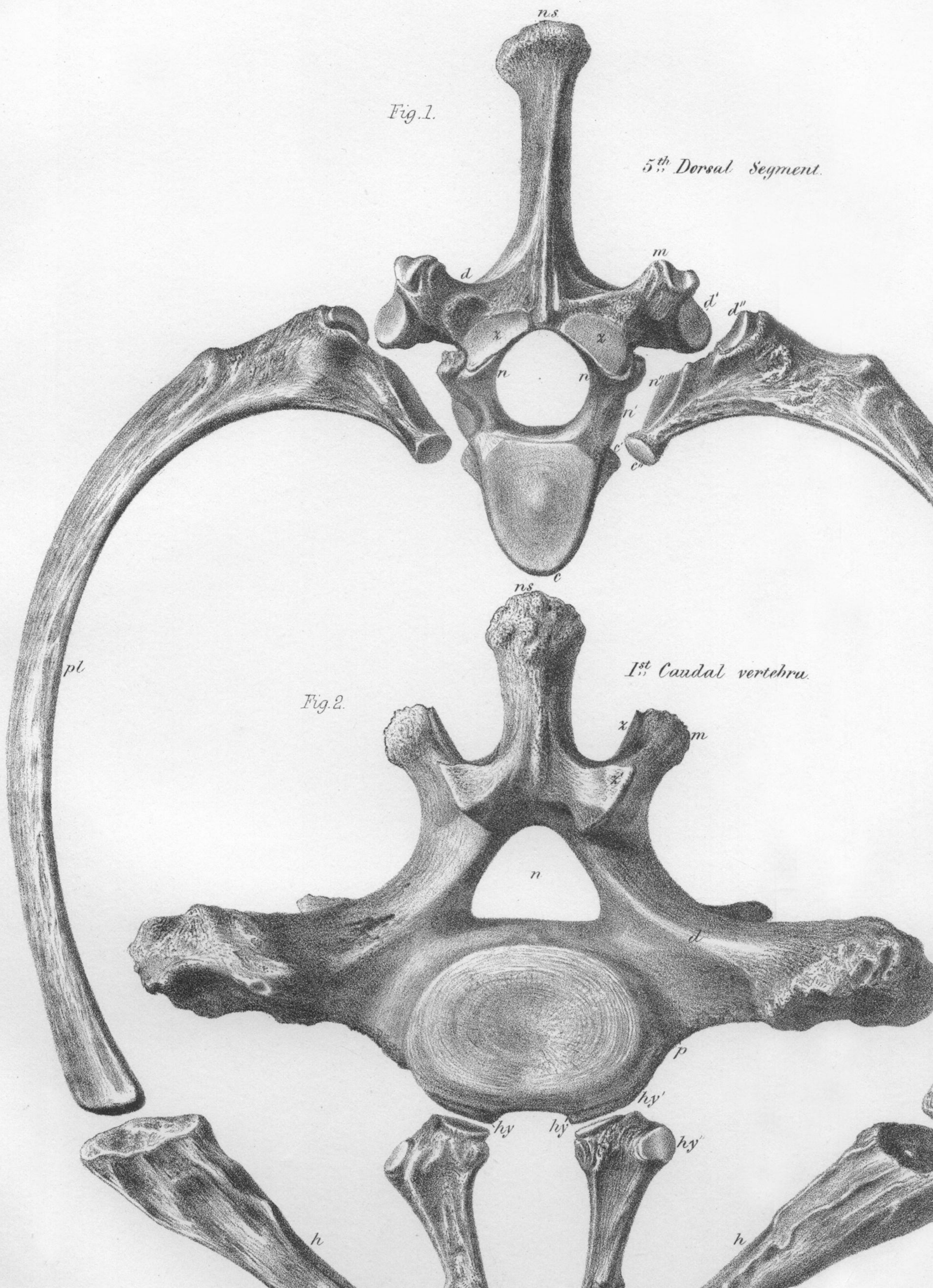

Fig. 1.

5th Dorsal Segment.

Fig. 2.

1st Caudal vertebra.

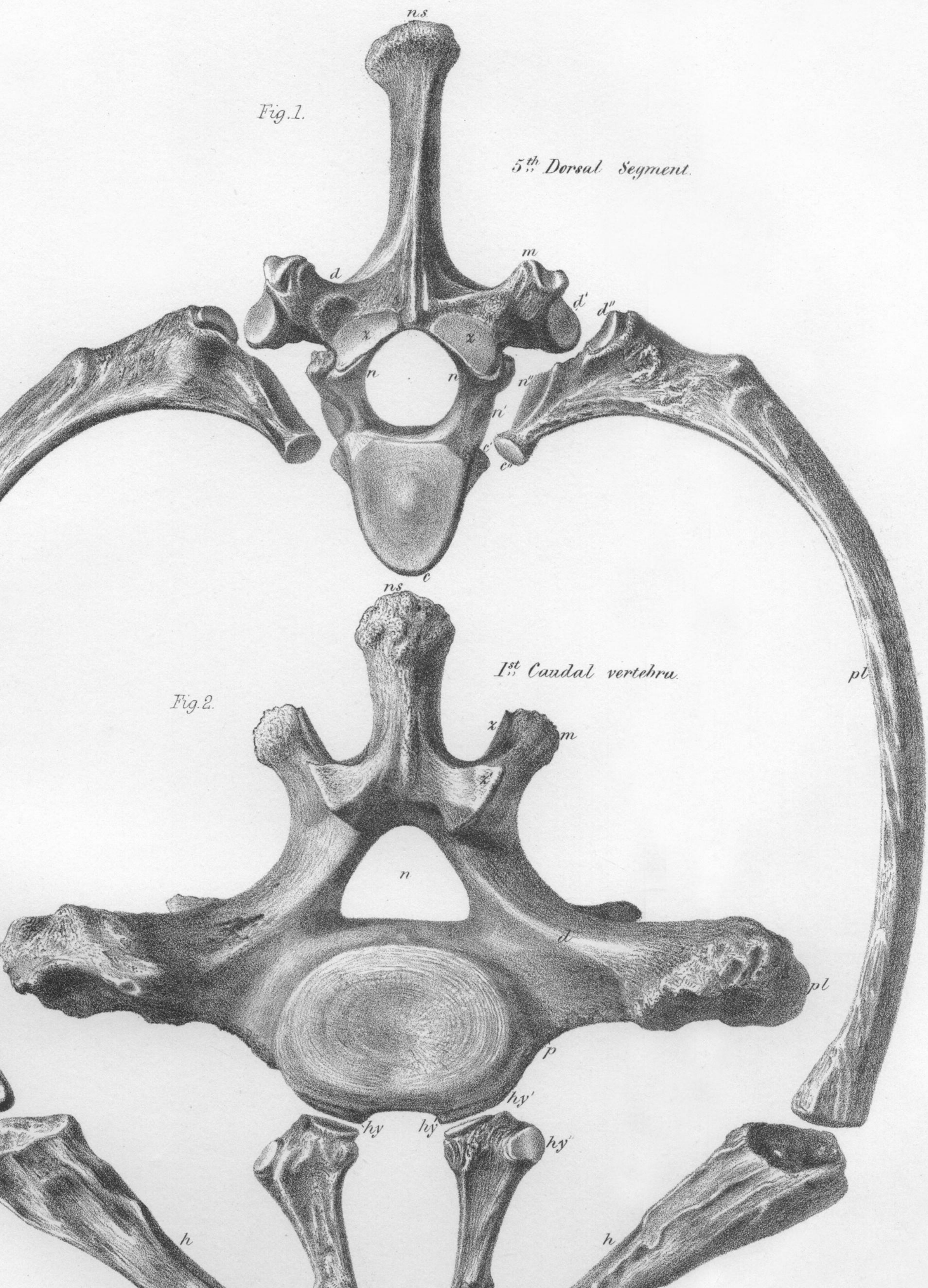
Fig. 1.
5th Dorsal Segment.
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d
d'
d''
z
z
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c'
c''
c
Fig. 2.
1st Caudal vertebra.
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hy'
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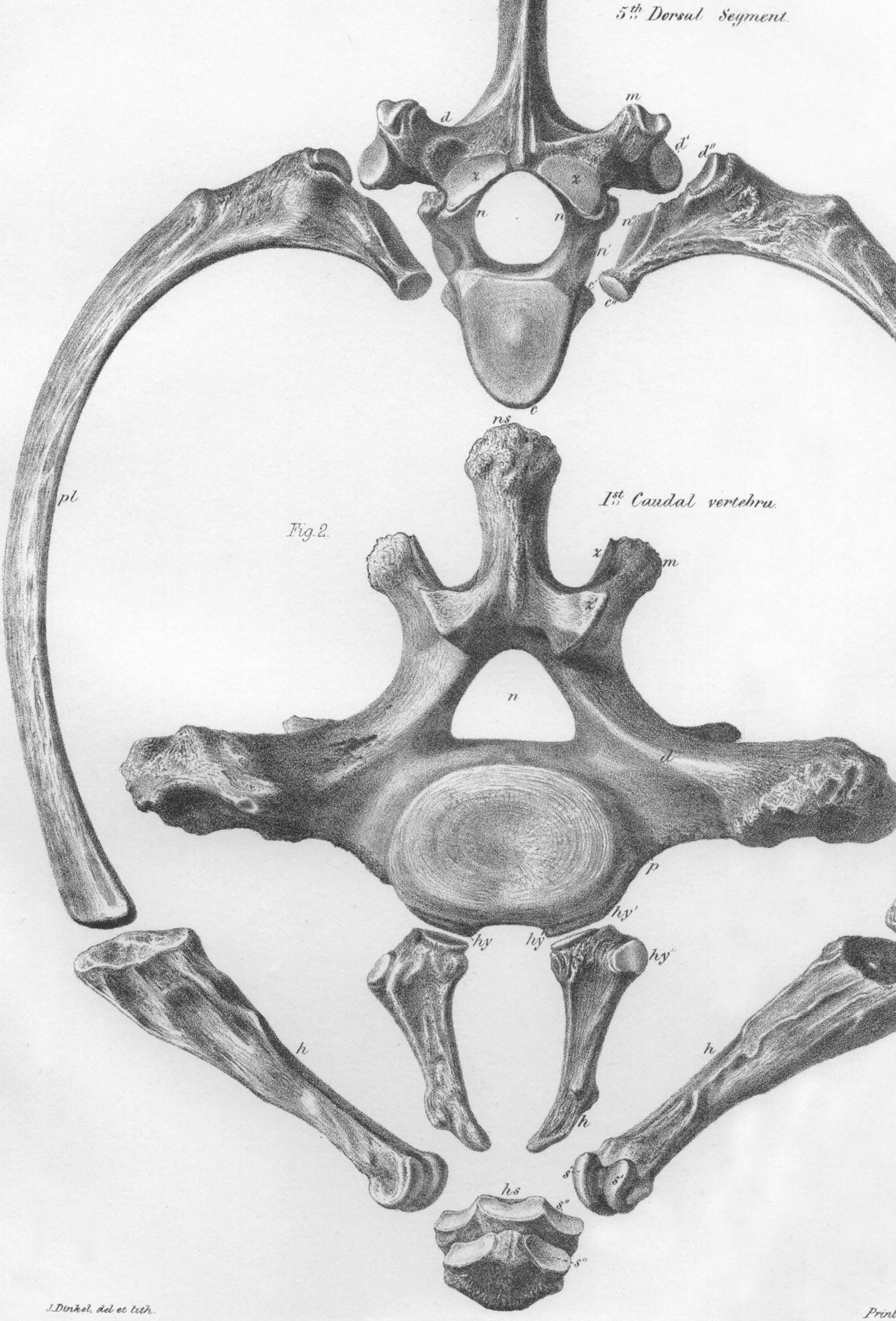
h

5th Dorsal Segment.



1st Caudal vertebra.

Fig. 2.

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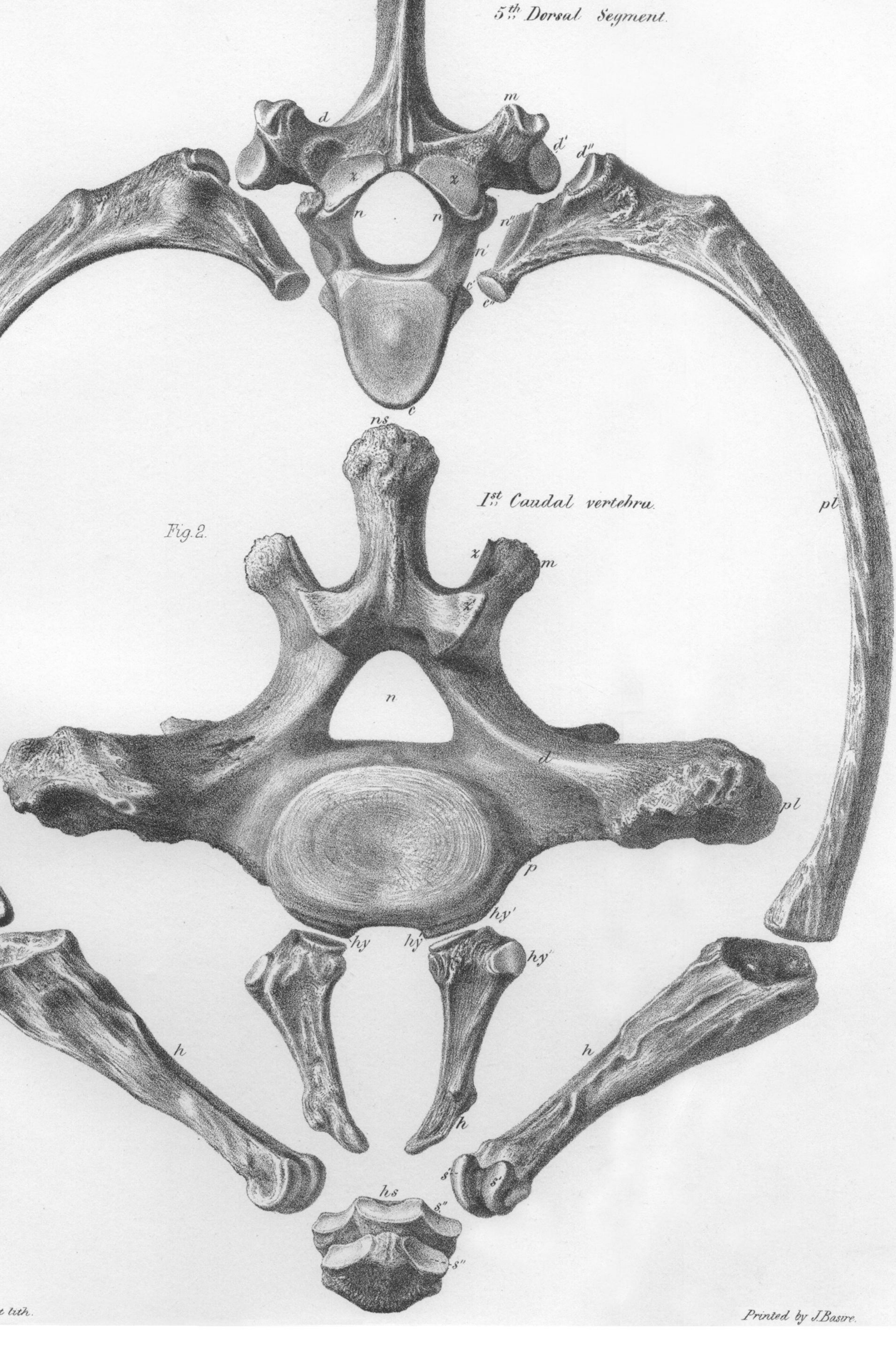

Fig. 2.

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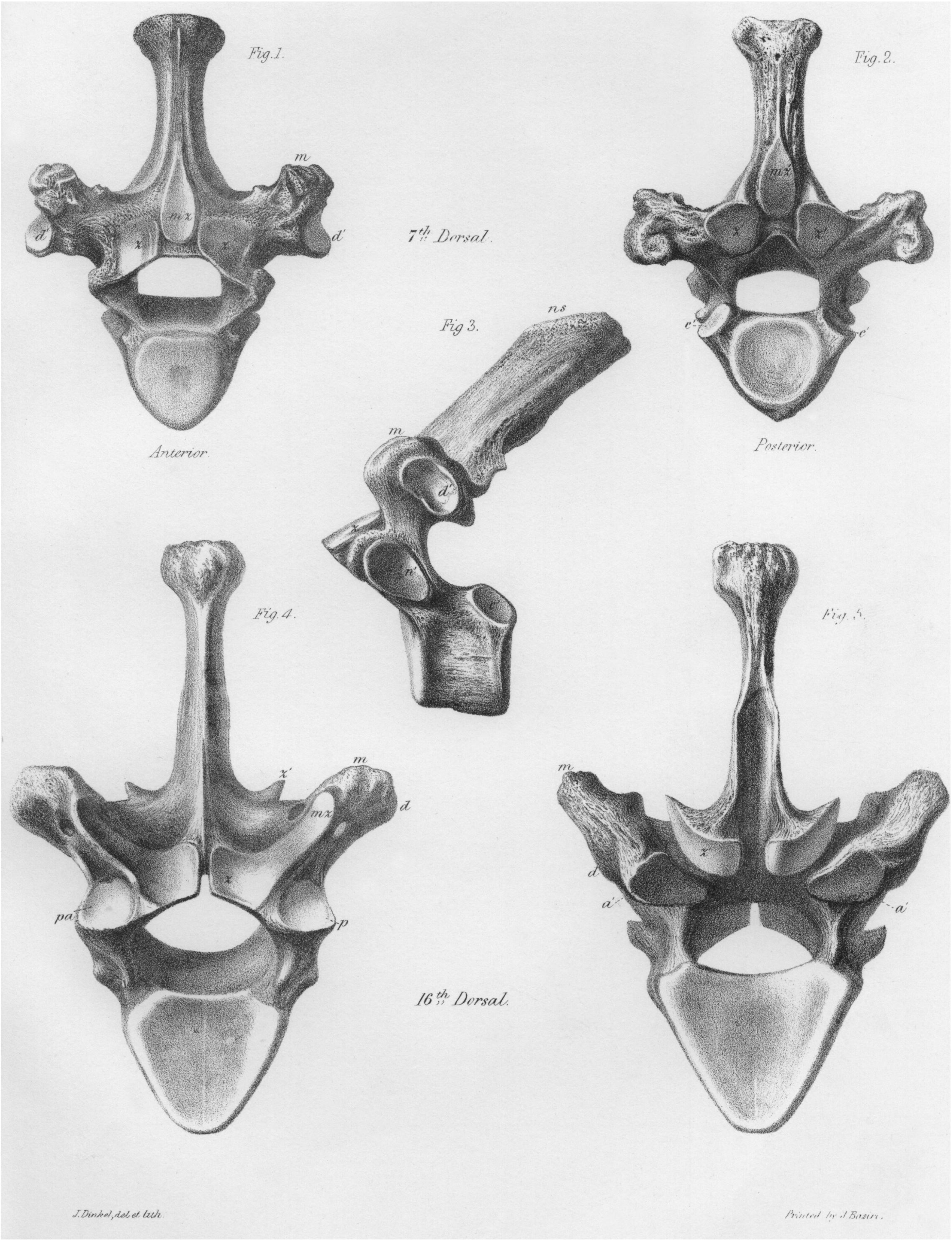

J. Dinkel, del. et lith.

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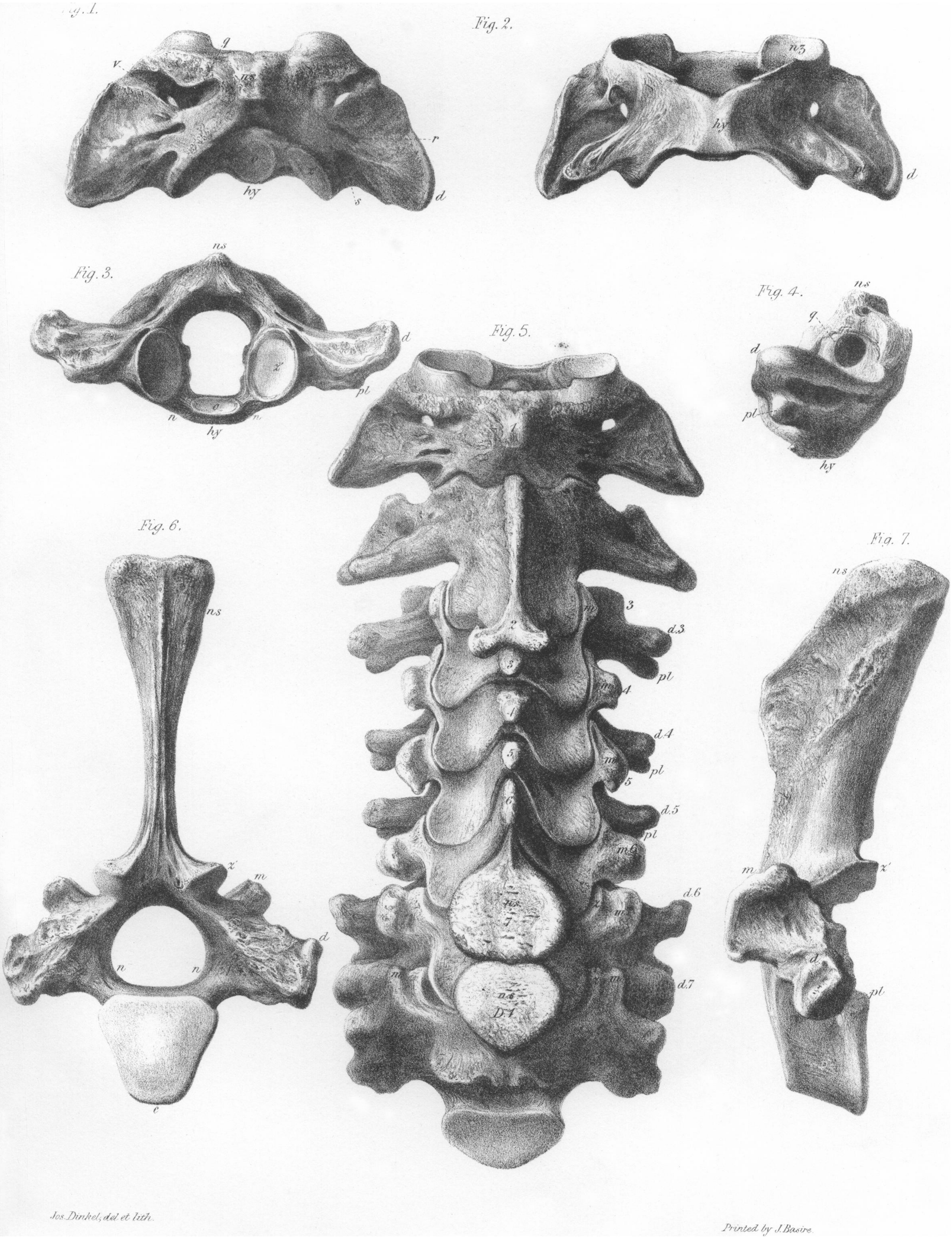

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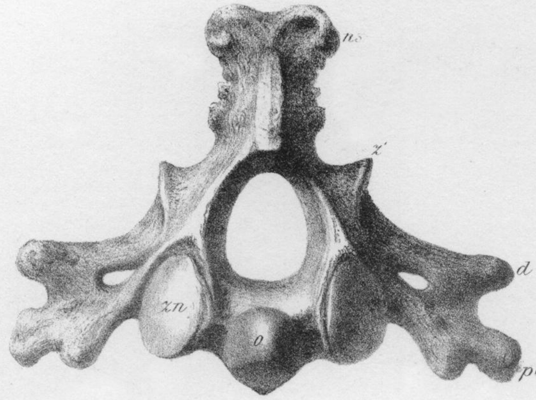

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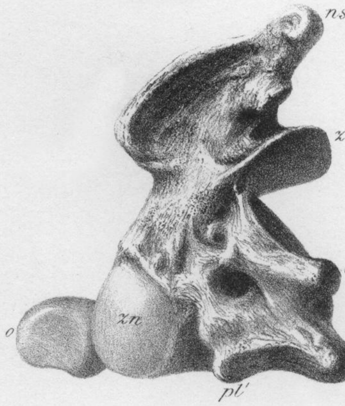

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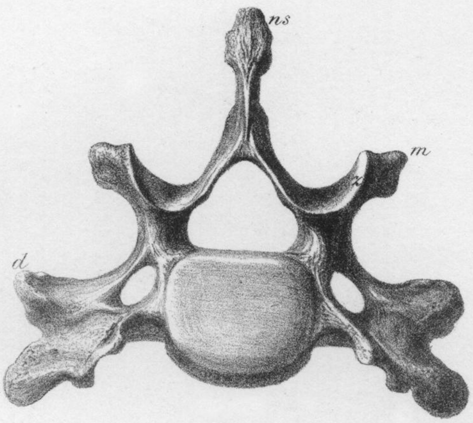

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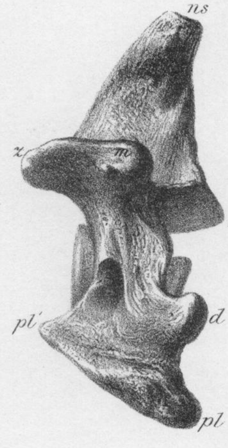

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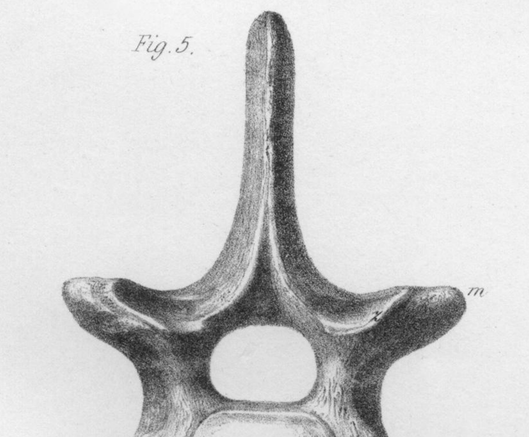

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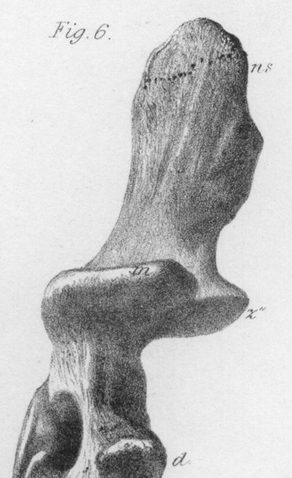

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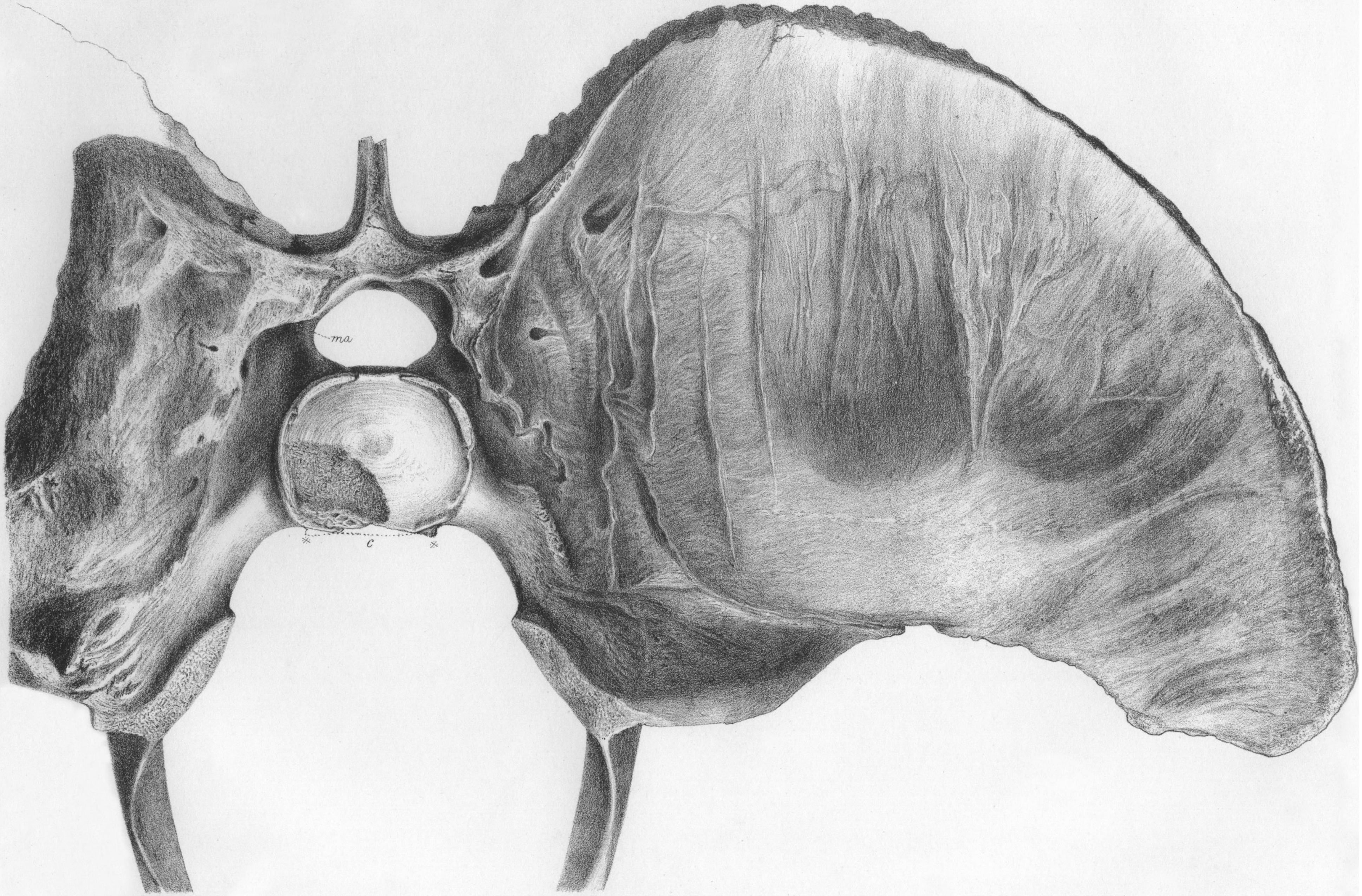

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Phil

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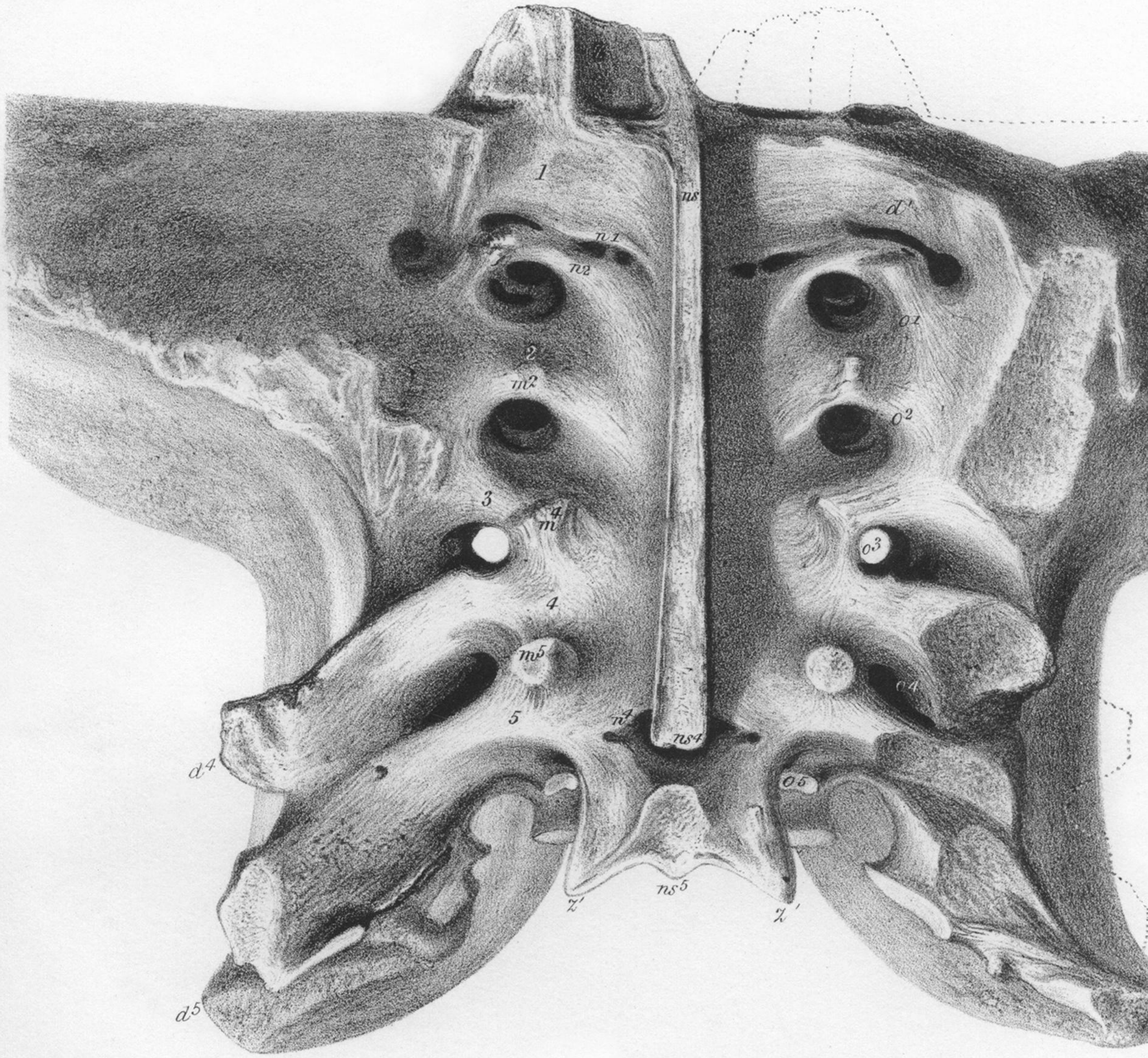

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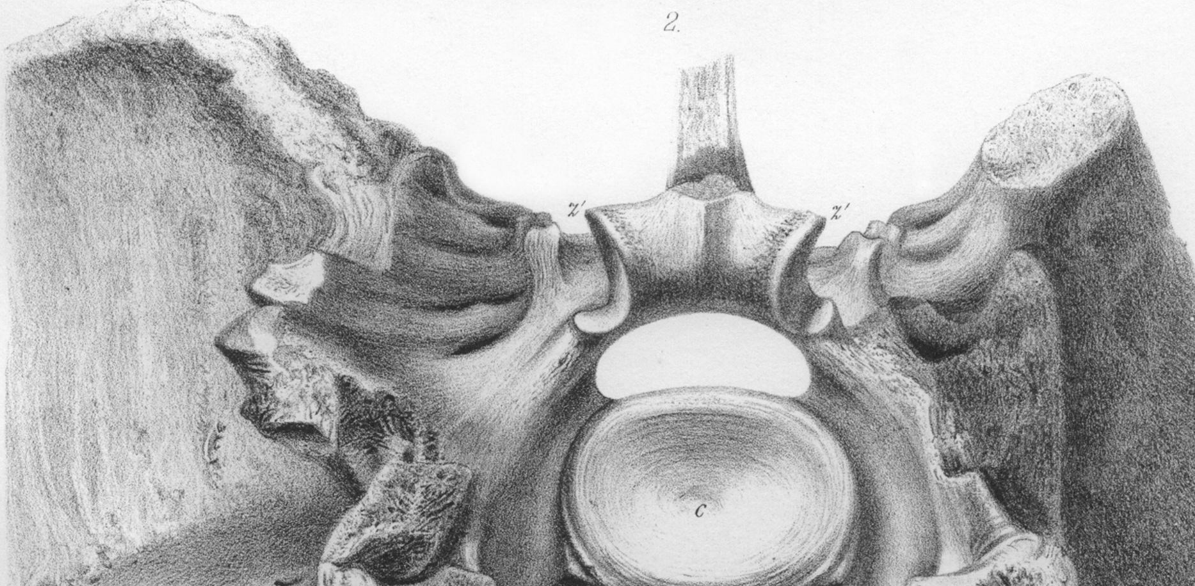

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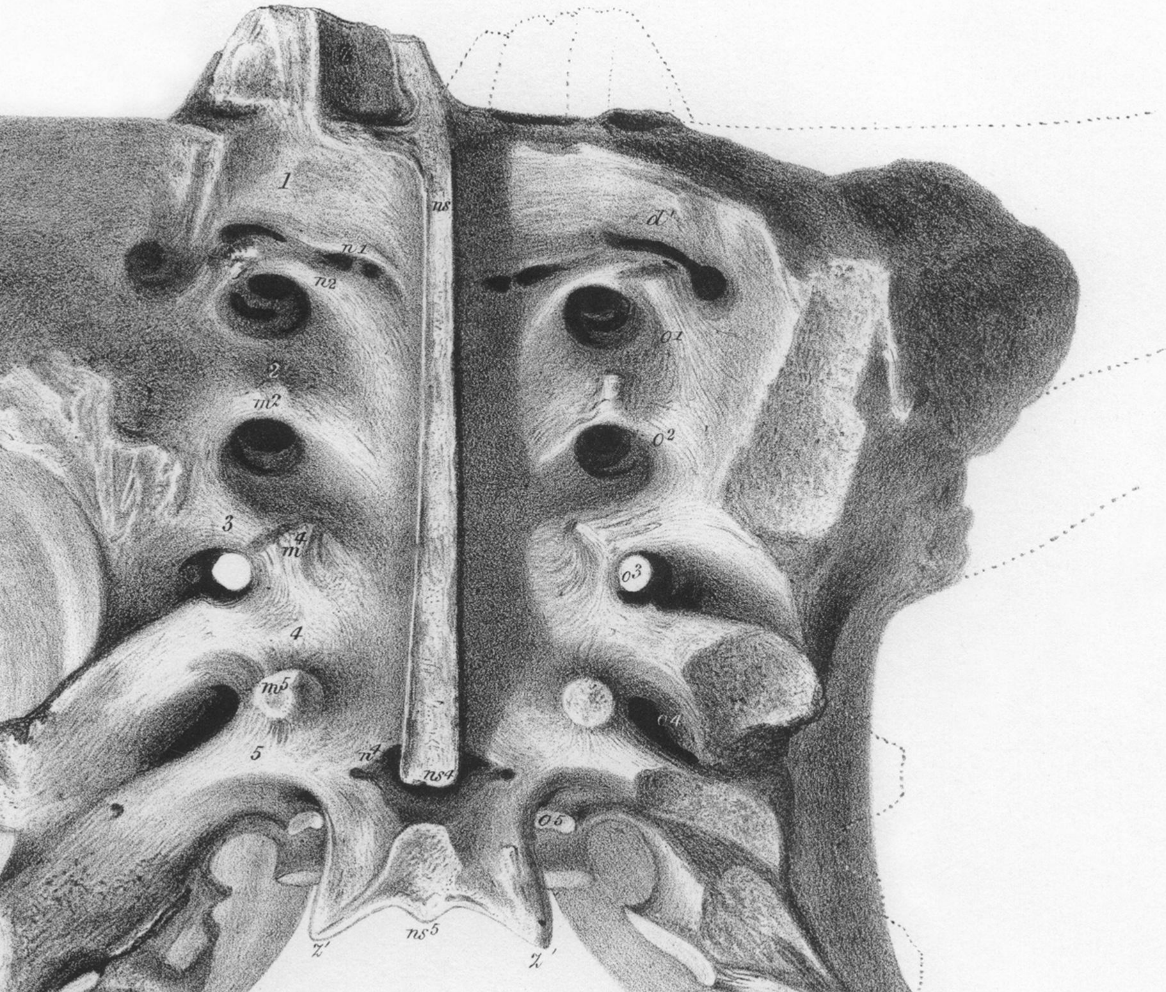

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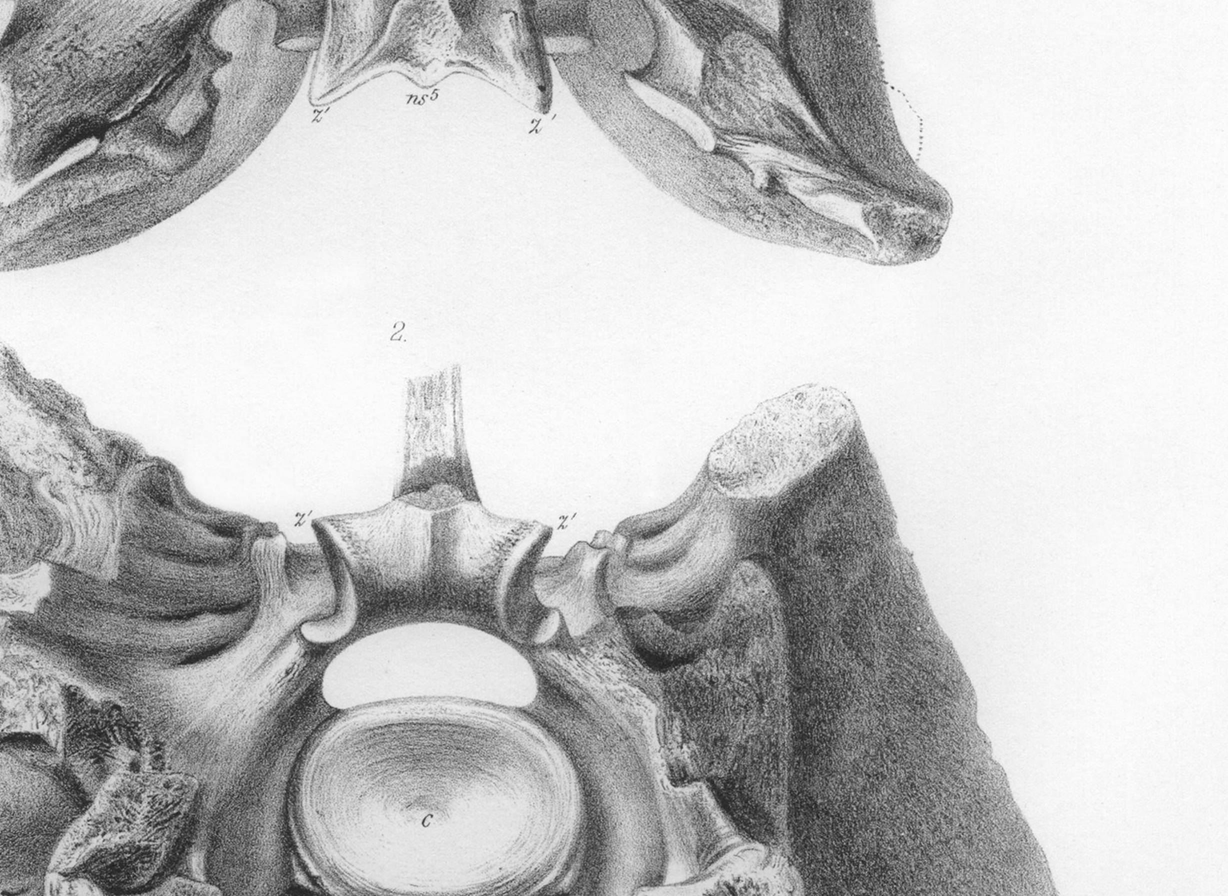

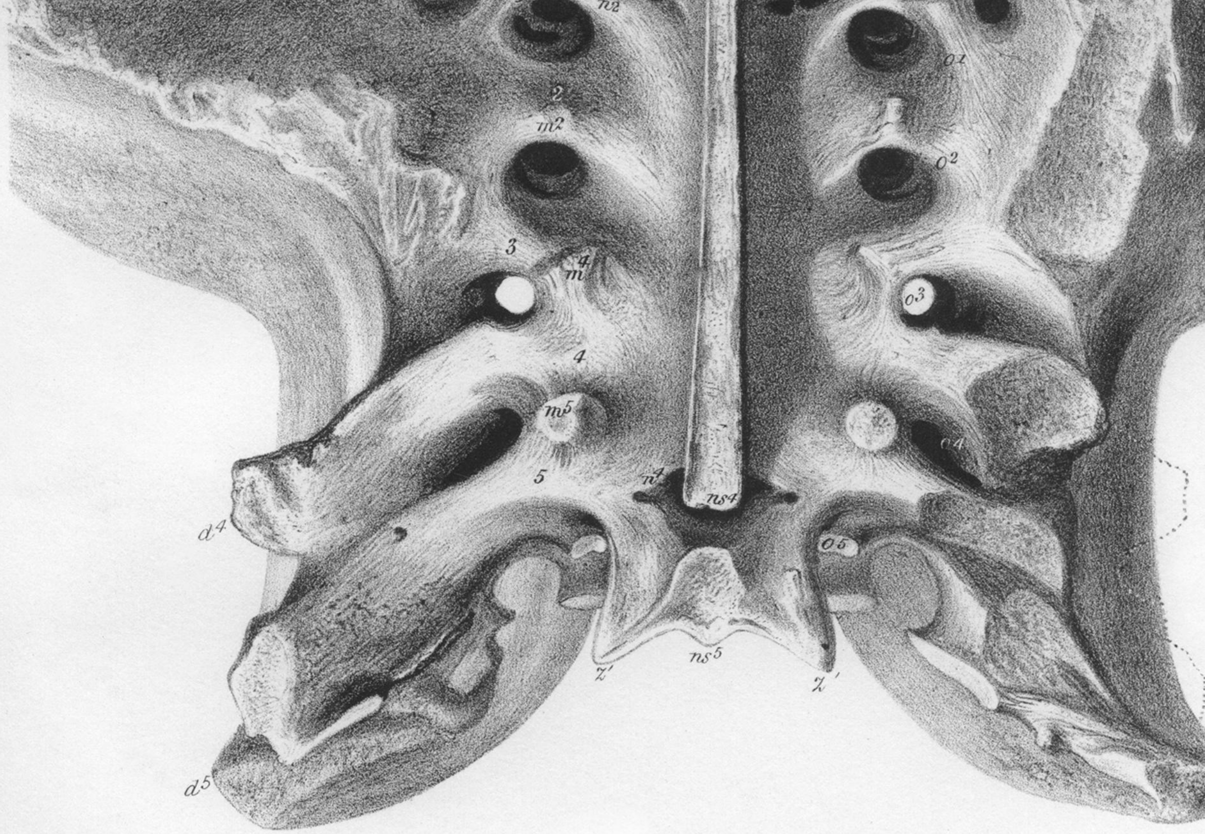

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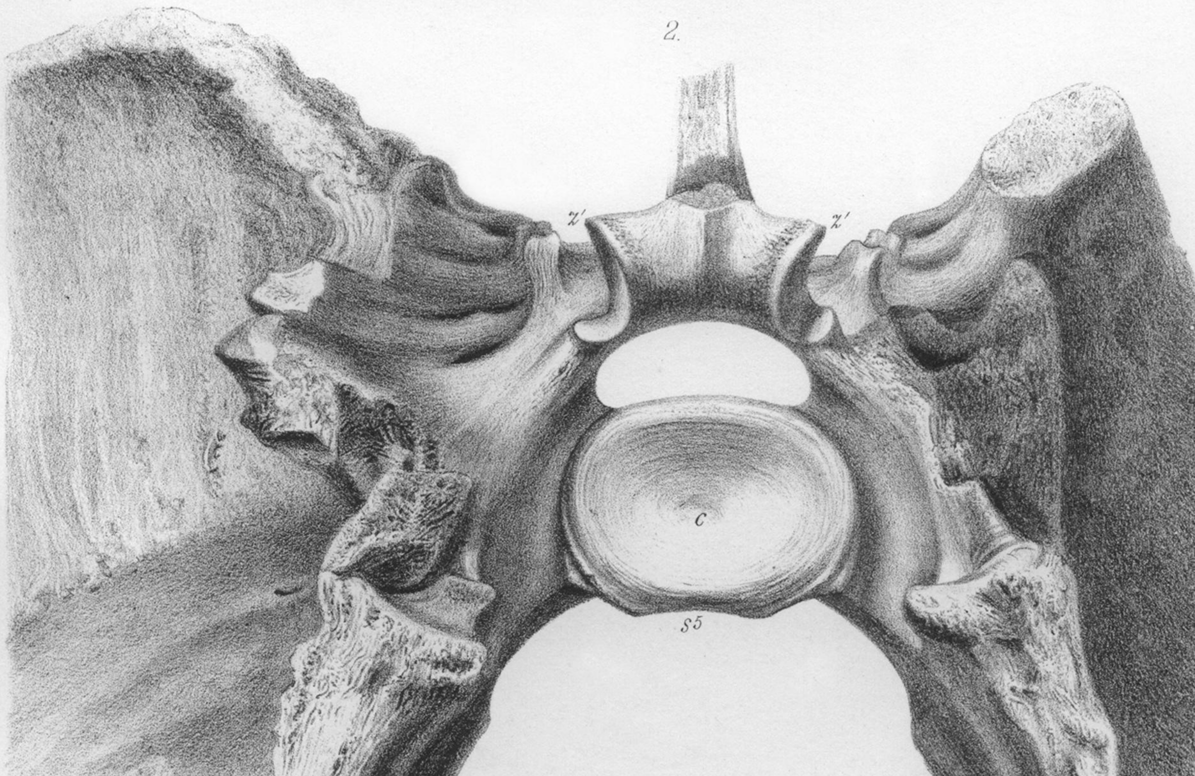

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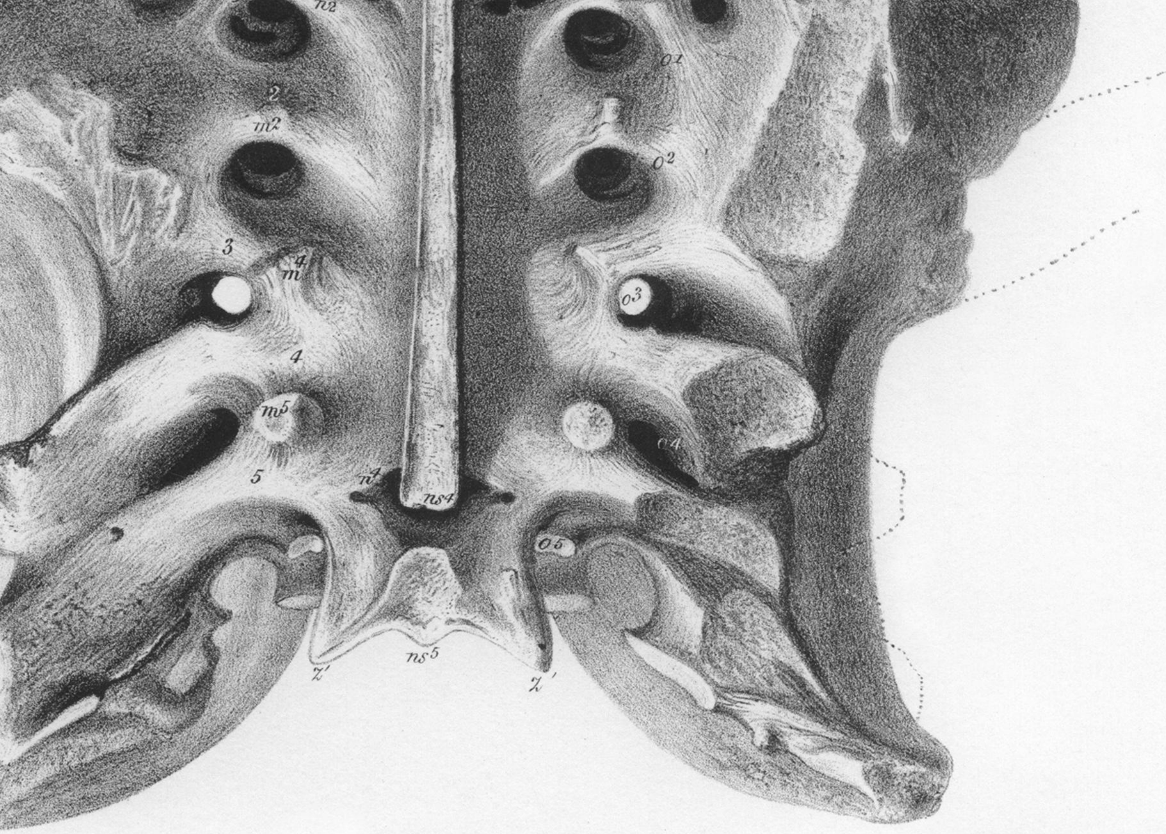

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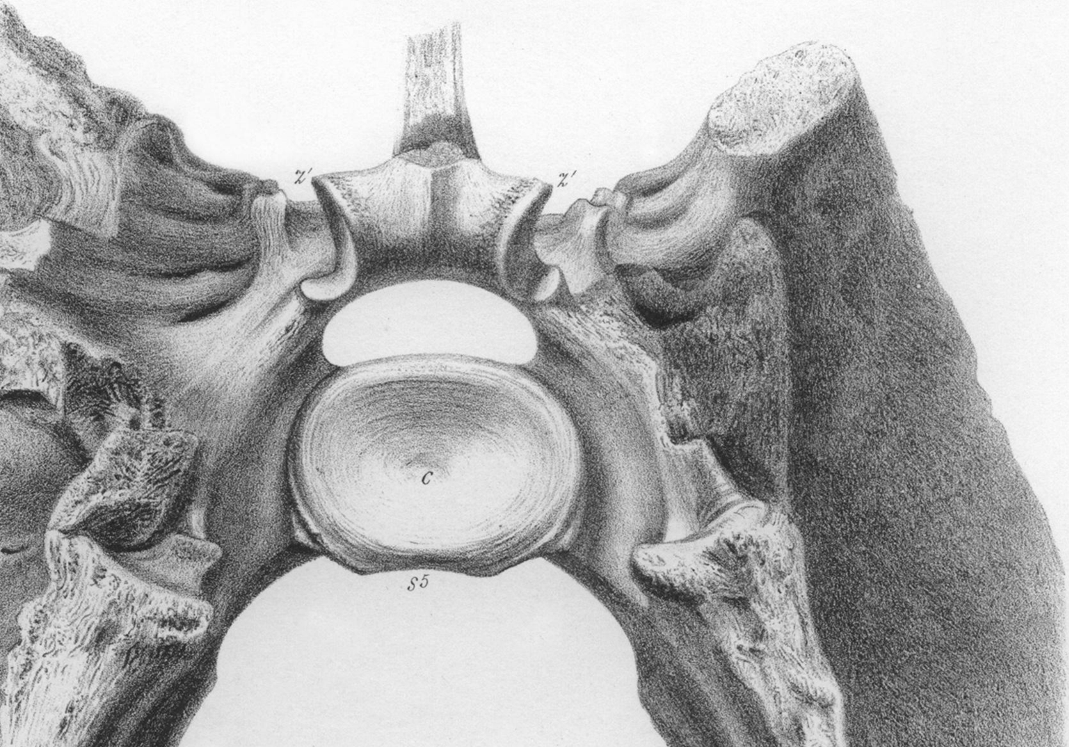

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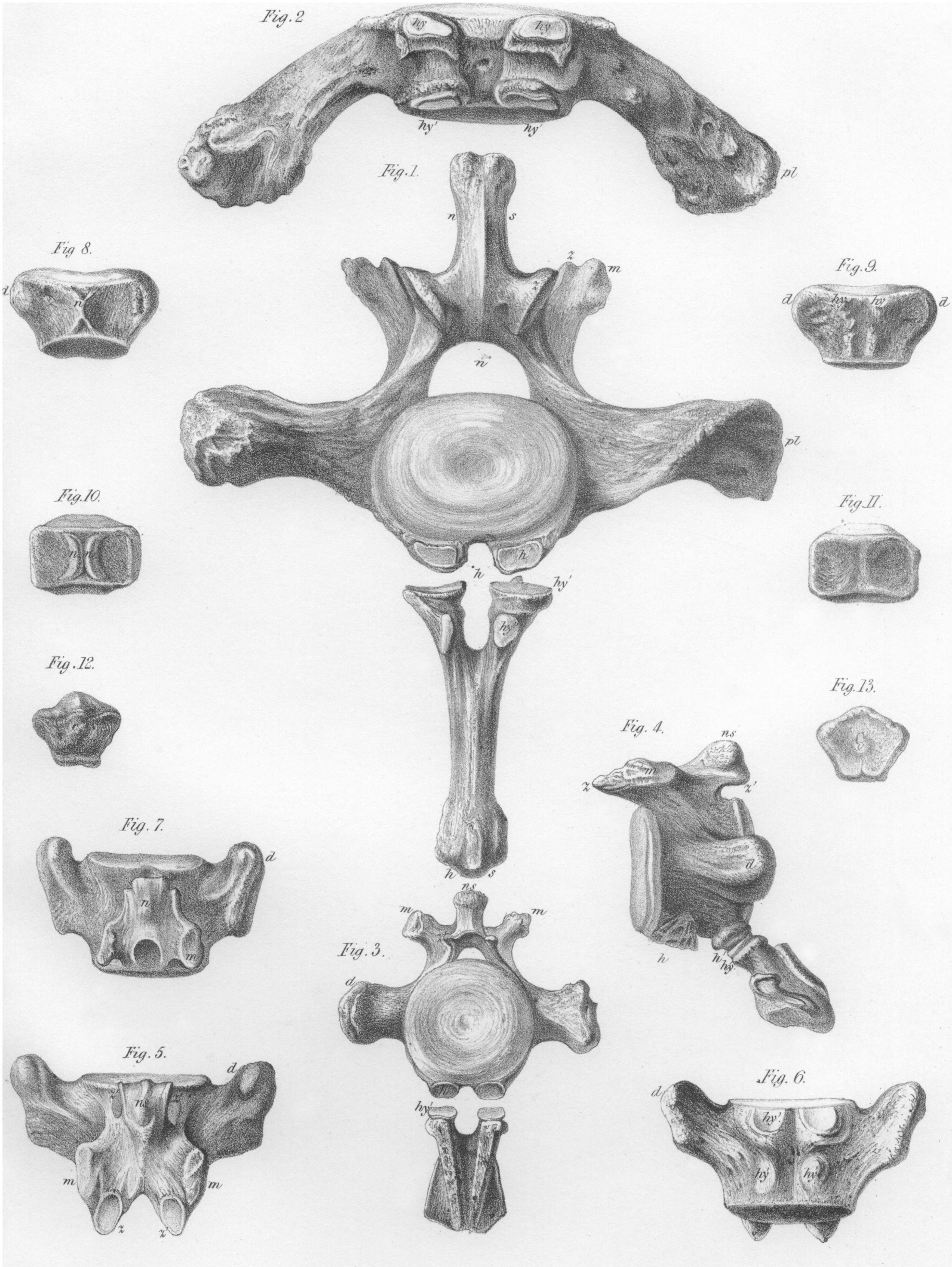

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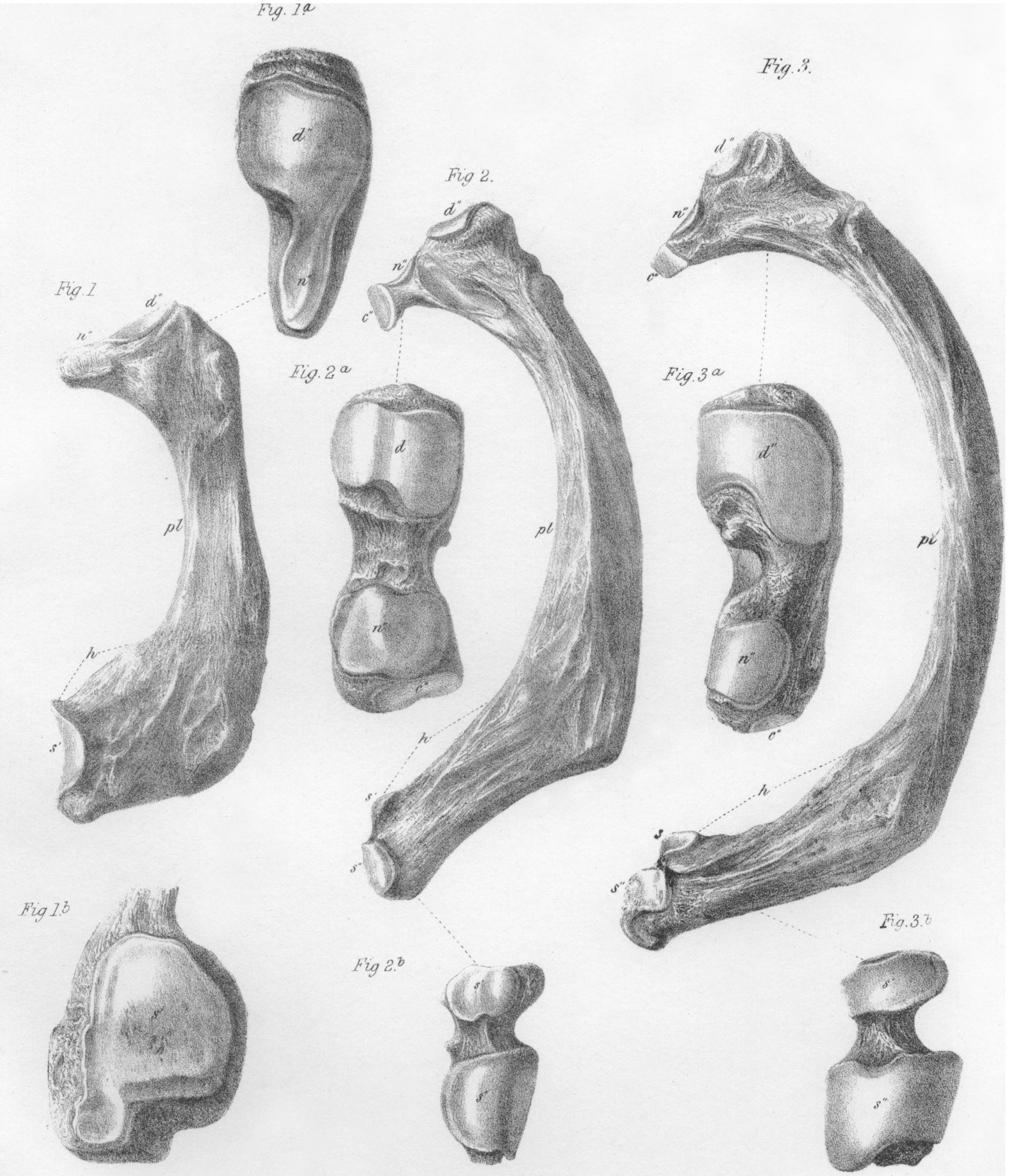

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Fig. 1.

Fig. 2.

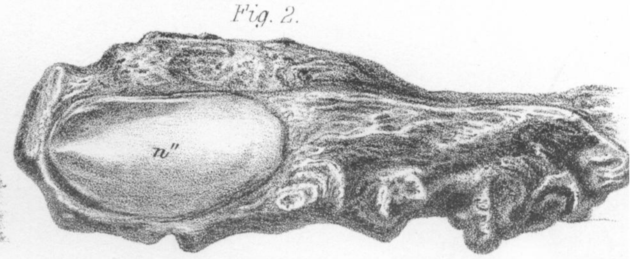

Fig 3.

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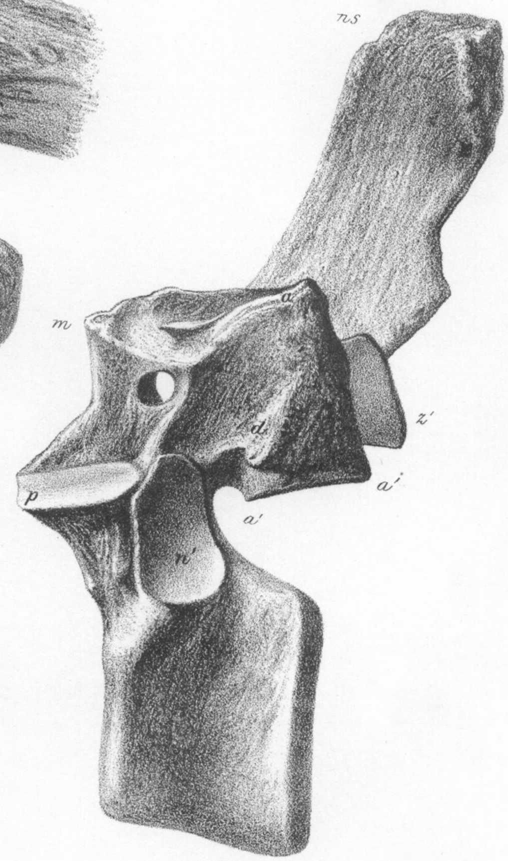

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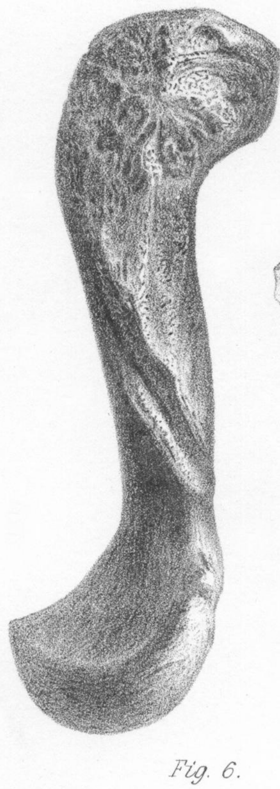

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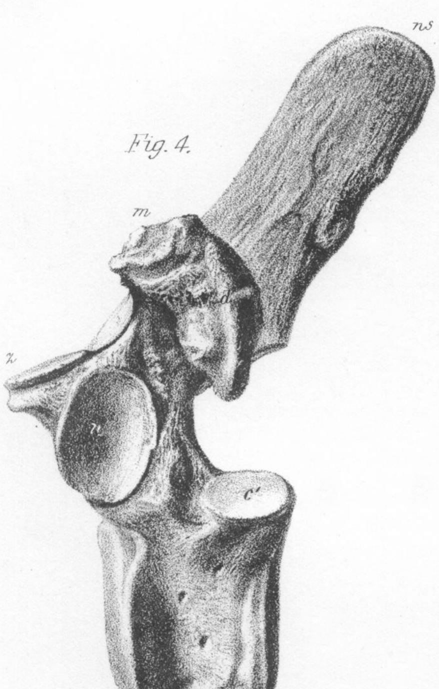

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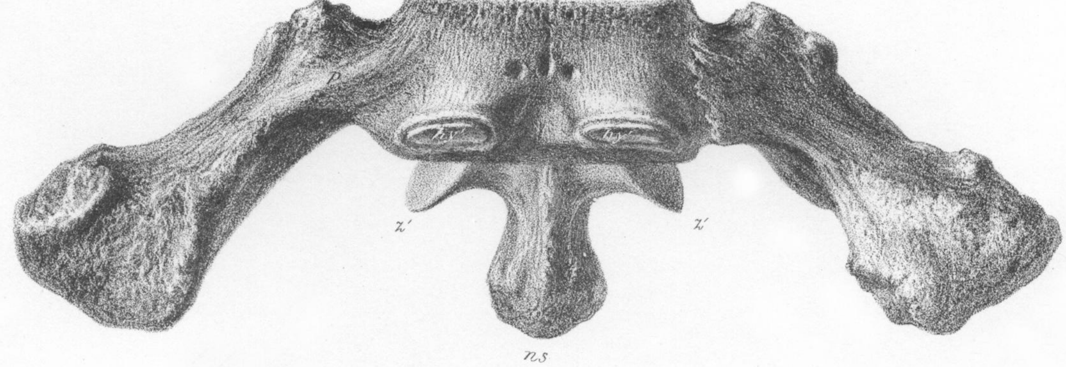

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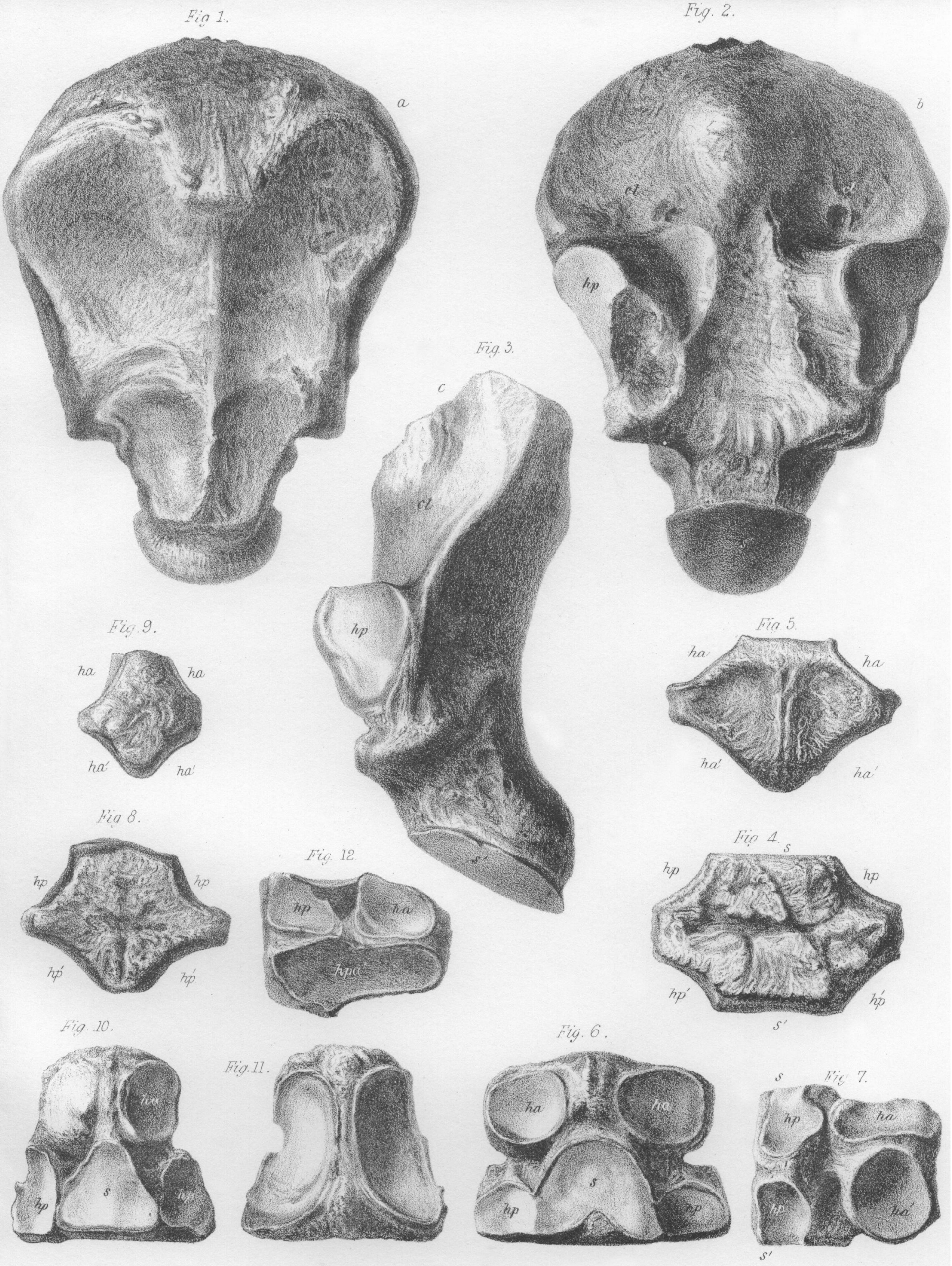

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