XVI. *On the Fossil Mammals of Australia.*—Part I. *Description of a mutilated Skull of a large Marsupial Carnivore* (Thylacoleo carnifex, OWEN), *from a calcareous conglomerate stratum, eighty miles S.W. of Melbourne, Victoria. By Professor* OWEN, *V.P.R.S. &c., Superintendent of the Natural History Departments in the British Museum, and Fullerian Professor of Physiology in the Royal Institution of Great Britain.*

Received September 18,—Read December 16, 1858.

IN a Report, No. X., on the Geology of the Basin of the Condamine River, by the Rev. W. B. CLARKE, to the Honourable the Colonial Secretary of Australia, dated 14th October, 1853, is the following passage:—"It is probable that Mr. STUTCHBURY, whose studies in palæontology fit him for the search, will be so fortunate as to find the remains of an animal indicated by Professor OWEN*, in the year 1842, of a carnivorous kind, for, as he says, 'some destructive species of this kind must have coexisted, of larger dimensions than the extinct *Dasyurus laniarius*, the ancient destroyer of the now equally extinct Kangaroo, *Macropus Titan*, &c., whose remains were discovered in the bone-caves of Wellington Valley.' There were some fragments in the immense heap of osseous matter accumulated by Mr. TURNER, which appeared likely to belong to such a carnivorous giant, but they were too small and imperfect to deserve conjectural description. The discovery of what *must have existed* cannot be altogether incapable of demonstration, and, therefore, such a verification of Professor OWEN's anticipation is to be hoped for on many grounds."—p. 6.

Now, although such verification has come to hand, I admit that the absolute terms in which the anticipation was expressed merit the mild rebuke implied by the italics in which those terms are emphasized in the quotation from the 'Report' by the accomplished geologist of Australia. Eighteen years of scientific experience have engendered a more cautious tone in referring to inductive probabilities.

The evidence of a large carnivorous marsupial, from pliocene formations in Australia, reached me not many years after my determination of the still larger herbivorous marsupial, *Diprotodon australis*†, which first suggested the idea of the coexistence. That evidence was received in the year 1846 with the accompanying letter from my esteemed friend and correspondent Dr. HOBSON, of Melbourne:—

* Letter to Editor of 'Annals of Natural History,' November 1st, 1842.

† Zoological Appendix to 'MITCHELL's Three Expeditions into the Interior of Australia,' 8vo, 1838, vol. ii. p. 362.

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"Bona Vista, New Melbourne, 25 January 1846.

"My dear Sir,—I send you, by Captain Burrell of the 'Achilles,' a box which contains some interesting fossil bones, from a lake eighty miles south-west of Melbourne. They were discovered and kindly forwarded to me by Mr. W. Adeney, who has a sheep-station on the banks of the lake. I have since visited the lake, which is called by the aborigines 'Colungoolac.' It is very shallow, indeed almost dry in autumn, its muddy bottom being covered with a pretty thick deposit of common salt of excellent quality. This is the case in most of those in this part of Australia. The whole of this part of the country is volcanic, and probably these salt lakes are the deeper parts of the ancient sea. There is one, however, called 'Parrumbat,' which appears to be the crater of an extinct volcano. Its waters are from eighteen to twenty fathoms deep, with abrupt and almost perpendicular escarpments, except at two points, which appear to have been the outlets to streams of lava. The sides are regularly stratified, and consist apparently of condensed scoriæ. The strata are singularly undisturbed and perfectly parallel, except in those places where large globular pieces of compact lava have fallen, and here their direction has been altered, as indicated in this rough diagram.

As these are some of the features of the country in which these bones are found, I think, perhaps, it may not be uninteresting to mention them. The fragment of skull and incisor I hope may be new to you.

"I sent you about a year ago a box of the Mount Macedon fossils, by Captain Fordyce of the brig 'Athens.'

(Signed) "Henry Hobson."

The 'skull' consisted of the cranial part (Plates XI. XIII. and XV. fig. 1), similar in size and in the development of the temporal ridges and fossæ to that of a Lion. The 'incisor' was a large tooth with a trenchant or incisive crown, implanted, with a small tubercular tooth, in a portion of the right superior maxillary bone, including part of the orbit and lacrymal bone (Plate XI. fig. 1, $p\,4$, and fig. 2).

The latter specimen gave decisive confirmation of the carnivorous character of the fossil, the 'incisor' tooth ($p\,4$) answering in shape and function to the great sectorial or 'carnassial' (Plate XV. fig. 4, $p\,4$), and the tubercular tooth (fig. 1, $m\,1$) to the small tubercular molar (fig. 4, $m\,1$) of the Lion*; being situated, as in that animal, on the inner side of the back part of the sectorial tooth. Fortunately the nasal process of the maxillary in the detached facial portion of the skull of the *Thylacoleo* fitted a surface at the fore-part of the cranium in such a way as to demonstrate that it formed part of the same skull, completing the lower half of the orbit (Plate XI. fig. 1, o'), of which the upper half (o) remains in the cranial portion of the skull.

* The real homologies of these teeth can only be determined by specimens of young *Thylacoleo*, showing the order of development and change of the dentition: the symbols here only indicate the conformity of geueral shape and function to p 4 and m 1 in *Felis*.

The upper sectorial tooth of the fossil (Plate XI. figs. 1 and 2, p^4) is larger than that of the largest Lion or Tiger which I have seen, and than that of the great extinct Lion (*Felis spelæa*, Plate XIV. fig. 4, p^4). Its antero-posterior extent is 2 inches 3 lines, that in *Felis spelæa* being 1 inch 7 lines. The greatest diameter of the upper tubercular tooth (Plate XI. fig. 2, *b*), which is at right angles to that of the sectorial one, is $7\frac{1}{2}$ lines, that of the Lion (Plate XIV. fig. 4, m^1) averaging 6 lines.

The upper sectorial tooth of the Felines is divided into a 'blade' and 'tubercle,' the latter being developed from the inner side of the base of the fore-part of the crown, and being supported by a fang which makes an extension of the socket inwards at right angles to the rest of the socket. A portion of the fossil tooth has been broken away at this part (Plate XI. fig. 2, p^4), but apparently little more than the enamel; and the socket certainly shows no inward extension indicative of a 'tubercle' so large and distinct as in the Felines (Plate XIV. fig. 4, p^4): the crown of the sectorial in *Thylacoleo* is thicker here than in the rest of its extent, and has been slightly convex on the inside as on the outside of this part of the tooth; but there appears to have been no distinct lobe or tubercle, and I conclude that the crown of the upper great sectorial in the *Thylacoleo* consists exclusively of the 'blade.' The trenchant edge of this is not notched as in the Felines where it is trilobate (Plate XII. fig. 1, p^4), but is even and uniform, describing a very feeble concavity lengthwise (Plate XI. fig. 1, p^4). In the specimen it has been worn to a sharp edge by the play of the blade of a similar sectorial obliquely upon its inner side. The outer side of the crown is convex vertically, wavy lengthwise, being in this direction gently concave at the mid-part, convex at each end, with minor undulations of the surface near the base. The inner side of the crown is gently concave vertically at its mid-part, slightly undulated, but mainly convex lengthwise. The anterior border of the crown is formed by a subdentate ridge, sloping with a slight convexity downward and backward, in vertical extent 1 inch: the crown gradually decreases in this diameter to its back part, which ends in the form of a low protuberance. The tooth is strongly implanted by, apparently, an undivided base coextensive with the crown. I have not thought fit to mutilate the unique fossil to determine the depth and precise character of this implantation. The thickest part of the tooth is 8 lines.

The tooth which most nearly corresponds with the sectorial of *Thylacoleo* is the penultimate upper molar of *Sarcophilus* (*Dasyurus*) *ursinus* (Plate XIV. fig. 2). In this tooth the 'blade' forms the chief part of the crown; it is concave externally, convex internally lengthwise; its edge is entire, slightly concave; but it is associated with an anterior lobe and antero-internal tubercle, wanting in the fossil.

The tubercular tooth (*ib.* fig. 1, *m*, Plate XI. fig. 2, *b*) in *Thylacoleo* is on the inner side of, and at right angles with the sectorial tooth, but is almost half an inch in advance of the hind end of that tooth: in *Felis* (Plate XIV. fig. 4, *m*) it is close to that end. In *Thylacoleo* this tooth consists of a principal portion next the sectorial, and a small lobe (Plate XI. fig. 2, *b*) forming the inner or 'mesial' end of the crown: the principal part

rises to a low obtuse point, with a middle longitudinal depression between two convexities, on the outside: the inside slopes forward gradually to the base so as to represent, and act as, a crushing surface. Besides being relatively larger, this 'tubercular' tooth is more deeply and firmly implanted than in the Lion, whence is due its preservation in the present fossil, a circumstance which is very rare in *Felis spelæa*. In no Feline does this tooth present the accessory lobe, as in *Thylacoleo*. In the presence of this lobe at the inner end of the crown, the last small molar in *Sarcophilus* presents a closer resemblance to the same tooth in *Thylacoleo*; but the principal lobe is more pointed and trenchant in the small existing marsupial carnivore; and the whole tooth is so situated that its outer end is visible in a side view. The firm implantation of the last small molar, and its shape, are significant of the affinity of *Thylacoleo* to *Sarcophilus*.

In the Felines the outer wall of the maxillary above the socket of the sectorial tooth is perforated by the large antorbital foramen: it is not so perforated in *Thylacoleo*. The canal for the suborbital nerve and vessels is relatively smaller in *Thylacoleo* (Plate XI. fig. 2, *c*), and must open some way in advance of the socket of the penultimate tooth, as it does in *Sarcophilus*. From that socket to the orbit the outer surface of the maxillary is smooth and even, first gently concave, then as gently convex: it does not show the zygomatic protuberance which intervenes in *Sarcophilus*. The vertical extent of this part of the maxillary is 2 inches, being nearly the same as in the Lion. The border of the orbit is sharper and more produced, especially at the lower and fore part (*ib.* fig. 1, *o'*), than in the Lion.

Sufficient of the palatal part of the maxillary is preserved in this fragment to afford a very significant character of the nature and affinities of the *Thylacoleo*. In most *Marsupialia*, and in all the carnivorous species, the bony palate is interrupted by large vacuities opposite the antepenultimate and penultimate molars. In all placental *Carnivora* the bony palate is here entire; it shows, at least, only a small oblique nervo-vascular foramen at the suture between the palatine and maxillary; and the roof of the mouth is extended by bone some way behind the last molar tooth. In the present specimen of the *Thylacoleo* is preserved the smooth rounded outer border (Plate XI. fig. 2, and Plate XIV. fig. 1, *d*) of a large palatal vacuity opposite the hinder half of the penultimate tooth, and at a distance of 14 lines from it transversely. Such a vacuity extends opposite the penultimate and antepenultimate molar in *Sarcophilus* (Plate XIV. fig. 2).

I now proceed with the description of the larger, cranial, portion of the present fossil, before returning to another character in the smaller portion which I regard as decisive of its marsupial affinities. The cranial part of the skull shows a broad and low occipital surface (Plate XV. fig. 1); the sides (Plate XI. fig. 1) excavated by large temporal fossæ (27'), with their ridges meeting at a low and short parietal crest (Plate XVI. *t'*); the upper surface expanding, in front of this, to a very broad, almost flat interorbital region, 11. The post-orbital processes, 12, with the zygomatic arches, 27, and part of the basis cranii, are broken away. The extreme length of this portion of skull is 8 inches; the least breadth of the cranium, at the temporal fossæ, is 2 inches 2 lines.

The upper border of the occipital foramen (Plate XV. fig. 1) is as broad as in the *Felis spelæa*, and broader than in most of the existing species of Lion or Tiger; it does not present the pair of processes that characterize it in those large placental *Carnivora*. As the occiput rises from this border it slopes forward with a slight concave curve to the ridge, 3, 8 (Plate XIII. figs. 1, 3, 8), dividing the occipital from the upper plane of the skull: transversely the occiput is concave in the middle and slightly convex on each side, with a surface marked by musculo-tendinous insertions; the median depression is partly bisected by a vertical ridge (Plate XV. fig. 1, *f*), on each side of which there is a venous foramen. The breadth of the occiput on the level of the upper border of the foramen magnum is 5 inches; its height from the same border 2 inches 2 lines. In *Felis spelæa* the breadth of this part is 3 inches 4 lines; its height being 2 inches 8 lines. The *Sarcophilus* (Plate XV. fig. 2) much more nearly resembles the *Thylacoleo* in its low and broad occiput.

The major part of the basioccipital is broken away (Plate XIV. fig. 1); the anterior portion, which has coalesced with the basisphenoid (*ib.* 5), forms with it, not a platform extending horizontally forward, as in placental *Carnivora*, but a bent surface forming a curve convex downward as it extends forward; this character is seen in the *Dasyurus macrurus* and in many Kangaroos; but the convexity at the junction of the basioccipital and basisphenoid, 5, appears to have been greater in the *Thylacoleo*. The base of the left occipital condyle, 2, remains; and in the fossa anterior to it, are the orifices of three precondyloid foramina (*g*), as in the majority of *Marsupialia*, including the *Dasyuri*; they unite to form a single hole internally in the *Thylacoleo*. In the placental *Carnivora* the precondyloid canal is single at both ends, and commonly opens externally into the jugular foramen (*Viverridæ*, *Hyæna*, *Felis*), or close to it, as in the Dog.

The jugular foramen (*i*) is bounded behind by a notch in the exoccipital, forming the margin turned towards the tympanic, 28, and which margin is extended further in advance of the precondyloid foramina than in the Dog or any placental Carnivore in which those foramina do not communicate with the jugulars; in this respect the *Dasyuri* and many other marsupials resemble the *Thylacoleo*.

The bones composing the complex framework of the organ of hearing are strikingly different in the placental and marsupial *Carnivora*. In the Cat, Dog, Hyæna, Civet, Otter, Bear, the tympanic bulla is formed by the inflated petrosal with which the true tympanic bone has coalesced; in the marsupials the petrosal remains comparatively small, and is confined chiefly, if not wholly, to the function of a capsule of the internal organ of hearing; the tympanic bulla is excavated in the inflated base of the alisphenoid; and the tympanic bone itself continues a free and distinct ossicle, which, in the Dasyures and Thylacine, is a small thick semicylindrical canal with smooth obtuse margins, and its concavity looking backward and upward.

On the right side of the fractured base of the fossil skull in question, the small compact petrosal (Plate XIV. fig. 1, 16) is exposed; it is similar to that in the *Dasyurus*, being grooved longitudinally at its inner and under side, the lower border of the groove forming a sharp edge, above which, on the inner side of the petrosal, the foramina

auditoria interna pierce the bone. On both sides the tympanic sinuses in the alisphenoid, 6, are exposed; and their concordance with those in the *Dasyuri* is very clearly exemplified on the left side, in which the tympanic bone, 28, is preserved, showing its characteristic shape and relative position behind and external to the alisphenoid bulla, 6.

The canal of the meatus (*k*) external to the tympanic, is excavated in the outwardly produced base of the zygoma, behind the postglenoid process (*l*), for an extent resembling that in the *Dasyuri*, but much greater than in the Dog or other placental *Carnivora*.

Another character distinctive of the marsupial order is the position of the entocarotid canal (*m*), which perforates the outer and back part of the basisphenoid, 5*: this orifice is lodged in a fossa between the basioccipito-sphenoid and the bulla auditoria in *Thylacinus* and *Dasyurus* (*ib.* fig. 2, *m*), and it presents exactly the same position, and perforates the same part of the basisphenoid, in *Thylacoleo*.

In the genus *Felis* the entocarotid enters the base of the skull at the fore-part of the *foramen jugulare*, notching the part of the petro-tympanic bulla at the fore-part of that foramen. In the Hyæna, as in the Viverrines, the entocarotid notches or perforates the tympanic bulla in advance of the jugular foramen close to the side of the basioccipital: it perforates the same part of the tympanic bulla in the Otter and other Mustelines.

The foramen ovale pierces the base of the alisphenoid immediately anterior to the bulla in the marsupial *Carnivora*, and is divided by a ridge from the carotid canal in the *Dasyuri*; it presents the same relations in *Thylacoleo* (Plate XIV. fig. 1, *n*), and the base of the ridge (ib. *s*) also remains to show the existence of that character.

The interval between the foramen ovale (Plate XI. fig. 1, *n*) and foramen rotundum (ib. *p*) is relatively much greater in the marsupial than in the placental *Carnivora*. In the genus *Felis*, they are separated from each other only by the base of the ridge or rising of bone extending from the ectopterygoid towards the glenoid cavity, and the foramen is on the same transverse line with the anterior boundary of that articulation; in the Hyæna, Viverrines, and Dog, it is a little in advance of the same boundary; in the Otter it opens externally into a fossa common to it with the foramen lacerum anterius (or for. ophthalmicum). In the Thylacine and Dasyures the foramen rotundum is distinct both within and without the cranial cavity from the foramen lacerum anterius, and is far in advance of the glenoid cavity. It presents the same relative position in the *Thylacoleo* (Plate XI. fig. 1, *p*).

In *Felis* the foramen rotundum is larger than the foramen opticum; in *Dasyurus* it is much smaller; and this is the case also with the *Thylacoleo* (Plate XI. fig. 1), although the foramen opticum (*q*) is relatively smaller than in the *Dasyurus ursinus*.

* "The carotid canals pierce the body of the sphenoid, as in Birds, and terminate in the skull very close together behind the *sella turcica*."—Zoological Transactions, vol. ii. (October, 1838), p. 390. See also Mr. Turner's careful and minute account of the "Foramina at the Base of the Skull" in Zoological Proceedings, May, 1848, p. 64.

In the marsupial *Carnivora* the basisphenoid is relatively longer than in the placental *Carnivora*, and, at its posterior part, it sends a ridge downwards from that part of each lateral margin which is not underlapped or covered by the base of the alisphenoid, the suture of which long continues distinct. These ridges, with the alisphenoid, render the whole under surface of the basisphenoid canaliculate, or concave transversely: the basisphenoid is flat beneath in the placental *Carnivora*, and that part of the base of the skull is made canaliculate by the development of the ectopterygoid plate from the alisphenoid: these plates exist likewise in the marsupials, but, as they extend backwards to join the alisphenoidal bullæ, they diverge from the basisphenoid ridges and are external to them.

Sufficient of the base of our fossil skull remains to demonstrate this characteristic marsupial structure: the basisphenoid, though convex lengthwise beneath, is concave transversely by the production from the lateral margins of its hinder part of the same ridges (*r*, *r*) as those of the Thylacine and Dasyures, and in the degree of concavity more resembles the latter: the commencement of the outer ectopterygoid ridge (*s*) of the alisphenoid is preserved, diverging as it extends backwards from its anterior junction with the basisphenoid ridge.

The sutures between the alisphenoids and basisphenoid still remain, indicating the great antero-posterior extent of the former, and the degree to which they underlap the basisphenoid, leaving only a strip $2\frac{1}{2}$ lines broad exposed at its junction with the presphenoid, 9; and gradually diverging as they extend backward, the basisphenoid, 5, being one inch and a half in breadth at their hinder borders.

The characters of the base of the cranium here displayed by the *Thylacoleo*, and the greater retention of the typical elementary construction of the skull, would be sought for in vain in any mammalian *Carnivora*, save those of the marsupial order.

In the placental *Carnivora*, the superoccipital region, defined below by a boundary line drawn across the upper ends of the condyles, is almost as high as it is broad, and in rising from the foramen magnum it curves slightly backward. In the marsupial *Carnivora* the same region so defined is much broader than it is high, especially in the Dasyures (Plate XV. fig. 2); in these the occiput is vertical; it inclines a little forward from the foramen magnum in the Thylacine. All these characters are repeated in the *Thylacoleo*; the occiput being relatively as broad as in *Sarcophilus*, and the superoccipital sloping more forwards than in the Thylacine before it rises vertically to the occipital crest; thus departing in a greater degree from the placental type, and manifesting, as might be expected from the superior general size of the skull, in a more marked manner, the inferiority of development of the brain. In every natural group or family of the warm-blooded Vertebrata the brain is proportionally less as the animal is larger, and its osseous case makes a smaller part of the entire skull.

In the marsupial *Carnivora* the brain is relatively much smaller than in the placental *Carnivora*, and the lateral walls of the cranial cavity make a smaller protuberance or convexity at the temporal fossæ. In the remarkable skull under comparison, the sides of the cranial cavity make no protuberance whatever into the temporal fossæ; they have

been moulded solely in obedience to the pressure of the enormous temporal muscles, and present a uniform concavity towards the temporal fossæ. The cranial walls here (Plate XIII. fig. 1, $_{27'}$) show as little indication of the brain within as in a cold-blooded reptile: amongst the mammalian *Carnivora* the *Thylacoleo* is unique in this respect; and in the diminutive relative size of its cerebral organ, it is approached only by the Thylacine and the largest existing species of Dasyure.

In the *Das. ursinus* the apparent breadth of the cranial chamber is here greater than it actually is, by reason of the swelling out of the squamosal above the root of the zygoma through the extension therein of tympanic air-cells; and similar air-cells are exposed on the right side of the fossil *Thylacoleo* (Plate XI. fig. 1, *c*); but I know of no species of placental Carnivore in which the squamosal is so modified.

Another equally instructive marsupial character is exhibited by the bony outlet of a vein (ib. *s*), which conducts part of the blood from the lateral sinus to the outer and back part of the cranium: this venous foramen is situated behind the root of the zygoma and above the meatus auditorius in the Thylacine (Plate XII. fig. 2, *s*) and Dasyures. A similar diverticular vein is present in certain placental *Carnivora*, and has its external outlet behind the glenoid cavity and in front of the meatus auditorius, as *e. g.* in the Dog and Otter; there is a small venous outlet on the outside of the tympanic bulla in the Cat and Hyæna; but in no placental Carnivore is such a venous foramen present behind, or piercing the ridge continued backward from the root of, the zygoma.

In the *Thylacoleo* this venous foramen (*s*) is present in nearly the same relative position as in the marsupial *Carnivora*, posterior, viz., to the commencement of the ridge or hind root of the zygoma; in the Dasyure it is below the upper margin of the ridge; in the Thylacine it is posterior to the beginning of the ridge; in the *Thylacoleo* it is posterior and superior to the beginning of the ridge. Thus in the same degree in which the *Thylacoleo* departs in this particular from the largest existing marsupial *Carnivora*, it differs from the placental *Carnivora*, in all of which the foramen, besides its other differences of position, is quite below the zygomatic ridge in question.

The interorbital part of the upper surface of the cranium (Plate XIII. fig. 1, $_{11}$) is remarkable in the marsupial *Carnivora* for its great breadth, especially as compared with that of the cerebral portion of the cranium; the transverse diameter of this part at the middle and highest part of the upper border of the squamosals is, in the *Dasyurus ursinus*, less than half the same diameter of the narrowest part of the interorbital portion of the cranium. In the Tiger, Lion, and *Felis spelæa* the diameter of the interorbital space is one-seventh less than that of the cranium of the *Thylacoleo*, taken across the same part as in the *Dasyurus*. In the *Thylacoleo* the least diameter of the interorbital surface is 2 inches 10 lines; the diameter of the cranium opposite the middle of the upper border of the squamosals, $_{27'}$, is 1 inch 3 lines.

The broad interorbital platform of the *Thylacoleo*, with a broad and shallow depression, and two slight lateral convexities at its anterior half, passing posteriorly into an almost flattened surface, decreasing to the point where the temporal ridges (t') meet above the

parietal, forms, in contrast with the contracted cerebral part of the cranium, a conspicuous marsupial character of the skull.

In the *Thylacoleo* the squamosal (Plate XI. fig. 1, 27) extends forward in the temporal fossa nearly half-way between the root of the zygoma and the postorbital process, and two-thirds of the way upward, 27′, between the root of the zygoma and the parietal ridge; its contour is almost semicircular. In the Felines the squamosal extends a very little way, if at all, in advance of the base of the zygoma, and does not ascend half-way from that part to the parietal ridge (Plate XII. fig. 1, 27′). It is only in the marsupial *Carnivora* that we find those proportions of the squamosal which characterize the *Thylacoleo*.

On the inner wall of the right orbit the fronto-lacrymal suture shows that the lacrymal bone, 73, was of large size, that it formed the anterior half of that wall, and extended upon the upper part of the skull, forming apparently the anterior superorbital protuberance, besides extending forward upon the facial part of the skull, as far as that part anterior to the orbit has been preserved in the fossil. The lacrymal bone presents the same relative dimensions and extent in the largest existing *Dasyurus* (*D. ursinus*), in which the lacrymal duct pierces, not the orbital, but the facial, plate of the lacrymal bone, and is consequently outside the orbit.

In the Lion, the *Felis spelæa* (Plate XII. fig. 1), and other placental *Carnivora* in which the lacrymal bone is best developed, it is almost confined to the orbit, its most forward portion forming about the middle third of the anterior margin of the orbit, where it developes a slight protuberance; its orbital plate, moreover, does not attain that part of the inner wall of the cavity where it is so conspicuous in the *Thylacoleo* and *Dasyurus*, but extends backward along the lower part of the inner wall to join the orbitosphenoid. The lacrymal foramen, 73′, is within the orbit.

The *Thylacinus* (Plate XII. fig. 2), which retains the marsupial proportions of the lacrymal bone, has an intraorbital perforation, besides two antorbital ones, 73′: in most marsupials there are only the two antorbital lacrymal holes, and in the *Dasyuri* there is only one lacrymal foramen, which is outside and in front of the orbit; the *Thylacoleo* (Plate XI. fig. 1, 73′) resembles the *Dasyuri* in its single antorbital perforation of the lacrymal bone, and this is one of the decisive marks of its marsupiality.

The postorbital process has been fractured on both sides; but on the left sufficient is preserved to show that the hind and front sides meet at a right angle, and form a ridge at its under part.

Sufficient of the articular surface (Plate XIV. fig. 1, *s*) for the lower jaw is preserved on the left side of the skull of the *Thylacoleo*, to show that it had a greater antero-posterior extent than in *Felis spelæa*, and was flatter at its fore-part, the margin there not being so produced: the same character is shown in *Dasyurus ursinus*. The post-glenoid process is fractured.

I am indebted to Mr. Samuel Stutchbury, F.L.S., for a cast of a portion of a right ramus of a lower jaw of a large Carnivore, a fossil which he obtained at Hodgson's Creek, Darling Downs, during his geological survey of that district of Australia in the year 1853.

This portion (Plate XI. fig. 3; Plate XIII. figs. 4 and 5) fortunately includes the carnassial and tubercular teeth, and by the correspondence of these in shape and size with the answerable teeth ($p\,4$, $m\,1$) in the upper jaw of *Thylacoleo* (Plates XI. and XIV. fig. 1), I believe it to belong to the same species.

The lower carnassial tooth consists only of the 'blade,' which is thickest anteriorly, with an even trenchant edge, describing a slight concavity lengthwise, and obliquely abraded by the play of the upper tooth upon the outer side of the edge. The outside of the tooth (Plate XI. fig. 3, $p\,4$) is convex lengthwise, and also vertically at the fore-part: the inside (Plate XIII. fig. 4, $p\,4$) is concave lengthwise, except near the fore-part; vertically it is convex at the base and concave above, the base being slightly grooved vertically. The anterior margin of the tooth, which is the highest, is bounded by a vertical ridge. The length of the crown is 1 inch 8 lines; the height at its fore-part is 9 lines; the thickness at the same part is 6 lines: the height and thickness of the crown diminish toward the back part. The small tubercular tooth (Plate XI. fig. 3; Plate XIII. figs. 4 and 5, $m\,1$) is immediately behind the preceding: it consists, more distinctly than the one above, of an anterior principal lobe and a small posterior one; the anterior lobe is convex on both sides, subconical, with a worn obtuse summit. The antero-posterior extent of the crown is 7 lines; the same extent of both the teeth just equals that of the upper sectorial, and the lower tubercular is so situated as to play, in lateral movements of the jaw, upon the upper tubercular. Behind the tubercular in place there is the socket of a rudimental one, which cannot have exceeded 3 lines in its longest diameter (ib. $m\,2$). From this socket the coronoid process begins to rise, sloping upward and backward. It is broken off within half an inch of its origin. The fore-part of the fossa for the implantation of the temporal muscle is preserved, showing by its depth the strength of that muscle; the anterior boundary of the fossa is vertical and convex forwards. The ramus of the jaw preserves the same depth from the last socket to the fore-part of that of the sectorial tooth. The symphysis (Plate XIII. fig. 4, *s*) begins behind, at a vertical line dropped from a little in advance of the middle of the sectorial, $p\,4$; it is of a wide oval form. To judge from the cast, but little of the jaw appears to have been broken away from the fore-part of the symphysis. The upper and fore-part shows the alveolus and base of a tooth (Plate XI. fig. 3, *c*) which has projected obliquely upward and forward. It is separated by an interspace of 3 lines from the sectorial, and would seem to be the sole tooth in advance of it. If the ramus be really produced at the upper part of the symphysis further than is indicated by the present cast, it may have contained one or more incisors, and the broken tooth in question may be the lower canine. If, however, this be really the foremost tooth of the jaw, it would appear to be one of a pair of large incisors, according to the marsupial type exhibited by the *Macropodidæ* and *Phalangistidæ*. However this may ultimately prove to be, the molar series in each ramus of the lower jaw is reduced to the enormous sectorial and the two small tuberculars; and it would seem, therefore, in the upper jaw, to be reduced to the single sectorial and single tubercular on each side. It is possible that a canine

may have existed in the upper jaw as much longer and larger than that below, as the upper canine is in the extinct *Machairodus*. But sufficient is demonstrated in the above-described fossils to make known the most anomalous dental system in carnivorous Mammalia, whether placental or marsupial.

There is an interesting resemblance between the known dentition of the lower jaw of *Thylacoleo* and that of the small extinct mammal from the Purbeck strata called *Plagiaulax* by Dr. FALCONER*; and the resemblance would be closer should the broken tooth in the lower jaw of *Thylacoleo* here described prove to be the foremost one. Certainly no other known mammal shows two posterior tubercular teeth so similar to those in *Plagiaulax minor*, in their relative size to each other, to the trenchant tooth in front and to the ramus of the jaw, as does the *Thylacoleo*.

The anterior orifice of the dentary canal (Plate XI. fig. 3, *o*) appears, in the cast, to have been in the fossa, on the outside of the jaw, between the socket of the sectorial tooth and the one anterior to it. As much of the lower border of the jaw as is preserved is straight. Not enough of the back part of the jaw remains to indicate the form or direction of the angle. But the lower jaw of *Thylacoleo* must have been singularly short in proportion to its depth and breadth, and a like extreme shortness of the muzzle or facial part of the skull may be inferred.

With the above-described portions of the cranium of the *Thylacoleo*, I received from my friend Dr. HOBSON a portion of a sectorial tooth with one of the fangs. It was so similar in the character of the crown to the great sectorial in place, that I had no doubt about the genus to which it belonged, but only as to whether it was a smaller anterior sectorial of the upper jaw, or the sectorial of the lower jaw. Mr. STUTCHBURY'S specimen has settled that doubt. The tooth (Plate XI. figs. 4, 5 and 6) is the hinder half, with the hinder fang of the left sectorial of the lower jaw. The characteristic markings and undulations or grooves of the enamel, and the thickness of this substance where it is exposed by the abrasion of the trenchant edge, are carefully shown in the figures.

In existing carnivorous mammals the ferocity of the species is in the ratio of the 'carnassiality' of the sectorial molar, *i. e.* of the predominance of the 'blade' over the 'tubercle;' and this ratio is shown more particularly in the upper sectorial, in which, as the tubercular part enlarges, the species becomes more of a mixed feeder, and is less devoted to the destruction of living prey. From the size and form of the carnassials of *Thylacoleo*, especially of the upper one, we may infer that it was one of the fellest and most destructive of predatory beasts.

The metacarpal bone (Plate XIII. figs. 6, 7 and 8) is here figured, as it resembles in its shape that of a large carnivorous animal, and may possibly belong to the *Thylacoleo*. The figures preclude the necessity of verbal description. It is from a freshwater deposit in Darling Downs, Australia.

On the occasion of a visit to London, in 1848, by the able comparative anatomist and palæontologist M. PAUL GERVAIS, at the period when the supposed marsupial character

* Proceedings of the Geological Society, March, 1857.

of the *Pterodon* or *Hyænodon* of the Miocene deposits of Auvergne, Gard, and Vaucluse was under discussion, I took the opportunity to point out to M. GERVAIS certain characters deducible from the 'foramen caroticum' and 'foramen lacrymale' bearing on this question, and illustrated my conclusions by reference to the then unique carnivorous fossil which I had a short time before received from Australia.

The estimable author of the 'Zoologie et Paléontologie Françaises,' 4to, 1848–52, enters the genus *Thylacoleo* in the Table of Fossil Mammalia according to their geographical arrangement*; and in his remarks on those of Australia (Nouvelle-Hollande), he writes, "Ses dépôts pliocènes ou pleistocènes ont fourni des Grands Kangaroos, un grand Wombat†, diverses autres espèces congénères de celles d'à présent, les genres de *Diprotodon* et *Notothérium* qui étaient aussi des Marsupiaux, mais dont les allures et la taille approchaient de celles de nos grands pachydermes diluviens, et le Dasyurien, plus grand que le Lion, que M. OWEN nomme *Thylacoleo*‡."

I cite this passage in testimony of the date of my determination of the marsupial nature of the great carnivorous Australian fossil, and of the imposition of its generic name; because the portion of the lower jaw with the carnassial and tubercular teeth of the same extinct species, which was obtained by my friend Mr. STUTCHBURY during the period in which he was fulfilling his valuable duties as "Geological Surveyor" of the colony of Australia, is alluded to under the name *Schizodon* in a Report to the Colonial Secretary, dated "Darling Downs, 1st October, 1853."

If this generic name had had priority of the one given by me to the same extinct genus, it must have been suppressed, since *Schizodon* had been previously applied in 1829 to a genus of fishes, which still retains it, by AGASSIZ §; to a genus of mammals by Mr. WATERHOUSE, in 1842; and, slightly modified as *Schizodus*, to a genus of mollusks by Mr. KING. Of course the two latter applications, like that by Mr. STUTCHBURY, must fall into the subordinate rank of synonyms.

The additional fossil of the *Thylacoleo* discovered by Mr. STUTCHBURY is a very welcome one. It was not, indeed, sufficient to guide the Colonial geologist to an idea of the order of *Mammalia* to which it belonged; and Mr. STUTCHBURY concludes his brief notice of the fossil by the remark, "Its affinities had better be left for future discussion, as it is probable that further search may bring to light more remains illustrative of this very singular animal ‖."

Such remains had, however, been obtained by Mr. ADENEY, and had been transmitted to me eight years previously; and the chief conclusion as to the affinities of the animal to which they belonged, had been indicated by the term *Thylacoleo*, i. e. Marsupial or

* *Op. cit.* vol. i. p. 190.

† That, viz., which is alluded to as being "at least four times as large as either of the known existing species," in my Memoir on the existing Species of *Phascolomys*, of July 1845, Trans. Zool. Soc. vol. iii. p. 306.

‡ *Op. cit.* vol. i. p. 192.

§ Selecta Genera et Species Piscium Brasiliensium, 4to, 1829.

‖ Papers relative to Geological and Mineralogical Surveys, 1853, p. 10.

Pouched Lion*, which conclusion was based on the characters and comparisons of those fossil remains detailed in the foregoing pages.

A desire to exhaust every needful and available subject of comparison has occasioned the long delay in communicating descriptions of the present selection of fossil remains of Australian Mammals.

The concurrence in them of so many cranial characters found only in the *Marsupialia*, will be deemed, I apprehend, demonstrative of the marsupial nature of the *Thylacoleo*; and, amongst existing *Marsupialia*, the *Sarcophilus* or *Dasyurus ursinus*—at present the largest existing species of its genus—seems to me to have the nearest affinities to the *Thylacoleo*, although the interval be still very great between them.

Description of the Plates.

PLATE XI.

Fig. 1. Side view of the cranium and part of the upper jaw of the *Thylacoleo carnifex*:—nat. size.

Fig. 2. Inside view of part of the upper jaw, showing both the sectorial and tubercular molars of ditto.

Fig. 3. Outside view of part of the lower jaw of the *Thylacoleo carnifex*.

Fig. 4. Inside view of part of the left lower carnassial tooth of the *Thylacoleo carnifex*.

Fig. 5. Outside view of the same specimen.

Fig. 6. Upper view of the same specimen.

PLATE XII.

Fig. 1. Side view of the skull of the *Felis spelæa* (from European Bone-cave):—half nat. size.

Fig. 1 *a*. Outline of the sutures between the nasals, 15, and frontal, 11, and between the superior maxillary, 22, and the frontal, 11, showing the backward extension of the maxillaries, which distinguishes the Lion from the Tiger:—nat. size.

Fig. 2. Outline of the skull of the *Thylacinus Harrisii*:—nat. size.

PLATE XIII.

Fig. 1. Upper view of the cranium of the *Thylacoleo carnifex*:—two-thirds nat. size.

Fig. 2. Upper view of the cranium of the *Dasyurus* (*Sarcophilus*) *ursinus*:—nat. size.

Fig. 3. Upper view of the cranium of the *Thylacinus Harrisii*:—nat. size.

Fig. 4. Inside view of part of the lower jaw of the *Thylacoleo carnifex*:—nat. size.

Fig. 5. Upper view of the same fossil.

Fig. 6. Side view of a metacarpal of a carnivorous quadruped; from Australian pleistocene.

Fig. 7. Proximal end of the same.

Fig. 8. Distal end of the same.

* From θύλακος, *marsupium*; λέων, *leo*.

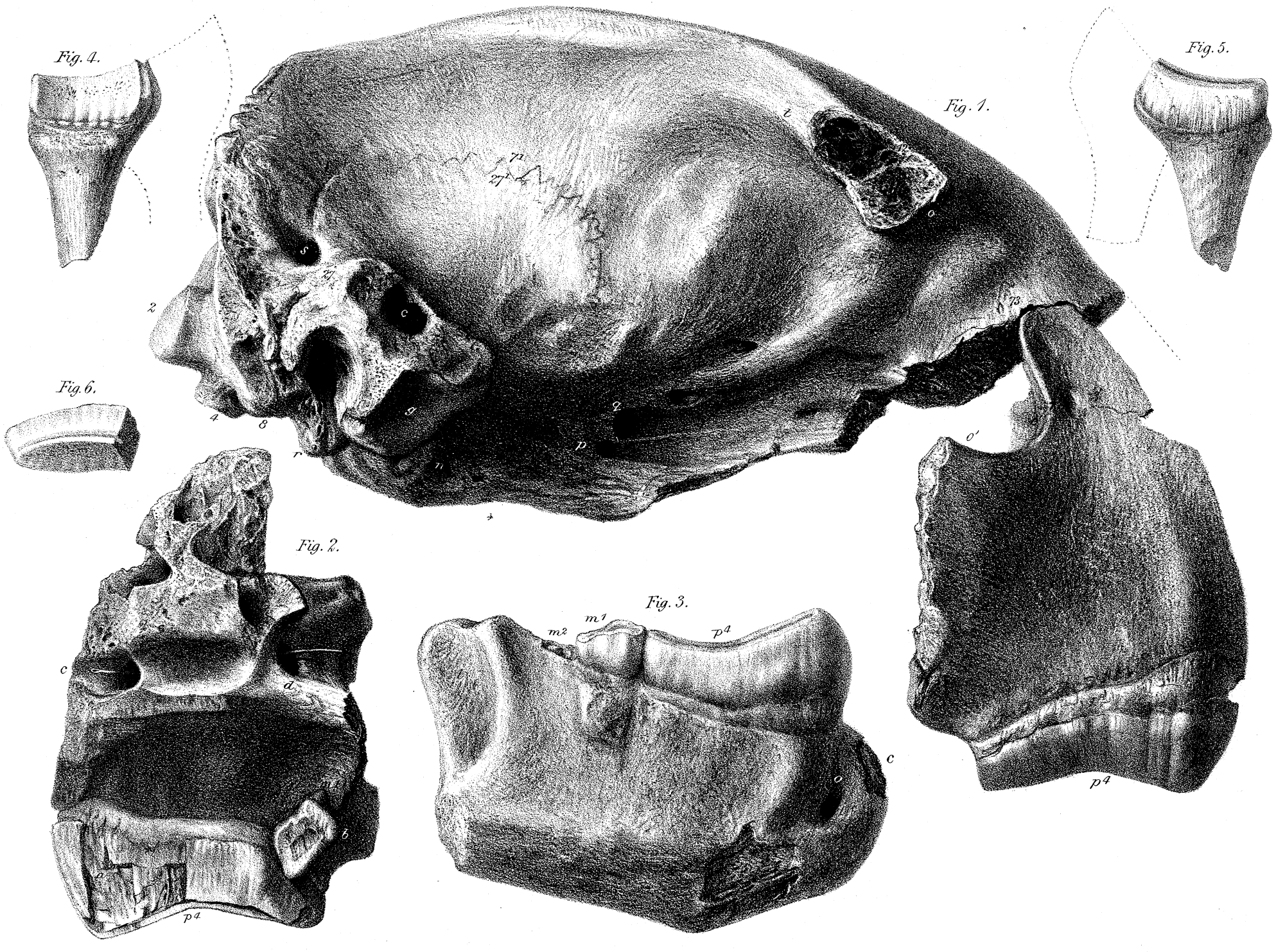
PLATE XIV.

Fig. 1. Base view of the mutilated fossil cranium of the *Thylacoleo carnifex*:—nat. size.
Fig. 2. Base view of the cranium of the *Dasyurus* (*Sarcophilus*) *ursinus*:—nat. size.
Fig. 3. Base view of the cranium of the *Thylacinus Harrisii*:—nat. size.
Fig. 4. Part of the palate, with the sectorial (p 4) and tubercular (m 1) molars of the Lion (*Felis Leo*):—nat. size.

PLATE XV.

Fig. 1. Occiput of the *Thylacoleo carnifex*:—nat. size.
Fig. 2. Occiput of *Dasyurus* (*Sarcophilus*) *ursinus*:—nat. size.
Fig. 3. Occiput of *Thylacinus Harrisii*:—nat. size.
Fig. 4. Occiput of *Felis spelæa*:—nat. size.

The letters and figures are explained in the text.



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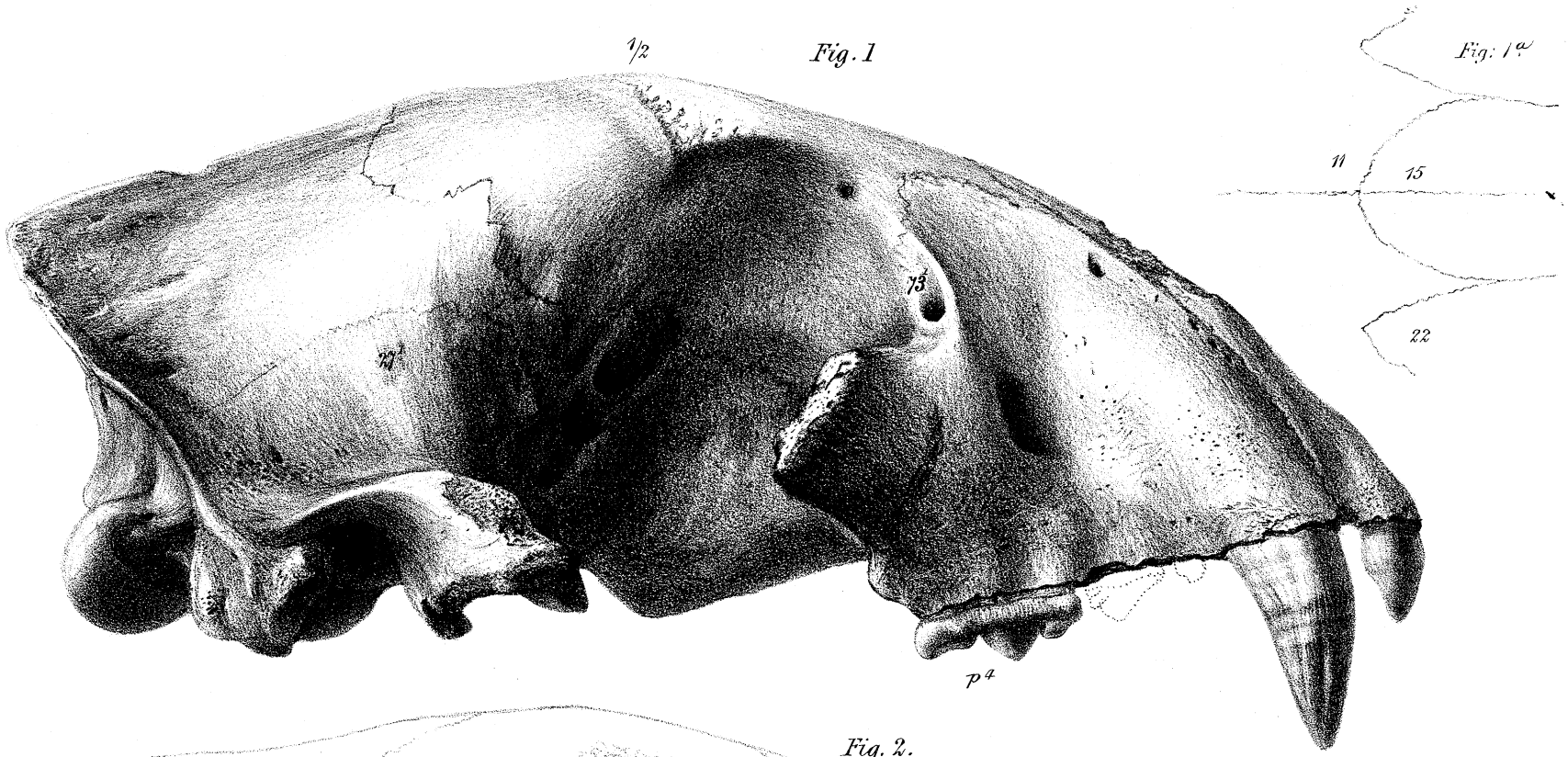

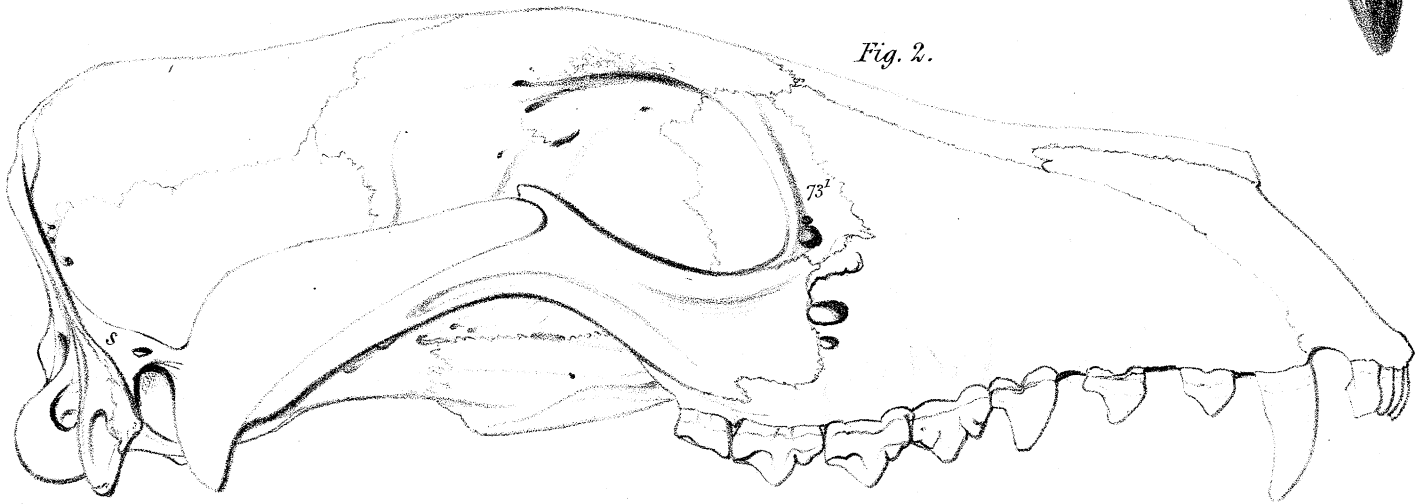

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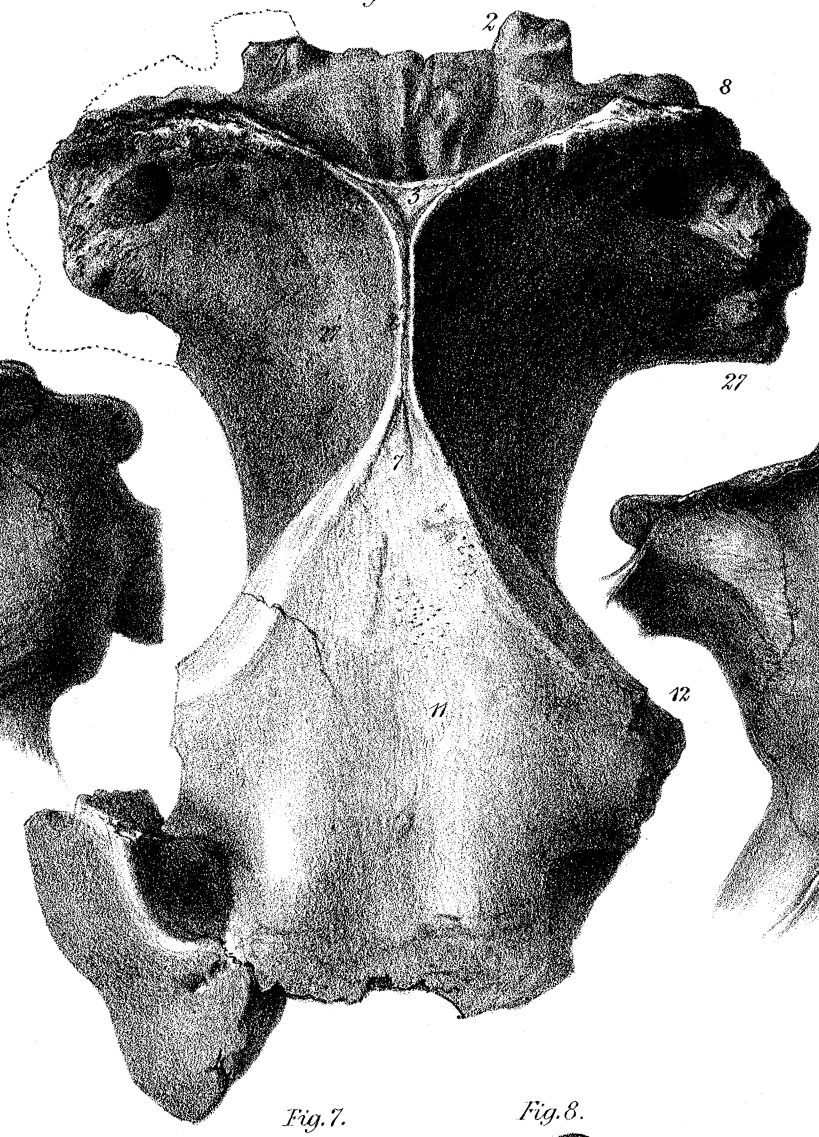

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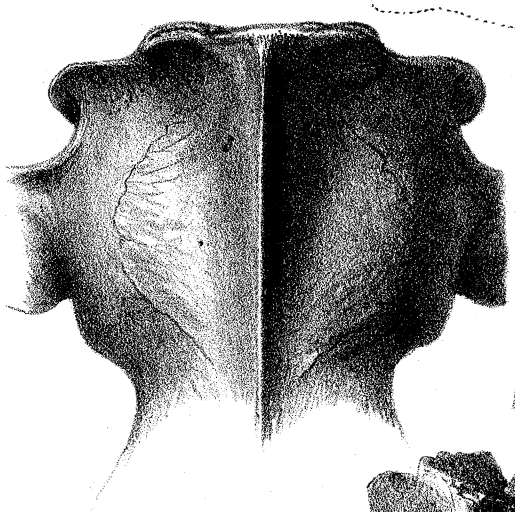

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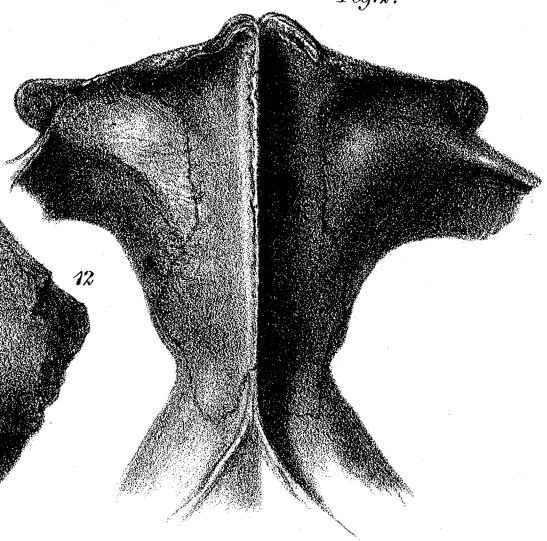

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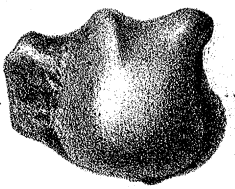

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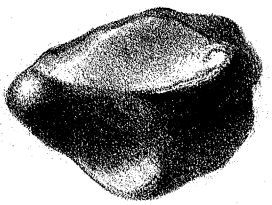

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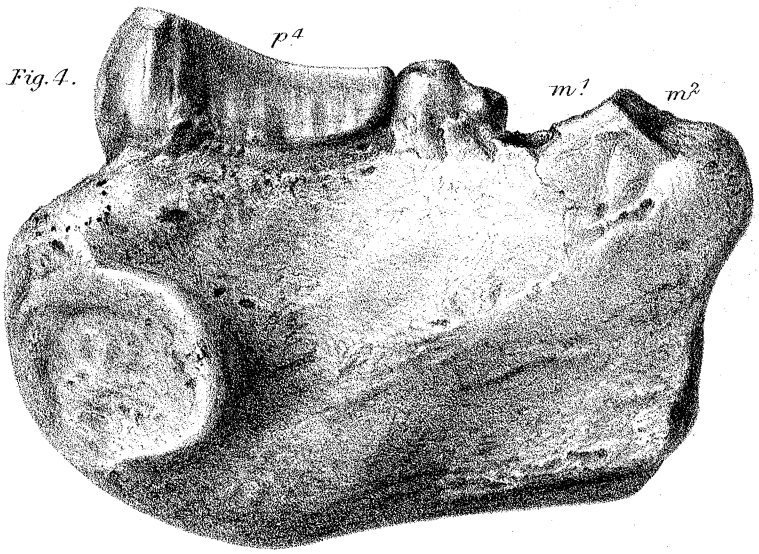

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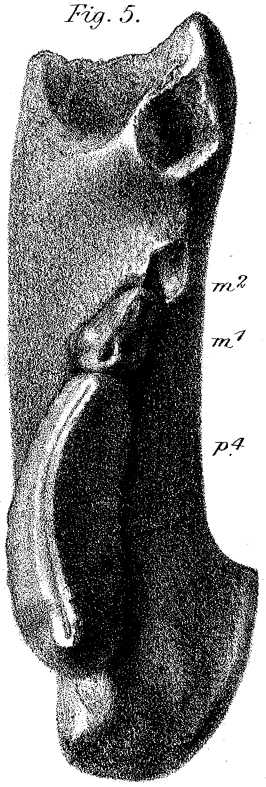

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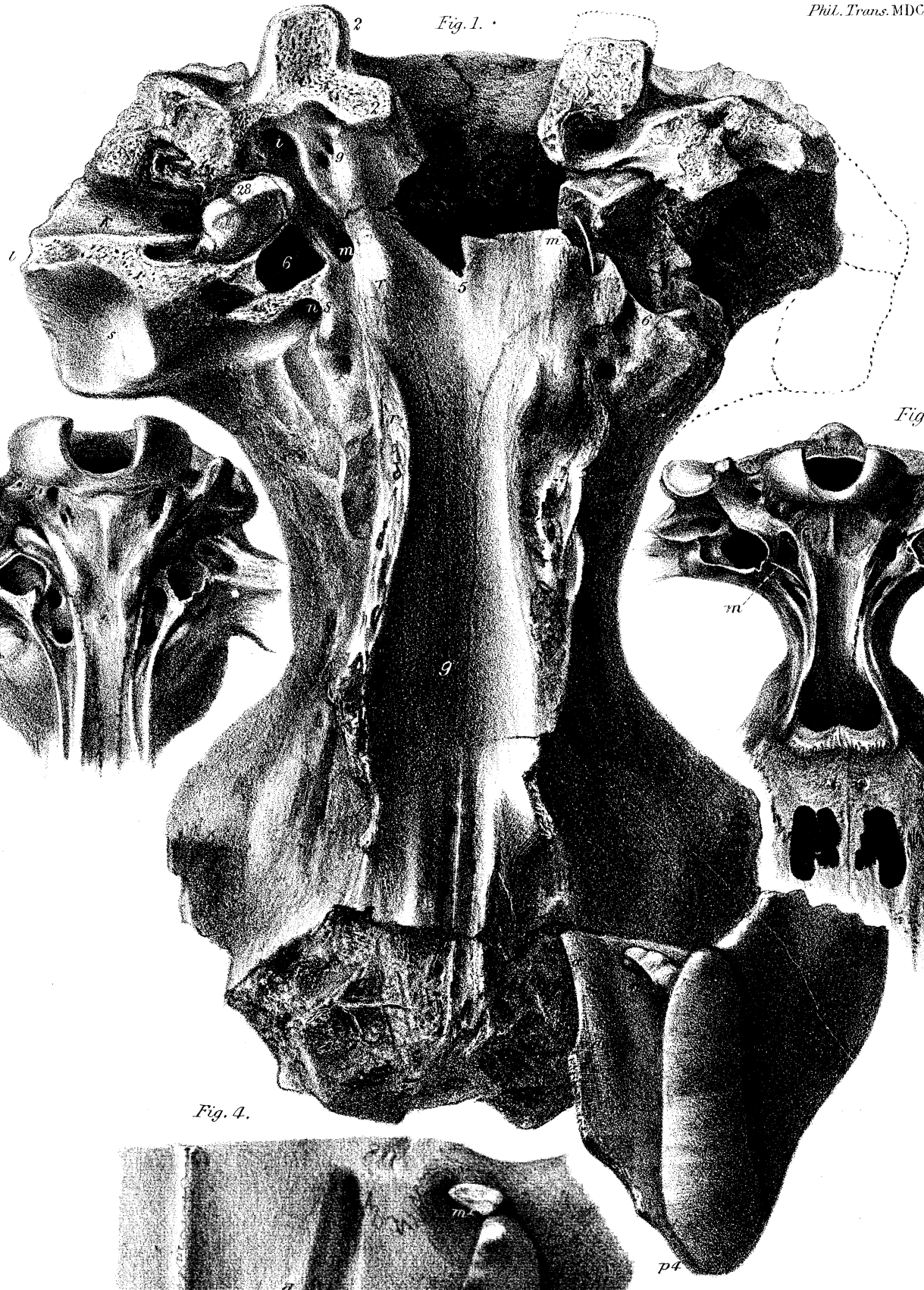

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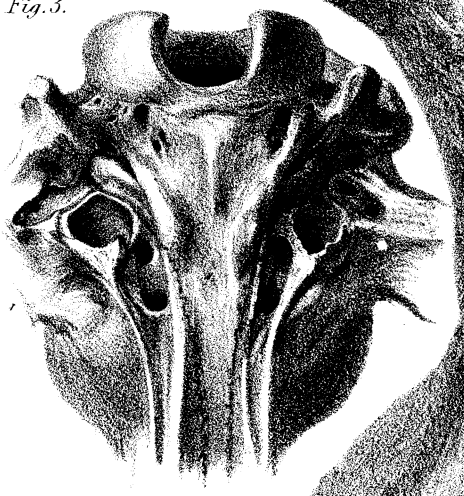

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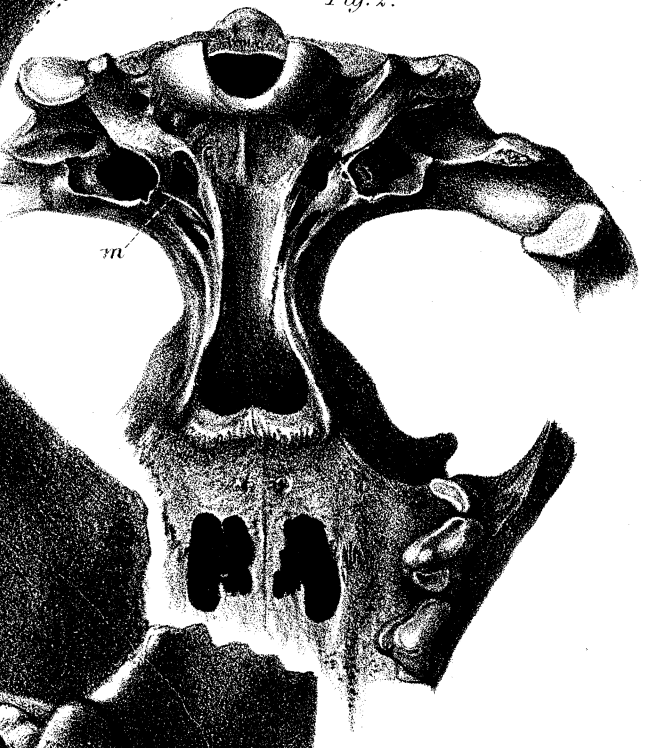

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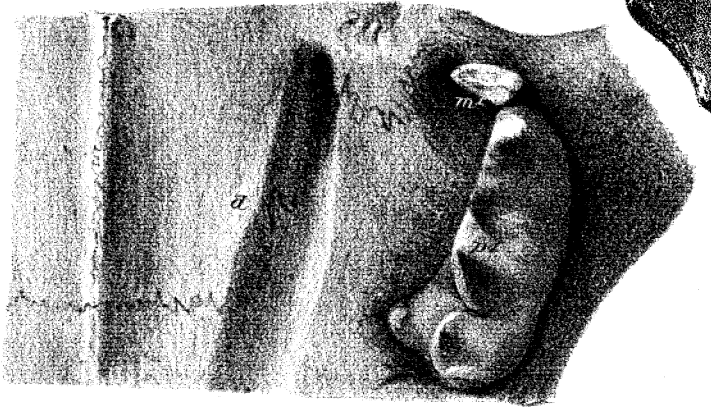

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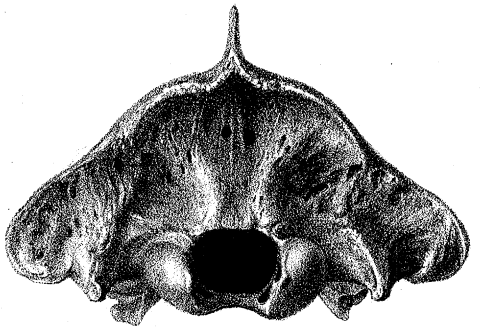

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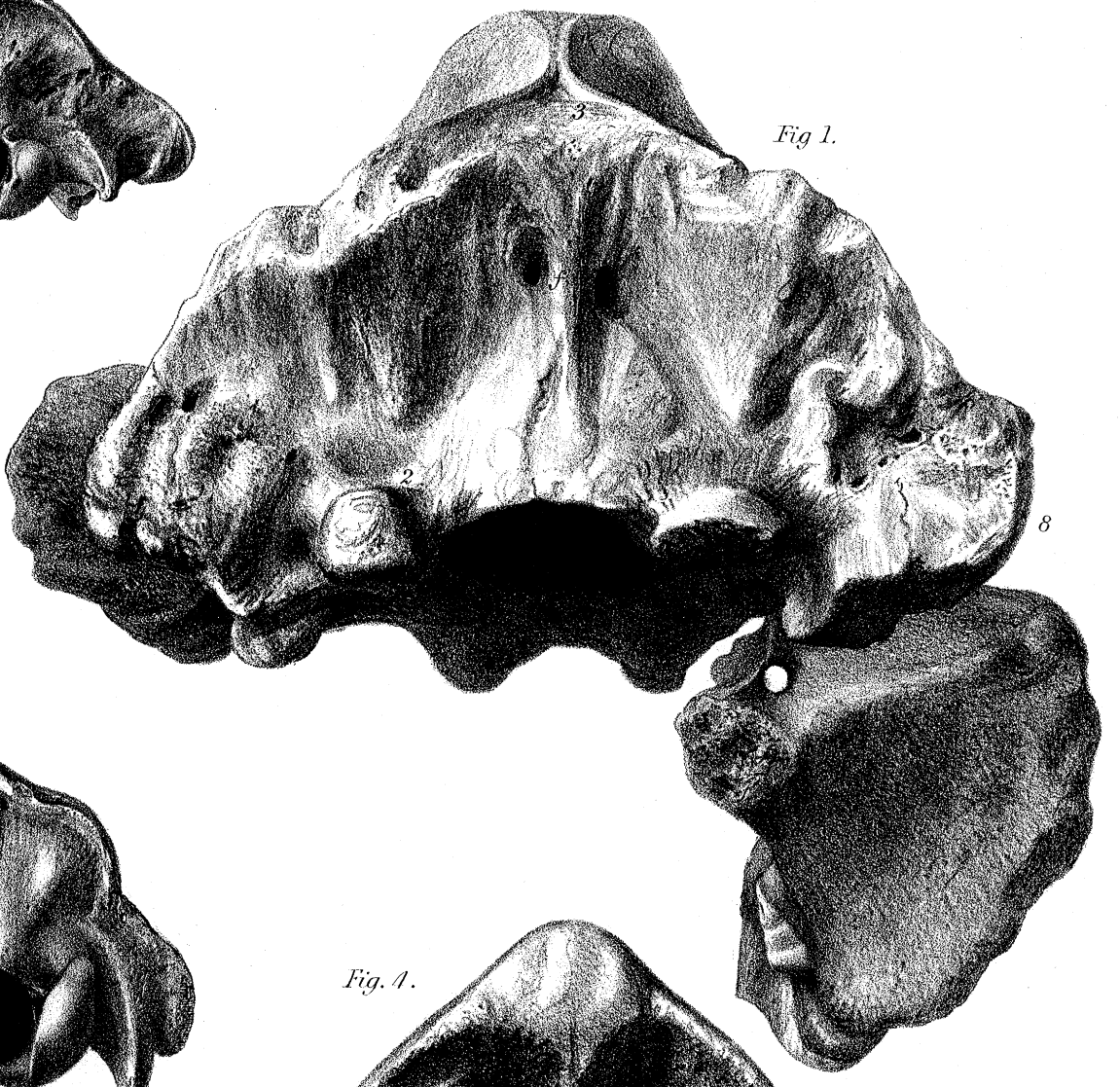

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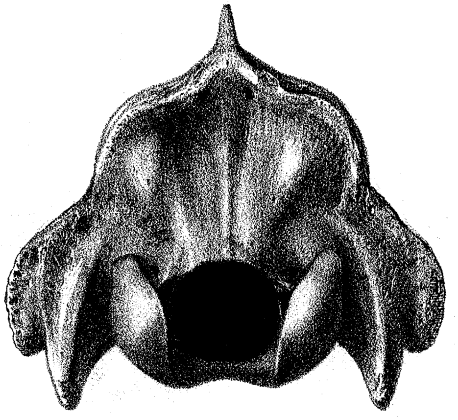

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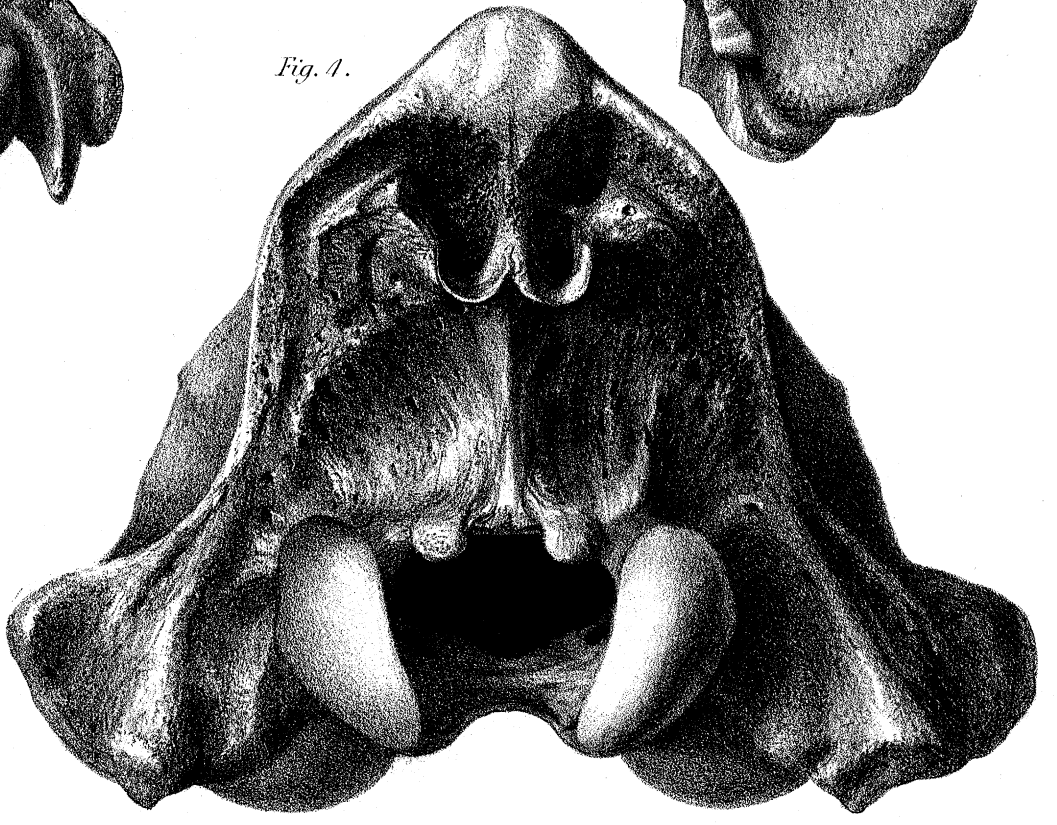

Fig. 4.

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