IV. *On the Fossil Mammals of Australia.*—Part V. Genus *Nototherium*, Owen.

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§ 1. *Introduction.*—The recognition of the genus which is the subject of the present paper was subsequent to that of *Diprotodon.* So much of the molar teeth as remained in the mutilated mandibles* transmitted to me, in 1842, by Sir Thomas Mitchell, C.B., from the bed of the Condamine River, indicated their transversely two-ridged character, and suggested at first sight that the fossils might belong to some smaller species of *Diprotodon.* Closer scrutiny, however, showed them to be parts of full-grown animals, and that they could not be the young of any larger extinct Herbivore.

Moreover, sufficient of the symphysial or anterior part of one of the mandibular fossils remained to demonstrate the absence of any incisor developed as a tusk or defensive weapon†, such as coexisted with the bilophodont molar teeth in the lower jaw of *Diprotodon.* The small portions of the enamel on the remaining bases of the molars (for the crowns of all had been more or less broken away) showed a smoother surface than that at the corresponding parts of the molars in *Diprotodon.* I was therefore led to recognize with much interest, in the fossils transmitted by my esteemed friend on his return to his duties as Surveyor General of the Colony of Australia, after the publication of the work‡ containing the first notice of *Diprotodon*, evidence of another genus of extinct herbivorous marsupials, second only in bulk to that first discovered, and I proposed for the smaller genus the name of *Nototherium* §.

Further comparison of the mandibular fossils referable to such genus indicated them to have belonged to two species, to one of which (fig. 1, p. 42) I was glad to attach the name of its discoverer (*Nototherium Mitchelli*); the other I proposed to call *Nototherium inerme*, as it afforded evidence of the absence of large incisor tusks. Whether any, or of what proportion, or in what number, incisors might have been present in the missing fore part of the fractured symphysis could not, of course, be determined; that which remained only gave the negative evidence as to incisors of the relative size and shape and persistent growth characterizing the *Diprotodon* ||.

* Owen, "Report on the Extinct Mammals of Australia, &c.," in Reports of the British Association for the Advancement of Science for 1844, 8vo, p. 223, plates 3 & 4.

† Ib. p. 231.

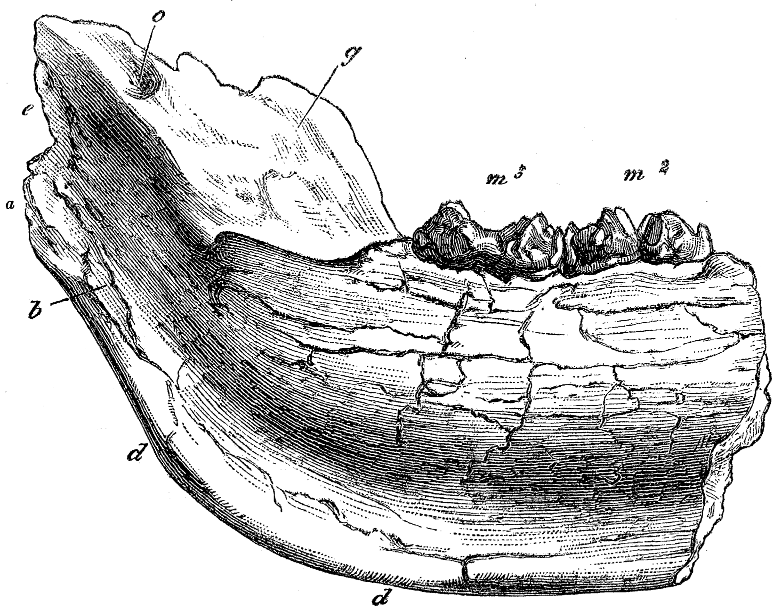
‡ 'Three Expeditions into the Interior of Eastern Australia,' vols. i. & ii. 8vo, 1838.

§ νότος, south, θηρίον, beast, 'Catalogue of the Fossil Mammalia and Aves in the Museum of the Royal College of Surgeons,' London, 4to, 1845, p. 314.

|| "The lower fractured surface exposes the dental canal extending obliquely from without inwards below the

In the year 1845 I received from the accomplished and determined, but unfortunate, explorer of Australia, LUDWIG LEICHHARDT, a fossil mandibular ramus of a young Notothere, showing the germ of an incisor which, in adult specimens subsequently acquired, proved to be a tooth of temporary growth with crown and fang distinct, as in *Macropus*,

Fig. 1.



Inner side of hind half of left mandibular ramus of *Nototherium Mitchelli* ($\frac{1}{2}$ nat. size), "On Extinct Mammals of Australia," Reports of the British Association for the Advancement of Science, vol. for 1844, pl. iv. fig. 3.

as will be shown in a subsequent part of the present memoir. One of these adult specimens included both rami, contributing satisfactory additional evidence of the characters of *Nototherium Mitchelli*. It was part of the series of fossils collected at King's Creek, Darling Downs, in 1845, and transmitted to London by Mr. BENJAMIN BOYD, where it was purchased by the Trustees of the British Museum, along with the cranium and lower jaw and other instructive parts of the skeleton of *Diprotodon*, described and figured in Part III. of the present series of Memoirs*.

A portion of maxilla with upper molar teeth of *Nototherium Mitchelli* also formed part of this purchased series.

In 1856 there was discovered in the same locality the skull, wanting the lower jaw, of *Nototherium Mitchelli*. This unique and valuable specimen came into the possession of FREDERIC NEVILLE ISAAC, Esq., by whom it was presented to the Australian Museum, then in course of formation in Sydney, New South Wales.

WILLIAM SHARPE MACLEAY, Esq., F.R.S., originator of the Quinary System and author

sockets of the anterior molars and then bifurcating; the outer and larger division terminating at the mental foramen, and an inner and smaller one extending forwards nearer the symphysis, but without any trace of a large incisor" (*op. cit.* p. 319).

* Philosophical Transactions, 1870, p. 519.

of works and monographs which gave great stimulus to the progress of philosophic zoology, published a notice of this remarkable fossil, naming it *Zygomaturus trilobus*, in a "Report on Donations to the Australian Museum during August 1857," which appeared in a Sydney newspaper of that date.

Photographs of the skull, made by the direction of the then Governor of Australia, Sir WILLIAM DENISON, K.C.B., were transmitted to Sir RODERICK I. MURCHISON, Bart., P.G.S., for presentation to the Geological Society of London. These photographs were placed in my hands, with the request to report upon them*. I had some time previously received from my friend GEORGE BENNETT, Esq., F.L.S., of Sydney, outline drawings of the same skull, from which materials I recognized it to belong to the genus *Nototherium*, and in all probability to the larger species, *N. Mitchelli*, of which the lower jaw, from the same formation and locality, had been previously received and added to the British Museum. I had written, on receipt of the 'Sydney Morning Herald' containing Mr. MACLEAY'S Report and Notice of his *Zygomaturus*, to the author, suggesting the probability that his subject might prove to belong to the *Nototherium*, and expressing the wish for the opportunity of making the requisite comparisons by means of a cast of the skull; and I received a friendly and favourable reply in a letter dated 9th March 1858, in which Mr. W. S. MACLEAY writes:—"Every month a list of donations received is published in our local newspapers, and it is true that in one of such monthly lists I lately wrote on this '*Zygomaturus*' a few words which you appear to have seen. They are, however, principally intended to please the donor, and to induce him to send us more specimens. The name, from the 'tail' or process of the zygoma, was given on the principle we adopted of cataloguing every thing, were it only for the purposes of correspondence and exchange."—"You ask for a cast of the skull of the *Zygomaturus*, and I am glad to think that, long ere you receive this letter, you will have had in your hands a cast that Mr. WANT, a Trustee of our Museum, took home for the British Museum."

The characters afforded by this cast and by the outlines and photographs of the original specimen dispelled all doubt, in my mind, as to the skull and upper jaw and teeth belonging to the same species as the lower jaw of *Nototherium Mitchelli*, also discovered in the bed of King's Creek, Darling Downs.

But there were many points in relation to sutures and foramina which could only be determined by inspection of the original specimen. It could scarcely be expected, however, that a donation of such unique rarity would be despatched for that purpose from the Antipodes. But the Trustees of the Australian Museum have kindly directed photographs, on a larger scale than those originally sent by Governor DENISON, to be prepared and transmitted to me; and they have also liberally caused casts to be made of the principal specimens of bones and teeth of *Nototherium* subsequently acquired for the Australian Museum, which casts, with photographs of the originals, have likewise safely come to hand.

These and other evidences of the present genus, received at different times from various

* Quarterly Journal of the Geological Society, vol. xv. 1859, p. 168.

sources and localities in the Australian continent, will be duly acknowledged in the descriptions of such about to be given; and I propose at once to proceed with the results of the examination of the evidences at my command of the cranial structure of *Nototherium* *.

§ 2. *Skull.*—The singular shape and proportions of this part of the skeleton will be recognized at a glance of Plates II. and III. The occipital region (Plate III. fig. 1) represents the upper half of a transverse ellipse, being arched above; the straight line, or section, below is interrupted by the paroccipitals ($_4$, $_4$), which descend on each side of the condyles ($_2$, $_2$), about 2 inches below the level of the foramen magnum, *o*; the mastoids ($_8$, $_8$) and squamosals ($_{27}$, $_{27}$) bound the region externally. The breadth of the occiput at its base is 13 inches, the height at the mid line 7 inches. The surface inclines forward (Plate II. fig. 1, $_3$) especially at its mid third (Plate III. figs. 1 & 2, $_3$), but becomes vertical, or nearly so, as it arches outward. The surface is broadly undulate transversely, being concave at the mid third, convex at the two outer thirds. Nearly the whole of this surface is roughened by ridges and insertional impressions of nuchal muscles, the sharpest and most prominent of which is the medial vertical one (ib. figs. 1 & 2, $_3$), extending from near the upper border of the foramen magnum to the transverse ridge bounding the occiput superiorly: this ridge describes a low arch transversely; lengthwise it extends toward the upper surface of the cranium, describing an open angle with the truncate apex forward (ib. fig. 2) The condyles form the lower two thirds of the foramen magnum, save at the interval of seven lines between their lower ends (ib. fig. 3, $_2$, $_2$). From these they diverge as they rise with a vertical convexity, greatest at the lower half of the condyle, and more gradual toward the upper and outer end. The transverse convexity is more regular, and affects the hinder, outer, and under parts of the joint. The length of each condyle is 2 inches 7 lines, the extreme breadth is 1 inch 3 lines, the distance between the upper ends is 4 inches 6 lines. The surface towards the foramen is almost flat in the least diameter, gently concave or rather undulating lengthwise. The plane of the occipital foramen is vertical; its shape is a full ellipse, with the least diameter transverse; this gives 1 inch 8 lines; the long diameter is 2 inches.

A broad groove or channel, directed from below upward and outward, divides the condyle from the base of the paroccipital ($_4$). This broad process inclines forward before it descends, its hinder plane being anterior to that of the convex part of the occiput above. The obtuse termination of the process is continued, with a curve upward and outward, by a thick and rugged ridge into the mastoid process ($_8$), which, with the squamosal, bounds the occipital region laterally. The outer margin rises from the mastoid with a slight convexity for four inches before curving inward to the upper arch of the occipital ridge. A fracture of the outer table on the right side of the occiput exposes the extension to this part of the cranial walls of the air-cells continuous with larger cavities in advance.

* Dr. J. D. MACDONALD, R.N., had the opportunity of seeing the remarkable skull which Mr. ISAAC had sent to Sydney from King's Creek, and his 'Notes' thereon are quoted in my Paper in the 'Quarterly Journal of the Geological Society,' *tom. cit.* p. 169.

The base of the huge zygomatic arch is continued (Plate II. fig. 1, $_{27}$), with a slight sinking inward, from the whole vertical extent of the mastoid ridge and from a part of the superoccipital; the lower end being formed by the tympanic, which is defined by a slight notch from the end of the mastoid process.

The parietal walls (ib. $_{7}$) extend from without inward and forward. From the short alisphenoid the parietal plate arches upward, with a strong convexity forward at its lower half (Plate III. fig. 3, $_{7}$); this subvertical part of the cranial walls forms the hind boundary of the vast subquadrate oblong vacuity combining orbit and temporal fossa (Plate III. figs. 2 and 3, *t*). The parietal or parieto-temporal wall (Plate II. fig. 1, $_{7}$) is divided from the occipital plane (Plate III. fig. 2, $_{3}$) by the superior or superoccipital arched ridge; it is divided from its fellow or opposite wall above by a flattened tract about an inch broad (ib. fig. 2, $_{7}$), near the superoccipital (ib. fig. 2, $_{3}$), but which expands as it advances from the parietal ($_{7}$) upon the frontal ($_{11}$) region. The parieto-frontal part of the cranium forms less than the middle third of the breadth of the entire skull as here completed by the enormous zygomatic arches. The frontal roof of the cranium, retaining its flatness transversely, gains a breadth of five inches, with a slight downward slope in profile (Plate II. fig. 1), and then (ib. $_{11}$) more abruptly arches down to the origin of the nasals (ib. $_{15}$), an arch being continued outward, on each side of the naso-maxillary pedicle, to the tuberosity (*s*) representing the antorbital or lacrymal process. There is a transverse depression above the origin of the nasal bone (Plate III. fig. 2, $_{15}$). The vertically convex outswellings of the frontal above and alongside this depression indicate the enormous air-sinuses within. The inner side or walls of the orbito-temporal vacuities sink sheer from the upper parieto-frontal tract to the outswelling of the maxillary molar alveoli (ib. $_{21}$), with a slight inclination inward. The greatest posterior depth of this cranial precipice is $6\frac{1}{2}$ inches.

At the junction of the alisphenoid with the parietal, near the bottom of the back wall, is a tuberosity. The diameter of the sphenoido-parietal part of the cranium is $4\frac{1}{2}$ inches; that of the skull at the corresponding part across, or including the zygomatic arches, is 16 inches! The cranium proper, from this singular constriction, gradually expands as it advances to the superorbital part of the frontals. If the cranial cavity concurred with its outer walls in shape it would be triradiate, two corridors extending along the transversely extended and antero-posteriorly contracted occipital part, and a third passage running forward from the mid line toward the face. But the singular departure in the outer walls from the normal shape of the brain-case is mainly due to a vast diploë of air-cells. The proper cerebral cavity makes no outward show, and it is insignificantly small in proportion to the entire skull.

Viewed from below (as in Plate III. fig. 3), the condyles ($_{2, 2}$) are divided by a deep notch; their lower ends descend a little below the level of the basioccipital ($_{1}$). This presents a rugged triangular tract in advance of the foramen, the apex being continuous with a sharp ridge longitudinally bisecting the surface of the basisphenoid. On each side of the tuberous tract and ridge is a wide and moderately deep depression, extending from the lower end of the occipital condyles forward to the pterygoid plates or posterior aperture of the nares. These "basioccipito-sphenoidal depressions" are bounded laterally by a small tuberosity, by the inner surfaces of the occipito-petrous prominence, and by a ridge inclining mesiad to the hind part of the base of the pterygoid plate.

The basioccipito-sphenoidal part of the "basis cranii" is $3\frac{1}{2}$ inches in length, and 3 inches in breadth posteriorly. Its plane forms with that of the "basis faciei," or bony palate, lengthwise, an angle of 130°; the basis cranii sinking, the basis faciei rising, as they advance.

The fore part of the tympano-mastoid ridge (Plate II. fig. 1, $_{8, 12}$) appears to form the smooth flat hind wall of the articular surface for the mandibular condyle, unless the squamosal should abut against the mastoid beneath the petrotympanic: the cranial bones of this part are evidently modified by original antero-posterior compression. This post-glenoid process or wall is $2\frac{1}{2}$ inches transversely, and probably was of great vertical extent when entire; it is directed from within outward and rather forward. The articular surface has the same direction, and consists of a hind groove (Plate III. fig. 3, *g*) and a front bar, *i. e.* it is divided from before backward into a strong convexity and a deep concavity; both are slighly concave transversely; in that direction the extent of the surface is $3\frac{1}{2}$ inches; from before backwards it measures $1\frac{1}{2}$ inch. The malar ($_{26}$) descends to bound the outer part of the articular bar, to which it contributes a share of the articular surface. The outer end of the groove opens freely upon the base of the zygoma, which it slightly indents; the inner end is blocked by the descending part of the rugged petrosal.

The palatal part of the premaxillaries (Plate III. fig. 3, $_{22*}$) is feebly concave, 1 inch 5 lines across at the interval between the sockets of i_2 and i_3, then contracting to a breadth of 1 inch at the middle of the diastema (ib. *d*) between the incisors and molars: the length of this toothless tract is 2 inches 9 lines in a straight line. It is formed by a well-defined ridge gently curved inward until near the socket of the anterior molar, which part of the alveolar tract bends abruptly downward, 9 or 10 lines, below the ridge (Plate II. fig. 1, $_{21}$, d_3). The palate is deep transversely between the right and left anterior molars (Plate III. fig. 3, d_3, $_{21*}$), their interval in a straight line being 1 inch 10 lines. As the palate expands its transverse concavity decreases; its greatest breadth between the penultimate molars (m_2) is 2 inches 9 lines. Lengthwise the intermolar part of the bony palate (ib. $_{20*}$, $_{21*}$) is, anteriorly, gently concave, then convex, and again concave; it extends about an inch beyond the last molars, is bounded behind by a thick low rough ridge, a median forward continuation of which divides the back part of the bony palate into two shallow rough depressions or channels leading outwards to behind the last alveoli. The bony palate appears to be entire; its length from the interspace of the alveoli of the front incisors ($_{22*}$) is 11 inches 6 lines, from between the alveoli of the front molars to the hind border it is 7 inches 6 lines.

The huge and extraordinary zygomatic arches (Plates II. & III. $_{27}$, $_{26}$, $_{21}$) extend straight forward in parallel lines for more than half the length of the entire skull (Plate III.

figs. 2 & 3), then bend abruptly downward and arch transversely inward to abut against the middle third of the alveolar plates of the maxillaries, a thick transversely extended process (Plate II. figs. 1 & 2, $_{21'}$) being continued downward from the angle of the inward curvature. From the hinder origin or "pier"($_{27}$) each arch gains, as it advances, a vertical extent of 4 inches 3 lines; then contracts to one of 3 inches, again expanding slightly in the vertical direction, and greatly in the transverse one, before the inward twist to form the maxillary pier or abutment. The inner surface of the arch is smooth and slightly concave; the outer surface is rough, convex, and outswells into two large protuberances, one at the part (*e*) anterior to that supporting the joint for the lower jaw, the other and larger (fig. 2, *f*) at the angle formed by the down-bending of the arch to the orbital floor; the latter is most prominent and best defined. The floor of the orbit (ib. fig. 1, *r*) is of comparatively small extent, limited to the inner or mesial half of the inwardly bent part of the zygoma, of a triangular form, indicative, with the inner orbital concavity leading to the antorbital process (*s*), of the small relative size and low position of the eyeball; with this position the foramen opticum corresponds. The extent of the anterior inwardly bent part of the zygoma is 5 inches. From the lower angle of the bend is continued downward the process ($_{21'}$) for an extent of 3 inches, with a twist, making its sides look forward and backward, its borders outward and inward. Its breadth is $2\frac{1}{2}$ inches, its termination subtruncate; from its inner border to the alveolar part of the maxillary, between the penultimate and antepenultimate molars, is 3 inches 6 lines, giving the span of the arch extending transversely from the anterior root of the zygoma to the masseteric process, the end of which reaches below the level of the upper grinding-teeth (Plate II. fig. 1, $_{21'}$). The anterior root of the zygoma is three-sided: one, the upper horizontal surface, forming the floor of the orbit, has a fore-and-aft extent of 2 inches; the anterior and posterior surfaces converge to a thick lower border, which is above the interval between m_1 and m_2, terminating about 10 lines above the outlets of the sockets of those teeth. The antorbital foramen (ib. $_{21}$) is vertically elliptic, 10 lines in long and 6 in short diameter, situated 1 inch 9 lines in advance of the orbit, and about 2 inches above the outlet of the anterior molar (d_3). The antero-posterior extent of the maxillary alveoli, in a straight line, is 7 inches; their outlets describe a gentle convexity downward as well as outward, the right and left series diverging from the anterior pair to the fourth and incurving slightly at the last pair (Plate III. fig. 3, d_3, m_3). The outer roots of the contained molars cause corresponding prominences of the sockets, giving an undulatory surface to that part of the upper jaw (Plate II. fig. 1). This extends, perhaps in conjunction with the palatine bone, about an inch beyond the last molar, with an upward slope.

The breadth of the hind part of the palate here is 3 inches 3 lines. The posterior nares form a triangular aperture, with the base above the palate, 2 inches 3 lines broad, thence contracting as it extends obliquely upward and backward to a point at the fore end of the basisphenoid ridge; the length of the aperture from this point is 4 inches 6 lines. The aperture is bounded laterally by the pterygoid plates.

If, as in the skulls of Mammals generally, we regard the part anterior to the orbits as the facial division, which is often the longest, the corresponding part in *Nototherium* offers the strangest and most anomalous form and proportions in the mammalian class. It looks like a mere pedunculate appendage to the rest of the skull. Instead of tapering to the end, as is usually the case, it expands forward from its base of attachment both vertically (Plate II. fig. 1, 15, *i* 1) and transversely (Plate III. fig. 2, 15, 22″). The vertical diameter at the base, or from the depression at the root of the nose to the fore part of the maxillary alveolar process, is 4 inches 9 lines; the same diameter at the fore end, from the tips of the nasal bones (15) to the first incisive alveoli (*i* 1), is 6 inches 6 lines. The breadth of the face at the outsides of the antorbital foramina is 2 inches 6 lines; the same dimension across the nasal processes of the premaxillaries (22″) is 6 inches. The length of the facial part of the skull from the antorbital foramen (Plate II. fig. 1, 21) to the fore part of the premaxillary (22′) is 5 inches 8 lines.

The nasal bones (15) appear to expand as they advance, chiefly transversely, for four fifths of their extent, then abruptly contract, from their outer borders, to terminate in a slightly deflected obtuse apex: their mesial suture appears to lie in a longitudinal chink or depression at the anterior third (Plate III. fig. 2, 15), but the chink does not extend to the conjoined apices. The sides of the most expanded part of the external nostril, contributed by the premaxillaries, swell into low and large, rather rough, tuberosities (22″); between these the upper surface is almost flat, like a platform.

The premaxillaries (22), which unite with the nasals (15), as in *Phascolarctos* (Plate II. fig. 3) and *Phascolomys* (ib. fig. 4), send their nasal processes upward, outward, and forward, where they expand and terminate, each in a tuberosity which projects below and a little in advance of the one above mentioned. These tuberosities, with the mesial prominence of the apices of the nasals, give a trilobate character to the upper boundary of the external bony nostril in *Nototherium* (fig. 2), exaggerating that in *Phascolomys* (fig. 4).

The premaxillaries (22) contract and descend, below the nasal processes, as vertical plates; slightly expanding again, below, to form the alveoli of the incisors, especially of the larger anterior pair: the outer surface of these alveoli appears to have been coarsely rugous. The inner walls of the alveoli rise, conjoined, as a vertical plate of bone, 3 inches above the outlets, and extend backward in close contact to form or support the beginning of the "septum narium." The space between the premaxillary septal plates and the superincumbent ends of the nasals is little more than an inch, which gives the vertical diameter of the nostril at that part; its transverse diameter is 4 inches. The antero-posterior extent of the alveolar part of the premaxillary is 2 inches 6 lines. The fore-and-aft diameter of the outlet of the first incisor is 1 inch 2 lines; the transverse diameter is 10 lines. The outlets of the smaller second and third incisors are subcircular; each has a diameter of 6 lines.

The cranial characters above described from casts, drawings, and photographs, I have been enabled to test by actual fossils of portions of the upper jaw and skull.

The first of these is a fragment of a right maxilla with two molars (*m* 1, *m* 2) *in situ*.

It shows part of the front pier of the maxillary arch, including its posterior surface, which springs from the alveolar plates on the vertical parallel with the interval between the two lobes of m_1, at its lower end, and extending as it rises with a curve convex backward to overhang part of the hind lobe of the same tooth. Sufficient of this maxillary zygomatic process remains to exemplify the difference between *Nototherium* and *Diprotodon* in the antero-posterior extent or thickness of this "pier;" it is characteristically greater in the smaller Herbivore, and of itself would save the palæontologist from being led astray by the close general resemblance of the upper molars of *Nototherium* with those of *Diprotodon.* The present fragment being from a young specimen, the dental lobes show well their vertical curve concave forward, and the transverse curve of the edge of the wedge concave backward. I availed myself of this fragment to expose the front roots of the anterior molar and the hind root of the posterior molar; but these, with other dental characters, will be noted in the section on the teeth of *Nototherium.* The present specimen afforded the subject of fig. 8 in Plate IX.: it shows a part of the convex roof of the alveolar tract which projects into the orbito-temporal vacuity, and the contiguous groove for the superior maxillary nerves and vessels.

The second cranial specimen is a larger proportion of the left maxilla with three molars *in situ* (d_4, m_1, m_2), part of the socket of the first (d_3), and the base of the crown of the last (m_3) rooted in its socket.

A portion of the bony palate extends with a slight upward curve, inward, from the sides of the sockets of d_3, d_4, and more distinctly inward from those of m_1 and m_2. A breadth of 1 inch 6 lines is preserved (opposite d_4): the fracture reduces the breadth to 6 lines as it extends backward to the alveolus of m_3. So much as is preserved of the bony palate confirms the inference of the entireness of the bony roof of the mouth deducible from the cut and photograph of the entire cranium, as far back at least as the sockets of m_3, right and left. The hind part of the origin of the zygomatic process of the maxillary is here at the vertical parallel of the interval between m_1 and m_2, consequently rather further back than in the former fragment. The worn surfaces of m_1 and m_2 show the present to have come from an older individual, as will be subsequently pointed out in detail. An extent of 3 inches of the massive maxillary pier, as its origin extends from behind obliquely upward and forward, is here preserved; the thickness of the process is 1 inch 3 lines. The height of the alveolar process or tract at the last two molars is 2 inches 9 lines. The transversely convex or arched roof of these sockets is, relatively, less broad and prominent than in the Wombat; its extent and proportions resemble more the corresponding part in the Kangaroo, conformably with the common character of three-rooted teeth of limited growth, which contrasts with that of the large undivided bases of the corresponding molars in *Phascolomys*, retaining their formative matrices, and making a proportional prominence outside the "superior maxillary channel." This channel in *Nototherium* describes a curve convex outward as it courses forward to perforate the antorbital part of the maxillary and emerge upon the outer surface of that bone (as the 'antorbital foramen,' 21, fig. 1, Plate II.).

The third portion of the skull of *Nototherium* includes part of the right maxillary with three molars (d_4, m_1, m_2) *in situ*, and part of the right palatine bone (Plate IX. figs. 6 & 7). The teeth are more worn than in the preceding specimen: the fossil is part of an aged individual; the teeth, moreover, show a superiority of size compared with those of the last described fragment, answering to the difference one sees between the molars of the full-grown male and female Kangaroos.

The hind surface of the maxillary pier of the zygomatic arch here lies vertically parallel with the fore half of the front lobe of m_2: an extent of 3 inches 3 lines is preserved of the origin of the pier as it passes forward and upward, where the fracture of the maxillary traverses the interval between the sockets of d_3 and d_4. The bony palate arches upward and inward from the inner walls of the sockets of m_1 and m_2, in as great a degree as from those of the socket of d_4. The extent preserved, in a straight line from the outlets of the alveoli, is 2 inches. The palato-maxillary suture begins at the inner or mesial fractured surface of the bony palate opposite the hind lobe of m_1; near the interval between m_1 and m_2 it extends outward and backward with an oblique curve to near the inner side of the outlet of the socket of m_2. Its relative position to the molars agrees with that of the palato-maxillary suture in *Phascolomys latifrons*; in *Macropus laniger* the suture begins, mesially, at the transverse parallel of the interval between m_2 and m_3, at least in an example with those molars in place and use.

The palatine bone, like the maxillary alveolar tract, has been broken at the part behind m_2, the broad single posterior root of which is exposed. But at the fractured surface of the palatine there occurs, just opposite or parallel with the back part of m_2, a small tract of the natural smooth unbroken surface of the palatine, indicating a posterior palatal vacuity, on the parallel of m_3, as in *Phascolomys*. The thickness, vertically, of the fore part of the bony palate here preserved is 1 inch, of the hind part half an inch.

In the younger, probably female specimens, the same admeasurements give 6 lines and 2 lines.

Contrasting the difference of size, shape, and relative position of so much of the maxillary zygomatic process and bony palate as is preserved in the two specimens just described, one is at first inclined to deem them to have come from different species of *Nototherium*; and three species of the genus are indicated by mandibular characters.

But in reference to the progressively backward extension of the zygomatic process of the maxillary, this may be coincident with the progressive growth of the alveoli of the hinder molars, as these teeth come into use; in like manner, as their crowns are pushed down to the line of wear in the ratio of the abrasion of their wedge-shaped ridges, so the alveoli will cling to and follow the roots, growing as they lengthen, and giving a curve or concavity to the palatal surface not present or needed in the less worn condition of m_1, m_2, and m_3, in younger individuals.

With the foregoing evidences of the cranial characters of *Nototherium* we may safely proceed to bring them out, or add to their saliency, by comparison with those in other extinct and in existing Marsupialia.

The skull of *Nototherium* is shorter in proportion to its breadth and depth than in *Diprotodon*, and differs in the singular way in which the maxillary or facial part is bent up upon the cranial part, exemplified in figure 1, Plate II., and by the angle, before noted, which the bony palate forms with the basis cranii. The shortness is mainly due to that of the antorbital extent of the skull; the diastema between the incisors and molars is relatively as well as absolutely less than in *Diprotodon*. The Notothere resembles the Koala (ib. fig. 3) and Wombat in the small proportion of the skull in advance of the orbits; the *Diprotodon* is more like the Kangaroos in the length of this part. The terminal expanse and lateral tuberosities of the upper half of the bony nostril is a peculiarity of *Nototherium*; but it is instructive to note them in both *Phascolarctos* and *Phascolomys* (Plate II. fig. 4); the fore part of the bony muzzle is expanded laterally by an outward swelling of the front border of the premaxillary (ib. $_{22}$) where it joins the nasal (ib. $_{15}$).

In the form, especially breadth, of the external nostril the Notothere resembles the Wombat, while the Diprotodon is more like the Kangaroo in this respect; but no known existing Marsupial shows the septal plates developed from the premaxillaries at the entry of the nasal passages, as in both *Nototherium* and *Diprotodon*. The Wombats make the nearest approach to this peculiarity.

The Notothere surpasses the Diprotodon in both the absolute and relative size of the zygomatic arches. This difference is very striking when a front view of the cranium (as in figure 2 of Plate II.) is compared with the similar view given of the Diprotodon's skull in Plate xxxv. fig. 2, in the Philosophical Transactions for 1870.

This most extraordinary feature in the cranial organization of the present large extinct Herbivore leads me to submit the following remarks.

The zygomatic arches are relatively stronger and wider in Proboscidians than in Ruminants and Solipeds; they are widest and thickest in the bilophodont Dinotheres, the temporal fossæ being of corresponding capacity. Still more developed are these arches in the Manatees, the Tapirs, and the bilophodont Megatheres, especially in the vertical extension of the bone giving attachment to masticatory muscles. It would seem that the working of opposed double-ridged grinders required greater strength and more direct horizontal pull of the masseteric muscular fibres than the working of the more complex but flatter molars of the Ox, Horse, Rhinoceros, or Elephant. The phytophagous Marsupials have the grinding-surface of their many massive molars raised into prismatic cones or transverse ridges, and their skull is remarkable for the great strength, size, and span of the zygomatic arches. The descending process from the fore and under part of the arch, for extending the origin of the premasseter muscle, adds to the zygomatic complexities and characterizes the *Poëphaga* among existing Marsupials. This osteological feature is not found in any gyrencephalous Herbivore; but it exists, with a different relation to the constituent bones of the arch, in the lissencephalous Sloths, Megatherioids, and Glyptodonts. In the Nototheres the zygomatic development reaches its maximum, with the dependent process extending from the maxillary element of the arch as in other Marsupials. The muscular force operating on the mandible, both for biting and chewing, was very great, indicative of unusual resistance in the alimentary substances to be ground down. The grip of the front incisors brought by the shortness of the face and jaw within the power of the crotaphyte muscles in a degree proportional to the proximity of the inserted movers must have been like that of a vice.

§ 3. *The Mandible.* A. *Nototherium Mitchelli.*—The mandible (Plate IV.) discovered in the bed of King's Creek, a tributary of the river Condamine, Darling Downs, which was purchased of the collector by Mr. BENJAMIN BOYD, and subsequently, with the rest of Mr. BOYD's collection, acquired by the British Museum, is from the same formation and locality as the skull above described, which fell into Mr. ISAAC's hands.

This mandible agrees so closely, not only in the shape, structure, and other characters of the teeth, saving the difference of upper and lower, but also in the dimensions of these and of the proportion of the jaw-bone preserved, that it might well have been part of the same individual; it certainly belongs to the same species.

Comparing the type specimen of *Nototherium Mitchelli*, Ow.*, with the answerable part of the above-mentioned mandible, the correspondence in size and configuration is such as to support the reference of the present more complete specimen to that species.

The depth of the mandible behind the last molar is 3 inches 9 lines in the first described, it is 3 inches 8 lines in the present specimen; the thickness of the mandible below the last molar is 2 inches 6 lines in both specimens. The antero-posterior extent of the two last molars in the original fragment with mutilated crowns is 3 inches 4 lines; in the more perfect mandible (Plate IV. figs. 1 & 2; Plate X. figs. 1 & 2, m_2, m_3) it is 3 inches 6 lines; from the back of the last molar to the entry of the dental canal (Plate IV. fig. 2, *o*) is 2 inches 9 lines in both specimens. The place and degree of inflection of the under margin and angle of the jaw (ib. *a* & *d*) are the same in both.

Referring on these grounds the mandible (Plate IV. figs. 1 & 2) to *Nototherium Mitchelli*, the cranium and upper jaw answering to that lower jaw must be referred to that species.

The mandible in question consists of the two rami mutilated at both ends, but fortunately retaining their natural confluence at the symphysis, of which a longitudinal extent of 3 inches 8 lines is preserved (ib. figs. 2, 3, *s*); this gives the angle of divergence of the horizontal rami from the place of confluence (ib. id.). It shows that the interval between the right and left mandibular condyles agreed with that between the articular cavities in the skull (Plate III. fig. 3, *g*, *g*); and that the distance of the condyle from the fore part of the first molar (d_3) was the same as that, viz. 12 inches, from the fore part of the first molar to the joint for the condyle in the upper jaw.

So much of the ascending ramus as is preserved, which closely corresponds with that in the type jaw, shows the same oblique direction of the curve (Plate IV. fig. 1, *a*, *b*, *d*)

* "Report on the Extinct Mammals of Australia, &c.," in Report of the British Association &c. for 1864, p. 13, pl. 4; and Cut, fig. 1, p. 42 (*suprà*).

by which the lower border graduates into the hind one of the rising branch: the curve changes slightly on rising to the level of the alveoli, being then feebly concave above the anterior inflected part of the lower margin; it becomes convex where the border is again inflected, and above this the hind border of the ascending ramus, after contracting, expands transversely, apparently to support the condyle. The angle or anterior inflection (*d*, *d*) is but slightly bent inward, with a thick and smooth border; the longitudinal extent of this inflected part is about $4\frac{1}{2}$ inches, closely repeating, as far as it is preserved, the characters of the more perfectly preserved angle of the type specimen (Cut, fig. 1, *d*, *d*)*. An oblique longitudinal wide and shallow channel intervenes on the inner side of the ramus between the inflection (Plate IV. fig. 1, *d*, *d*) and the low tuberous termination† of the postalveolar ridge (ib. & fig. 2, *t*), about an inch and a half behind the socket of the last molar (m_3).. This channel is continued backward with a partial interruption, caused by the forward extension of the inflected angle or hind border of the ascending ramus (Plate IV. fig. 2, *a*, *e*). This part is broken away in the type specimen.

In no part of the oblique channel (ib. *b*) occupying and mainly forming the inner surface of the ascending ramus of the jaw is there any trace of inlet of a dentary canal; in this respect, as in the somewhat unusual position of that inlet or entry, the present mandible agrees with the type fragment‡. Some nerve or vessel has left its impress along the middle of the channel, but has quitted it for contiguous soft parts without penetrating the bone.

The outer surface of the ascending ramus rises from the line of the anterior inflection (*d*) with a feeble vertical concavity, speedily changed to a convexity curving outward to the thick obtuse lower boundary (Plate II. & Plate IV. fig. 1, *h*) of the ectocrotaphyte depression (ib. *f*). The fore part of this depression is formed by the corresponding part of the rising ramus (ib. and fig. 2, *q*), which commences opposite the hind part of the last molar (m_3), and at a distance outside it of 1 inch 3 lines. The base of the "coronoid" plate (Plate IV. fig. 2, *q*, *h*) describes a curve, concave outward, of which base an extent of 5 inches (in a straight line) is preserved. The process is broken off in both rami; it was thickest at the fore part of its base (Plate IV. fig. 4, *q*), which here gives half an inch. The dental nerves and vessels groove the inner and back part of the base of the coronoid before penetrating it obliquely in the same position (at *o*, figs. 1 & 2) as that in the types pecimen (Cut, 1, *o*).

Between the postinternal alveolar process (Plate IV. figs. 1, 2, *t*) and the base of the coronoid process, is an irregular shallow channel (ib. *u*), narrowing as it passes backward to the dental canal (*o*). The depth of the mandibular ramus at the back of the last tooth-socket is 4 inches, the thickness of the ramus at the fore part of the origin of the coronoid process is 2 inches 6 lines.

The interspace between the right and left last socket is 3 inches 6 lines. The breadth of the mandible, taken anterior to the origin of the coronoid process, is 7 inches 8 lines; whence the jaw gradually expands to the condyles. We may estimate its breadth at the

* *Op. cit.* pl. 4. figs. 3 & 5, *a*. † *Loc. cit.* figs. 2 & 3, *b*. ‡ *Loc. cit.* fig. 3.

outsides of these, from the cavities (Plate III. fig. 3, *g*, 27) receiving them, to have been 1 foot, or thereabouts.

The outer surface of the horizontal ramus (Plate II. fig. 1, 32, *q*) is smooth, very convex vertically where it advances from the ascending ramus, but rising with a slight concavity to the outlets of the sockets; the convexity subsides as the jaw advances and the surface ascends more vertically to the outlets of the three anterior molars (ib. d_3, d_4, m_1), but it continues the vertically convex curve to the lower border. The thickness of the ramus before inbending to the symphysis is 2 inches; its height where it joins its fellow at *s* (Plate IV. fig. 2) is 3 inches 5 lines. At the lower and back part of the symphysis is a transverse roughish crescentic depression (Plate IV. fig. 3, *v*) for muscular insertion. The general longitudinal lay of the outer surface of the horizontal ramus is a feeble convexity forwards as far as below the second molar (d'_4), where it begins to change to a concavity leading on to the symphysial part (fig. 1, 32–*k*), containing, anteriorly, the sockets of the incisors. On the vertical parallel of the fore part of the first molar socket, about halfway between the upper and lower borders of that part of the ramus, is an outlet of the dental canal (ib. 32); it is subcircular, 5 lines in long diameter.

The inner surface of the horizontal ramus (Plate IV. figs. 1 & 2, *i*) sinks sheer below the outlets of the last socket, and with a slight vertical convexity from that of the penultimate molar; it is at first feebly concave, then convex to the back part of the symphysis, and the surface is uniformly concave at the upper part of the symphysis (ib. fig. 2, *s**), between the three anterior sockets of the right and left sides. The longitudinal lay of the inner wall of the ramus is feebly convex posteriorly, changing to a concavity deepening into the back and upper part of the symphysis. This junction of the right and left rami is completely ossified without a trace of the primitive separation shown in Plate VI. figs. 2, 3, 4, *s*, *s′*, *s**; herein contrasting strongly with the condition of the joint in the Kangaroo†.

The hind surface of the symphysis (Plate IV. figs. 2 & 3, *s*), vertically convex and smooth, is on the vertical parallel with the back lobe of third molar (m_1), near, but not quite extending, to the interspace between its socket and that of the fourth molar (m_2). The upper surface of the symphysis (ib. fig. 2, *s**, *s*) between the three anterior molars (m_1, d_4, d_3) is a rather deep smooth longitudinal canal, the margins of which begin to be encroached on by a diastemal ridge (ib. *k*), continued forward from the socket of d_3 with a slight curve convex inward.

The antero-posterior extent of the five molar alveoli is 7 inches 5 lines. The breadth of the anterior division of the first socket is 3½ lines, of the posterior division 5 lines; the depth is shown in the jaw of the young *Nototherium* (Plate VI. fig. 5, *l*). The sockets of the other molars increase in breadth to the anterior division of the last, which is 1 inch 1 line across. The alveolar plate rises in an angular form at the intervals of the sockets, and at those of the diverging roots of each tooth on both outer and inner sides of the jaw.

† Owen, Osteology of the Marsupialia, 'Anatomy of Vertebrates,' vol. ii. p. 350.

At the fractured part of the symphysis are parts of the bottoms of a pair of incisive alveoli; that on the left side gives a transverse breadth of 9 lines and a vertical one of about 1 inch; but the lower wall is broken away from the base. A still smaller portion is preserved on the right side.

The indications suffice to show that the incisors were not developed as tusks, of size and proportions fitted for offensive or defensive purposes, as in *Diprotodon*; their base and socket not extending backward beneath any of the molar alveoli, at least in the adult. Not more than an inch and a half of the toothless part of the symphysial end of the lower jaw has been preserved in the present specimen, and that only on one (the left) side.

Accepting the evidence from size and proportion in the preserved parts of the present mandible and its dentition, in proof of its appertaining to a full-grown individual of the same species as the skull above described, the length of the part of the lower jaw with its incisors, in advance of the molar series, can be estimated and restored from that of the premaxillary and its incisors anterior to the molar teeth in the upper jaw. This estimate gives from the fore part of the anterior molar socket of the mandible to the tips of the pair of lower incisors an extent of at least four inches and a half.

Complete as is this lower jaw compared with previously received specimens, including the one originally described, the relative extents of the sockets and protruded parts of the lower incisors would have remained to be determined.

Fortunately a mutilated mandible, but with the symphysial end nearly if not quite entire, has been received by the Trustees of the Australian Museum, Sydney, and a plaster cast of this specimen has been prepared and transmitted, with their characteristic liberality and promptitude, to the Trustees of the British Museum.

In this specimen an extent of the jaw forming the sockets of the pair of incisors (Plate V., *k*, *ï*), 2 inches 6 lines anterior to the first molar (ib. fig. 3, d_3 & *s**), has been preserved; but at this distance, the incisors with, perhaps, some small part of the fore part of their sockets have been broken off. The symphysis dwindles vertically and transversely to the condition of mere sheaths of the two approximate teeth, such sheath in no part of the fractured surface exceeding three lines in thickness, and where the bone comes nearest to the fracture it thins off to a fine edge (ib. fig. 4). As far as a cast can be trusted, part of the natural outlet of the sockets is shown below the teeth (ib. fig. 2, *s'*), the alveolar wall having extended further forward at their upper part†.

The vertical diameter of the fractured or partially fractured end of the symphysis at the mid line is 1 inch 6 lines; the transverse diameter is the same. The broken surface, including the roots of the incisors (Plate V. fig. 4, nat. size), is of a subquadrate form, with a mesial groove above (*s'*) and a slighter one below.

The lower contour of the mandible is continued, without interruption, but with gradual loss of convexity, from the inflected border (fig. 1, *d*) to the outlet of the incisors (*ï*).

† See "Memoir on *Diprotodon*," Philosophical Transactions, 1870, Plate XLI. fig. 2, *s*, where the same form of incisive alveolar outlet is shown in the mandible.

At the upper part of the symphysis the ridge (fig. 3, *k*), of which the beginning or hind part was noted in the description of the preceding specimen (Plate IV. figs. 1 & 4, *k*), is here seen to converge toward its fellow for the extent of an inch, then to be continued straight forward, broadening and subsiding. The pair of ridges form the sides of the smooth channel (*s**), grooving the upper surface of the symphysis, and gradually shallowing to the fore end. Posteriorly the channel rapidly widens to the intermolar space, then gradually expands, preserving or gaining depth to the hind border of the symphysis (*s*). The entire length of this confluent tract of the mandibular rami is 5 inches 10 lines; the thick rounded hind border is on the vertical parallel with the hind lobe of the third molar (m_1). It is satisfactory to find this character of the former mandible of *Nototherium Mitchelli* (Plate IV. fig. 2, *s*) here repeated. The under part of the hind end of the symphysis shows the insertional depressed surface (Plate V. fig. 2, *v*, *v*, of similar size and shape to that in the subject of Plate IV. fig. 3, *v*). The symphysis is subcompressed anterior to the molars, but the transverse diameter diminishes less gradually than the vertical one.

The present mandible is of a full-grown and, from the wear of the teeth, rather aged individual. The last three molars and a portion of the second are in place in the right ramus: the first, second, and part of the third molars remain in so much as is preserved of the left ramus.

The fore-and-aft extent of the molar alveoli is 6 inches 10 lines; that of the three hindmost is 5 inches 2 lines. I give this measurement, as well as the first, to show the close correspondence in size of the present with the preceding mandible of *Nototherium*: the present specimen is rather smaller; the bone is rather more slender; the vertical diameter, for example, of the ramus anterior to the foremost molar-socket is 2 inches 4 lines, in the subject of Plate IV. it is 3 inches; the vertical diameter behind the socket of the last molar in the subject of Plate V. is 2 inches 10 lines, in that of Plate IV. it is 3 inches 9 lines, in the type jaw† it is 3 inches 8 lines. With the closer conformity in the molar series, I infer the more slender proportions of the present mandible to be sexual, and to indicate its having come from a female Notothere.

Rather more of the base of the coronoid process (Plate V. figs. 1 & 3, *q*, *o*) is here preserved than in the subject of Plate IV.; it occupies the same proportion, and shows the same shape and curve as in that jaw; the dental canal perforates its hind part in the same position and with the same obliquity. The postalveolar process, broken as in the former mandible, and as it usually is in these Australian fluviatile fossils, holds the same relative position to the last molar tooth as in the male jaw. The smooth oblique channel between the fore part of the coronoid and the last alveolus has a breadth of 9 lines in the female, instead of 12 lines as in the male specimen. The anterior inflected angular border repeats the characters of the part in that specimen, but is not entire; the exceptionally perfect condition of the part in the type mandible‡ gives consequently valuable evidence of this character.

† *Loc. cit.*; and Cut, fig. 1

‡ *Loc. cit.*; and Cut, fig. 1, *d*.

The commencement, an inch above the anterior angular inflection, of the posterior inflected margin (Plate V. figs. 1 & 5, *a*) and the corresponding outswelling at the outer part of the ascending ramus (ib. fig. 5, *h*) indicate more definitely than in the first described mandible the part from which the neck of the condyloid process has been continued. The breadth of the back part of the jaw here is 2 inches 2 lines.

The anterior outlet of the dental canal is, as in the former mandible, on the same vertical line as the fore part of the first molar; but it is placed rather lower down: it is of similar size and shape.

A third example yielding Nototherian mandibular characters is also from the freshwater deposits of Darling Downs; it was discovered at Eton Vale by EDWARD S. HILL, Esq., and was presented to the British Museum by Sir DANIEL COOPER, Bart. It is part of the left ramus of an adult and seemingly male jaw, and includes the sockets of the last three molars with the penultimate and last of these teeth in place, but mutilated. It retains a similar proportion of the ascending ramus to that in the two preceding jaws, but with more of the fore part of the base of the coronoid process. The vertical diameter of the ramus behind the last molar socket is 3 inches 9 lines; the thickness of the jaw below that socket is 2 inches 7 lines.

From the hindmost socket to the orifice of the dental canal is 2 inches 8 lines. The postalveolar process with the base in the Nototherian position is, as usual, broken away, like most projecting parts in these rolled and transported drift-fossils. The fore part of the coronoid rises to 1 inch and 9 lines above the dental orifice, but at that height has been fractured. The antero-posterior extent of the two last sockets is 3 inches 6 lines, as in the first described mandible, with which all the other characters of the present specimen correspond so far as they are shown. I refer it, therefore, to a large old male of *Nototherium Mitchelli*. The marks of torrential action are very plain in this water-worn fossil: it is massive and heavy from some mineral infiltration.

A fourth rolled and mutilated specimen from the same locality, contributed by the same liberal donor, retains the last three molars and the socket of the second, with the hind part of the symphysis, showing the same vertical relative position to their molar (m_1) as in the former specimens of *Nototherium Mitchelli*. The teeth, so far as they are preserved, agree in size, shape, and proportion with those of that species. The ascending ramus has been broken away behind the last alveolus and the beginning of the base of the coronoid process. The dental canal is here exposed an inch below that part of the process, and half an inch from its outer side.

The fore-and-aft extent of the three last sockets is 5 inches 5 lines. The depth of the ramus at the interspace between the last two sockets is 4 inches 2 lines in a straight line; below the interval between the penultimate and the antepenultimate molars it is 4 inches 3 lines. In the first described mandible the same admeasurement is here 3 inches 9 lines; in the type jaw it is 3 inches 7 lines; in the second and supposed female jaw it is 2 inches 10 lines. Between this and the mandibular fragment under description the difference of depth of the horizontal ramus seems too great for mere sexual variety; yet the three last molars are not at all larger than, or in any appreciable degree different from, those in the subject of Plate V. But, besides the greater depth, the outer surface of the jaw is rather less convex vertically beneath the third molar (m_1) than in the three preceding specimens. Nevertheless I cannot feel that I have grounds for propounding any distinction of specific value for the Notothere yielding the present fossil. The fracture through the hind part of the symphysis exemplifies the complete bony confluence of this part, and the non-existence therein of the wide alveolus of a large scalpriform tusk. The transverse fracture anterior thereto at the interval between the first and second molars exposes the dental canal, of 4 lines diameter, situated 2 inches below the outlet of the socket, and $1\frac{1}{2}$ inch above the lower surface of the symphysis.

The fifth mandibular specimen of *Nototherium Mitchelli* is from the freshwater beds traversed by Gowrie Creek, Darling Downs; it was there collected by HENRY HUGHES, Esq., by whom it was presented to the Natural-History Society of Worcester. This specimen is chiefly valuable for the more perfect and less worn condition of certain of the molar teeth. It consists of a right ramus mutilated (as most of these fossils from river-beds are) at both ends. The relative position of the back part of the symphysis and of the entry of the dental canal, with the general size and proportions of the best preserved parts of the ramus, show the specimen to have belonged to the *Nototherium Mitchelli*; and it agrees most closely with the more perfect mandible in the Australian Museum at Sydney, which I have referred to the female of that species.

The subject of Plate VI. is an instructive specimen of a mandibular ramus and dentition of a young Notothere; it was transmitted to me, in 1847, by the enterprising and unfortunate explorer of Australia, LUDWIG LEICHHARDT, to whom I had been previously indebted for the account of the geology of the locality yielding this and other remains of extinct Marsupials, which was communicated to the Society in a former Memoir*.

I incline to refer this specimen, from the size of the incisor and of the three anterior molars, to *Nototherium Mitchelli*. The generic indications in the present fossil will be noted in § 4, on the teeth of *Nototherium*: the characters of the bone exemplify mainly those of immaturity. It consists of a right ramus, which, being figured of the natural size in Plate VI., precludes the need of noting dimensions. The antero-posterior extent of the three anterior molar-sockets will be seen to agree with that in the mature mandible, Plate V.

The ascending ramus has been broken away, exposing the formative alveolus of the penultimate molar (figs. 3 & 4, m_2) and the like cavity at an earlier stage of the last molar (ib. m_3). Provision has been made in this cavity for the lodgment of the anterior lobe of a tooth of equal transverse diameter (14 lines) with that of the tooth (m_3) in place and use in the largest examples of the present species. The dental canal (fig. 3, *o*) exposed by the hinder fracture presents a semielliptic form, 9 lines transversly and 3 lines from before backward. The canal undermines, as it were, the shell of the

* "On the Fossil Mammals of Australia, Part III. *Diprotodon australis*, Ow.," Philosophical Transactions, 1870, p. 571.

last formative alveolus, and it contracts as it inclines toward the outer wall of the ramus in its forward course.

The contour of the lower border of the ramus from the hind fracture to the symphysis (figs. 1 & 4, *e*, *s'*) is a more open curve than in the adult; it is feebly interrupted between the inflected border (*d*) and the hinder inflection or angle *a*; the slight concavity between *d'* and *a* being less apparent in the adult jaw. The ridges (fig. 1, *h*, *q*) bounding the ectocrotaphyte depression (*f*) are naturally feebler, less pronounced, in this young jaw; the base of the anterior one (*q*) rises from the transverse parallel of the hind lobe of the penultimate molar (m_2). The postinternal angle of the formative alveolus of the last molar appears to represent the postalveolar process of the mature mandible.

The oblique channel (answering to *u* in figures of the adult jaw) between the coronoid and postmolar processes here runs from that lodging the fore lobe of the penultimate molar to near the middle of the outer part of the interspace between the lobes of the antepenultimate molar (m_1); it thus preserves its general relative position to the last grinder "in place" and use, and doubtless was still more advanced when m_1 was "en germe."

Such changes in the relative position of parts, and differences of general shape, of the mandible in the adult and young Nototherе are dependent on, or concomitant with, the growth called for to sustain in action the full complement of teeth in the adult. No inference of specific difference can be deduced from the relative position of the hind part of the "symphysis mandibulæ" (*i*) in this young jaw to the front lobe of the second molar (d_4); because the socket of that tooth would move forward in the course of growth, whilst the symphysis extended its grasp of the fore parts of the two rami prior to the ultimate obliteration of the syndesmotic joint in the adult. At the present immature stage this articulation remains. The surface (fig. 4, *s**) is vertical, flat, with roughish rugæ, mostly directed from above downward and forward, gaining in prominence, through deepening of the intervals, along the lower third. It seems as if confluence had already begun at a small part of the upper and posterior border of the articular surface, such portion having been broken away from the left ramus and left adherent and seemingly confluent with the right one. Behind the lower part of the posterior border of the symphysis is the flattened, rough, slightly depressed surface (fig. 2, *v*) for muscular insertion noted in the older specimens.

The shallow indent or concavity dividing the inflected parts of the horizontal (*d'*) and ascending (*a*) rami has a more advanced position and a direction more approaching the horizontal than in the mature jaw: in Plate VI. fig. 4, *a–d'* is shown to be below the interval between the penultimate and last molars and parallel in extent with the contiguous lobes of these teeth. The inward extension of the bone at *a*, fig. 4, represents a resumption of the inflection of the lower margin of the jaw at its hinder part, from which resumption the bone thins off to be continued backward into the thickened part (*e*), which contributed to support the broken-off condyle.

This character is retained, but is better marked, in the adult mandible of *Nototherium Victoriæ* from South Australia (Plate VII.); but the incisor tooth in that species has a smaller and more advanced socket than in the present immature jaw, which in this more important character agrees with *Nototherium Mitchelli.*

In the removal of the part of the outer wall of the ramus in quest of a possible germ of a premolar or vertically replacing tooth, the base of the socket of the incisive tusk (Plate VI. fig. 5, *i**) was shown to extend beneath the first molar (d_3, *l*) as far as the septum, dividing the socket of that tooth from the next, lodging d_4.

The base of the incisive socket makes a feeble prominence at its upper and inner side at the hind third of the plate, sloping to the symphysial articular surface. The direction of the socket and of its contained incisor is that of the long axis of the symphysis.

The outlet of the socket (figs. 1 & 4, *s'*), 1 inch in advance of that of the foremost molar, is subquadrate, 7 lines in vertical and 6 lines in transverse diameter. The anterior outlet of the dental canal (fig. 1, $_{32}$) holds the same relative position as in the first described jaw of *Nototherium Mitchelli.*

The general depth of the present young jaw is of course much less, relatively to the crowns of the teeth in place, than in the adult.

I have been favoured by the Trustees of the Australian Museum, Sydney, with photographs and a plaster cast of the left ramus and back part of the symphysis of the mandible of a mature *Nototherium* from the freshwater deposits of Darling Downs.

It includes the series of five alveoli of its side, the last three of which support their teeth, which are rather more worn than in Mr. HUGHES's specimen, and rather less so than in the mandible figured in Plate IV.

The longitudinal extent of the five alveoli is 6 inches 9 lines, as in Mr. HUGHES's specimen; that of the last three molars is 4 inches 6 lines, but the hind talon of the last molar seems to have been broken away; were it entire, as in the first-described mandible, the three teeth would occupy an extent of 5 inches. The inner wall of the crown in each of the three molars has been broken away; but they appear to have equalled in breadth those teeth in the subject of Plate V., or the female mandibular specimen.

The inflection of the lower border of the jaw begins, as usual in the adult, on the vertical parallel with the socket of the last molar; the hind part of the symphysis extends to the vertical parallel with the fore part of the third molar (m_3).

The vertical diameter of the jaw below the last molar (m_3), taken at the outer wall of its alveolus, is 3 inches 2 lines; that taken at the third molar (m_1) is 3 inches 1 line.

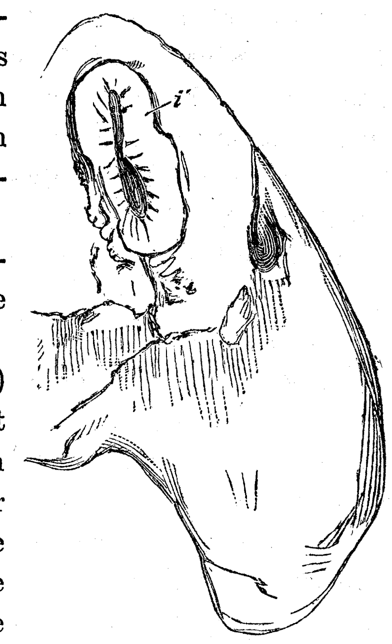
At the fractured fore part of the cast is plainly shown part of the bottom of the socket of the left incisor, with its longitudinally striate and finely rugous surface. There is not enough of the cavity preserved to show that the missing part (almost the whole) of the socket and incisor differed in shape or direction from those in the subject of Plate IV. fig. 1, *i*.

Agreeing, to the extent to which this cast does, with that of the more complete mandible of the inferred female of *Nototherium Mitchelli*, in every particular in which the comparison can be instituted, I am unable to point out any character whereby it can be referred to a different species; and I doubt whether a scrutiny of the original specimen would have supplied indications of such distinction.

Mr. KREFFT has favoured me with a pencil-sketch of the base of the incisor (Cut, fig. 2, ï), of the natural size, from the original fossil, showing the exhaustion of the pulp in this tooth of limited growth.

B. *Nototherium Victoriæ*, Ow.—In the specimen of the left ramus of the mandible (Plate VII.), liberally transmitted for my examination by direction of the Trustees of the Museum of Natural History in Adelaide, South Australia, more of the ascending ramus is preserved than in any of the foregoing specimens; and there are differences which deserve to be interpreted as specific.

Fig. 2.



Fractured symphysis of jaw, with base of broken incisor, *Nototherium Mitchelli.*

The specimen was discovered by Mr. TILGATE, of Wentworth, South Australia, in freshwater deposits near Lake Victoria, in that colony.

The posterior orifice or entry of the dental canal (fig. 2, *o*) is on a level with the outlet of the last alveolus (m_3), not perforating the base of the coronoid above that level as in *Nototherium Mitchelli.* The inflection of the lower border (ib. *d*, *d'*, *d'*) begins on a vertical parallel with the hind lobe of the penultimate molar (m_2), and terminates a little behind the vertical parallel of the last alveolus, before the horizontal ramus bends upward into the base of the ascending ramus. After a subsidence for the extent of an inch and a half, the lower border again begins to be inflected, suddenly (at *a e*), and to a greater degree than at any part of the more posterior inflection in *Nototherium Mitchelli* (Plate V. fig. 1, *a*). The second inflection in the present species, at first as thick as the anterior one (viz. 5 lines), quickly thins off as it recedes to a plate of 1 line in thickness (*e*); which, after the course of about an inch, suddenly expands to form the thick inner part (*n*) of the broad posteriorly flattened hind surface of the ascending ramus, supporting the condyle (*c*). Much of this joint is broken away, but both the outer and inner beginnings of its base or "neck" remain, together with the entire extent of the base of the coronoid plate (fig. 1, *q*, *r*), the summit of which is also wanting. The concave platform (fig. 2, *u*) between the fore part of the coronoid process and the postalveolar ridge and process has a breadth of about an inch and a half; the process, as usual, has suffered fracture.

From the back part of the last alveolus to that of the base of the process is 1 inch 5 lines; from the same part to the dental orifice (*o*) is 2 inches 2 lines: the dental canal runs obliquely forward; only the two anterior thirds of the orifice are defined by a sharp border; the diameter of the orifice is 4 lines. A groove (fig. 2, *p*) of the same breadth, and about an inch and a half in length, runs forward along the under and inner side of the orifice (*o*); this groove has a sharp inner border. A parallel ridge is directed from the back part of the dental orifice where it is broadest, backward, becoming narrower as it recedes, and subsiding an inch and a half from the orifice.

About 3 inches, following the curve, of the back part of the base of the coronoid (r, f') are preserved; its commencement from the neck of the condyle (*r*) is raised much above the horizontal plane of the molar alveoli: the plate here is thin, but its margin is obtuse or rounded; at the hind part of the fracture (f') it shows a thickness of 2 lines; as it advances it gains one of 3 lines; as the anterior border descends it gradually increases in thickness to 6 lines, near its obtusely rounded basal beginning. This (fig. 1, *q*), as usual, rises, buttress-like, from the outer wall of the mandible, on the transverse parallel of the middle of the last alveolus, and about an inch and a half lower than the outlet of that socket. The course of the base of the coronoid upward and backward is with a slight outward concavity at its anterior half, and is then level; its extent is 4 inches 9 lines; the anterior border of the process is gently convex, to the extent (4 inches) to which it has been preserved. The breadth of so much of the condyle (*c*) as is preserved is 2 inches 3 lines; the outer portion shows a small part of the articular surface, convex from before backward.

The ectocrotaphyte depression (fig. 1, *f*) is smooth and shallow; it is divided from the lower inflected part of the ascending ramus by a change of contour of the smooth outer surface, forming a broad convexity vertically; but this becomes, as it recedes, rather more prominent, thinner, and shows a roughened, as it were worm-eaten, surface (fig. 1, *h*), and, from a slight inflection at its termination towards the back surface of the ascending ramus, it there indicates the fore-and-aft extent of that part of the jaw as giving, viz. from the fore part of the base of the coronoid, 6 inches. It is possible that a smoother surface of the hind prominent outer and lower boundary of the ascending ramus may have suffered some abrasion in the fossil. There is no perforation of the crotaphyte depression.

The symphysial end of the present ramus has been broken away at the fore part of the second alveolus, exposing part of the anterior root of that tooth (fig. 4, d_4), and a small part of the bottom of the incisor's socket (*i*).

The antero-posterior extent of the last three molar sockets is 4 inches 10 lines; a thin plate rises to form the outer wall of their outlets.

The inbending of the inner surface to form the hind part of the symphysis begins at the vertical parallel of the middle of the third molar (fig. 2, *s*, m_1). The lower part of the symphysis shows a pair of transversely crescentic insertional depressions, concave backward (fig. 3, *v*, *v*). The depth of the ramus at the interval between the third (m_1) and fourth (m_2) sockets is 2 inches 8 lines: in the female (?) of *Nototherium Mitchelli* it is 3 inches; in the male (?) it may attain 3 inches 10 lines.

The symphysial joint in *Nototherium Victoriæ* has become completely obliterated in the present full-grown specimen; a dense, minutely spongy tissue is included in a thin compact crust of bone.

The inner wall of the alveolar outlets does not rise so high as the outer one; it thins off to an edge closely fitting the contour of the base of the crown of the tooth; the inner side of the horizontal ramus (fig. 2) at once descends with a gentle vertical convexity, interrupted beneath the last and part of the penultimate sockets by the concavity due to the inflected lower border (*d*, *d'*). The depth of the inner side of the ramus behind the fifth (last) socket is 2 inches 9 lines; in *Nototherium Mitchelli* it is 3 inches 6 lines.

The portion of the base of the incisor-socket exposed by the anterior fracture (fig. 4, *ï*) gives a vertical extent of 1 inch, a transverse breadth of 4 lines. The bottom is smooth; the side-walls worm-eaten, with a tendency to longitudinal striation. External to this part of the socket, about a line's distance, the dental canal is exposed, of a subcircular section, 3 lines in diameter; about the same thickness of the osseous tissue divides it from the outer surface of the jaw. Two inches behind this part a small orifice pierces the outer surface at the same distance below the middle of the outlet of the alveolus of the molar (m_1, fig. 1).

The colour of the fossil above described from the deposits near Lake Victoria is a rich brownish yellow. The osseous tissue is massive, the bone heavy, but does not adhere to the tongue. The minute cancelli are vacant, not filled up by mineral matter. The dental canal contains the easily displaced lacustrine deposit. The Nototherian fossils from Darling Downs are either of a deeper and duller brown colour, as in the first described jaw (Plate IV.), or of a greyish mottled stone-colour, as in the third and fourth specimens.

C. *Nototherium inerme*, Ow.—The fossil (Plate VIII.) on which the species *Nototherium inerme* is founded consists of a left ramus of the lower jaw, mutilated and abraded as in most of the specimens from the river-beds and deposits of Queensland. The base of the coronoid (fig. 1, *f*), with the entry of the dental canal (fig. 3, *o*) and part of the inflected angle (ib. *b*, *e*), remain at the hind end of the specimen, and the back part of the symphysis (figs. 2 & 3, *s*) terminates the fore end. The symphysis does not extend backward beyond the vertical parallel of the fore half of the second molar (d_4). The dental canal (fig. 3, *o*) begins near the level of the molar, and 1 inch 9 lines behind the last alveolus. In the type mandible of *Nototherium Mitchelli*, as in the subjects of Plates IV. & V., the orifice of the dental canal is raised above the level of the grinders, and is 3 inches behind the last alveolus; yet the antero-posterior diameter of that alveolus is less in *Nototherium Mitchelli* than it is in *N. inerme*. The specific difference of *N. inerme* from both *N. Mitchelli* and *N. Victoriæ* is also shown in the relative position of the symphysis to the fully developed molar series. The absence of any trace of incisive alveolus at the fractured part of the symphysis indicates the tooth to have been relatively smaller, still less of the character of a tusk or weapon offensive or defensive;

whence the specific name originally suggested by the present fossil*. The depth of the horizontal ramus is relatively less than in *Nototherium Mitchelli*, and diminishes in a greater degree toward the symphysis. The vertical diameter at the back part of the symphysis is 2 inches in *Nototherium inerme*; in *N. Mitchelli* it is 2 inches 10 lines; yet the fore-and-aft extent of the four last alveoli is 6 inches in the former and 5 inches 7 lines in the latter, the same specimens which afford the difference of depth of ramus yielding the latter admeasurement.

The longitudinal extent in which the lower border of the ramus is inflected (fig. 3, *d*, *d'*) equals that in *Nototherium Victoriæ*; it is also interrupted at a similar part, but apparently less abruptly. The dental canal (fig. 3, *o*) perforates the smooth ridge or longitudinal rising of bone leading from the postmolar process toward the back part of the rising ramus, and, as in other *Nototheria* and in the *Diprotodon*, does not communicate with any canal leading to the outer surface of that ramus, as is the case in *Phascolomys* and the *Poëphaga*. The anterior outlet of the dental canal is below the position for the socket of the first molar (d_3), which socket would seem to be obliterated and the tooth shed earlier than in *Nototherium Mitchelli* or in *N. Victoriæ*. In the forward slope of so much as is preserved of the posterior margin of the ascending ramus and its uninter rupted continuation with the convex curvature leading to the symphysis, in the presence and position of the postmolar process, in the position of the base of the coronoid process exterior to the hindmost molar, in the thickness of the horizontal ramus and the convexity of its outer surface, the present jaw exemplifies its resemblance to that in *Phascolomys*; but it differs in the absence of the deep excavation on the outside of the ascending ramus, and in the inferior depth of the inner concavity due to the inferior extent of the inward production of the angle of the jaw, which marsupial character reaches its maximum in the smaller existing Poephagous and Rhizophagous families.

D. *Comparison of the Mandible.*—In comparing the mandible of *Nototherium* with that of *Diprotodon*, the chief difference relates, as might be surmised, to the chief dental one, viz. to the development, in the larger marsupial Herbivore, of the mandibular incisors into deeply implanted scalpriform tusks. The part of the jaw supporting and wielding these instruments is accordingly both deepened and widened in *Diprotodon*, and it is also, on an obvious mechanical principle, strengthened or rendered more massive by the presence of the pair of subsymphysial tuberosities †, of which there is no trace in *Nototherium*. The horizontal ramus in the smaller extinct genus is less deep in proportion to its breadth or thickness, and it loses depth at the symphysis instead of gaining it there, as in *Diprotodon*‡. Consequently the lower contour of the horizontal ramus presents opposite curves in the two genera; it passes to the symphysis, describing a concavity in *Diprotodon* and a convexity in *Nototherium*. These differences are more

* 'Catalogue of the Fossil Mammalia &c. in Mus. Coll. Surg.,' 1845, p. 314.

† Philosophical Transactions, "On the Fossil Mammals of Australia," Part III. *tom. cit.* Pl. xxxv. fig. 2, *f*, *f*.

‡ Ibid. Pl. xxxv. fig. 1, *s*; and compare Pl. xlii. fig. 2, with Plate VIII. fig. 3 of the present Paper.

marked in the adult than in the young animals, becoming more conspicuous in *Diprotodon* as the incisive tusk acquires its adult proportions.

In all the Nototherian mandibles the lower border is inflected at two parts; the one in the horizontal portion, the other in the ascending portion, or "ramus." It may well be that this character, which is not present in Kangaroos and Wombats, may be presented by *Diprotodon*, when a perfect mandible of that animal is obtained; but if the fore part of the inflected border shown in the subject of Plate XLII. fig. 2 (Phil. Trans. 1870) be the beginning of an anterior inflection divided by a non-inflected tract from the posterior inflection, which represents the inflected angle in *Macropus* and *Phascolomys*, such beginning is more posterior in position, more nearly where the angular inflection begins in *Nototherium*. In the adult jaw of *N. Victoriæ* (Plate VII.) and in the immature one of *N. Mitchelli* (Plate VI.) the whole extent of the anterior inflection (*d*) is shown; only, in the adult specimen, the free border has suffered.

The orifice of the dental canal is raised to a level above that of the summits of the last molars in *Diprotodon*. The largest of the species of *Nototherium* differs little in this respect; but in *N. Victoriæ* and *N. inerme* the orifice is brought down to, or near to the level of the alveolar outlets. In the smaller existing herbivorous Marsupials it is placed still lower, being hidden in an excavation which does not exist in the extinct pouched herbivorous giants.

Of the position of the condyle we can speak only as it is indicated in *Nototherium Victoriæ*. Here it is raised high above the level of the molar series, as in all herbivorous Marsupials, but not so much raised relatively as in *Diprotodon*.

In the curve by which the coronoid process advances and rises from the fore part of the neck of the condyle, *Nototherium* resembles *Phascolomys* more than it does *Macropus*, in which the process rises in almost a straight line obliquely forward to its pointed apex.

§ 4. *Dentition*.—The dental formula of *Nototherium*, as of *Diprotodon*, is $i\,\frac{3-3}{1-1}$, $c\,\frac{0-0}{0-0}$, $m\,\frac{5-5}{5-5}=28$. The homologies of the molars with those of diphyodont Mammals are given by the symbols d_3, d_4, m_1, m_2, m_3, by which those teeth in the present paper will be signified as they range from before backward*.

The upper incisors, i_1, i_2, i_3 (Plate II. fig. 1, Plate III. fig. 3), follow one another in the same direction in each premaxillary, the foremost being the largest and the sole pair visible in a front view (Plate I. fig. 2). The right and left series run nearly parallel, slightly converging posteriorly; the greater interval between the right and left incisors of the second and third pairs is due to their smaller size, and their outer surface ranging with that of the larger exterior pair (Plate II. fig. 3, $_{22*}$). In the old *Nototherium Mitchelli* the first incisor does not project beyond an inch from the socket, the crown being

* In my Memoir on *Nototherium* (Quarterly Journal of the Geological Society, vol. xv. 1859), I state, in regard to these molars, that "the first appears to be a premolar and the rest true molars" (p. 171). I am now able to adduce [Plate VI. fig. 5] evidence that the first tooth is the homologue of d_3 in *Macropus*, and has no vertical successor $=p_3$.

directed downward very slightly forward and outward. The entire tooth (Plate IX. figs. 1 & 2) is 5 inches 1 line long in a straight line, 1 inch $7\frac{1}{2}$ lines in the greatest (fore-and-aft) diameter, which is about the middle of the root, 10 lines in greatest transverse diameter. The enamelled crown (ib. fig. 1, *e* and 1, *b*) is 1 inch in length, bevelled off, chisel-wise, from before upward and backward, and shows the partial application of enamel usual in such teeth: the free margin on the outer side of the crown (fig. 1, *b*) extends further back than that on the inner side (fig. 1, *e*), and is slightly everted; it is also thicker than on the even inner border. The breadth of the unenamelled back part of the crown at its base is $6\frac{1}{2}$ lines. Owing to the difference in extent of enamel on the sides of the crown, the abraded surface slopes from without inward and backward, as well as from before upward and backward. The enamel is $\frac{1}{4}$ of a line in thickness at the outer side of the crown; the whole outer surface is smooth. The crown is broadly convex anteriorly, rather flatter on the inner than on the outer side. The root is thickly covered by cement, and increases in every dimension, chiefly from before backward, as it recedes from the crown, until at a little below its mid length it attains the dimensions above given; it then diminishes to the pulp end. The outer side begins to be impressed by a longitudinal shallow channel about an inch and a half below the crown; and this channel increases in breadth, but not in depth, becoming, indeed, shallower near the pulp end of the root. On the inner side (fig. 1) the longitudinal channel begins somewhat nearer the crown, and sinks deeper as it recedes, besides becoming wider. The tooth is compressed and gently recurved, the front margin describing a greater convexity lengthwise than is the concavity of the hind margin; the root contracts to an antero-posterior diameter of 1 inch 3 lines; it is slightly excavated by the shallow remnant of the pulp-cavity (fig. 1, *a*). The breadth, owing to the opposite lateral channels, is least at the middle of this end, where it contracts to 3 lines; the part anterior to this gives a breadth of $4\frac{1}{2}$ lines.

Thus the first incisor in *Nototherium* differs from that in *Diprotodon* not only in size, both relative and absolute, in curvature, and in shape, but in structure or in kind. It is not scalpriform, not an ever-growing tusk with the enamel continued to the widely open base, but is a tooth of limited growth, consisting of a well-defined crown and fang. In this character the *Nototherium* resembles the Kangaroos, whilst the *Diprotodon* shows the Wombat or Rodent type of incisor.

Of the second and third incisors of *Nototherium*, nothing more is known to me than may be inferred from the sockets indicated in the cast of the skull now at Sydney. These seem to show that *Nototherium*, like *Diprotodon*, had them of similar and small size; the third not having its enamelled crown longitudinally extended and trenchant as in many Kangaroos. The longest diameter of the crown would appear to have been 6 or 7 lines.

Of the molars of the upper jaw I have, of *Nototherium Mitchelli*, the second, third, and fourth *in situ*, in a portion of the left maxilla; the same teeth (d_4, m_1, m_2), more worn, in a portion of the right maxilla of an older and larger Notothere; and the third and fourth *in situ* in a fragment of the right maxilla of a younger specimen. The entire molar series of both sides is shown in the cast of the skull in the Australian Museum (Plates II. & III.), and the left series in the cast of the left maxilla of another individual, probably female. Photographs of both these specimens, now in the Museum of Natural History, Sydney, New South Wales, have been transmitted to me, with the sanction of the Trustees of the Museum, by the kindness of the able Curator, GERARD KREFFT, Esq., Corr. M.Z.S., &c.

Of *Nototherium inerme* I have the entire molar series of both sides of the upper jaw; and I infer, from a lithograph of "Australian Fossil Remains" sent me by Mr. KREFFT, that the Museum at Sydney possesses a similar specimen.

From these materials the characters of the upper molars of the present genus can be satisfactorily given.

The series of five molars in the entire skull [Plate II. fig. 1, Plate III. fig. 3 (reduced), Plate IX. figs. 3 & 4, nat. size] occupies an alveolar extent of 7 inches 2 lines; it describes a slight convexity downward and also outward, the right and left series converging anteriorly (Plate III. fig. 3) in a rather greater degree than in *Diprotodon*. The interval between the anterior lobes of the right and left last molars (m_3) is 2 inches 3 lines; that between the first small molars (d_3) is 2 inches. As in *Diprotodon*, the inner end of the front lobe of each two-ridged molar projects inward beyond the inner surface or contour of the antecedent tooth; but the hind lobe does not project so far beyond the level of the front lobe of the succeeding tooth as in *Diprotodon*.

The first upper molar (d_3) may be said to be two-lobed, but is divided in an opposite direction to that in the rest of the series; viz. into an outer and an inner, rather than a front and a back, lobe. The working-surface is subtriangular in form, the angles obtusely rounded, measuring in fore-and-aft extent 1 inch 1 line in the male *Nototherium Mitchelli* (Plate IX. figs. 3 & 4, d_3); the transverse diameter, posteriorly, is 11 lines. The outer lobe or division is the chief one, and constitutes the outer two thirds and the whole fore-and-aft extent of the tooth; the outer side of its base swells out like part of a cingulum or ridge; the summit is subcompressed, and seems to have been trituberculate; the inner and lower divisions consist of a larger hind tubercle and a smaller front one. On the whole, therefore, the tooth approaches the subsectorial type of its homologue in the Koala (*Phascolarctos*, Philosophical Transactions, 1871, p. 233, fig. 6, p_4); it is implanted by two roots, one behind the other, the posterior being the largest and grooved anteriorly, as if preparatory to further transverse subdivision.

The second molar (ib. ib. d_4) has a subquadrate working-surface, divided into two transverse wedge-shaped lobes (a, b), with an anterior (f) and a posterior (g) basal ridge; the latter is the thickest, and developes a small tuberosity at its outer end. This ridge is continued upon the outer and inner borders of the hind surface of the hind lobe, and further upon the outer than the inner one. A short ridge closes the outer and inner ends of the transverse valley. The antero-posterior diameter of the crown is 1 inch 1 line, as is likewise the transverse diameter of the broadest part of the tooth. The direction of the summits of the two lobes is downward and a little forward; they run across the tooth rather more obliquely than in *Diprotodon* (Phil. Trans. 1870, Plate XXXVII. fig. 2, d_4), but with a similar curve of the apical ridge slightly concave backward. The less exposed enamel toward the bottom of the valley and near the basal ridges is punctate; but generally the enamel is smoother and more polished than in *Diprotodon*. This molar, like the rest of the upper ones, is implanted by two transversely disposed anterior roots (Plate IX. fig. 8), and one long transversely extended posterior root.

The third molar (Plate IX. figs. 3 & 4, m_1) has its ridges extended rather less obliquely than in d_4, but more so than in m_1 of *Diprotodon*. The antero-posterior diameter is 1 inch 4 lines; the transverse diameter 1 inch 3 lines. As the lobes are more entire they show better the curve of their summits, concave backward. The thicker anterior basal ridge (f) is continued at both ends upon the corresponding borders of the anterior lobe. The posterior basal ridge (g) is continued internally to the apex of the posterior lobe, gradually subsiding; externally it curves upon the end of the lobe, and subsides halfway to the summit.

The fourth molar (Plate IX. figs. 3 & 4, m_2) shows a diminution of breadth of the hind lobe in a greater degree than the corresponding tooth does in *Diprotodon*; its fore-and-aft extent is 1 inch 8 lines. The transverse breadth of the front lobe is, in the old male (fig. 7), 1 inch 7 lines; in the subject of fig. 4, 1 inch 6 lines; that of the hind lobe is 1 inch 5 lines. The inner end of each lobe is made thicker by a backward expansion, rather more marked in m_2 than in m_1.

In the last molar (Plate IX. figs. 3 & 4, m_3) the slightly abraded summits of the lobes show the more vertical or steeper slope of their fore side, which is convex transversely; also the transverse concavity of the hind side, due to the seeming backward bend, with thickening, of the outer and inner borders, and the curving slope of the hind part of the lobes, which gives them in profile a slight bend forward (fig. 3, m_3) as in *Diprotodon*.

The fore-and-aft extent of this tooth is 1 inch 8 lines; the breadth of the front lobe is 1 inch 7 lines; that of the hind lobe is 1 inch 3 lines; it contracts more rapidly to its summit than in *Diprotodon*. The posterior root of m_3 is slightly impressed lengthwise at its back part, and deeply so at its fore part.

The origin of the outstanding zygomatic process of the maxillary terminates posteriorly opposite, or on a vertical parallel with, the interspace between the third and fourth molars. In one large old Notothere (Plate IX. fig. 6) it extends, as before observed, a little further back; in an immature individual its origin hardly extends backward beyond the middle of m_1. This abutment against the upper molar alveoli is strengthened, as the hind molars take more share in the work of mastication. The base of the process stretches forward and upward as far as the parallel with the first alveolus.

A portion of the left upper maxillary of *Nototherium*, with d_4, m_1, and m_2, rather more worn than in the above-described specimen, exemplifies the same relation of the base of the malar process of the maxillary with the alveoli of the three anterior molars.

In not any of the upper molars is the anterior basal ridge (f) so large relatively as in *Diprotodon*.

In the upper jaw of *Nototherium Mitchelli*, in which the last molar had recently come into place and the enamel had been slightly worn along the summit of the anterior ridge, the second molar showed the lobes worn down two thirds of the way toward the valley. In the cast of the right maxilla with the dentine exposed on the lobes of m_3, those of d_4 are worn down to the shallowest part of the valley. In the oldest specimen of this species the grinding-surface of this tooth (ib. fig. 7, d_4) is reduced to a smooth field of dentine (d) and osteodentine (o), with a peripheral boundary of enamel, e. This dental constituent does not exceed a line in thickness at this stage of abrasion.

The dentition of the upper jaw of *Nototherium inerme* is known to me by a portion of that jaw with the right and left series of grinders and much of the intervening bony palate; but the premaxillaries and upper incisors are wanting, being broken away with the contiguous part of the maxillary close to the molar (d_3); and both this and the second molar (d_4) are mutilated on the left side of the jaw. The right series is represented of the natural size in figure 5, Plate IX.

The first molar is relatively smaller and less complex on the grinding-surface than is d_3 in *Nototherium Mitchelli* (ib. fig. 4): the transverse and antero-posterior diameters are alike. The outer lobe or division has one coronal prominence upon which a slender triangular tract of dentine is exposed extended antero-posteriorly; a more equal-sided triangular tract is exposed on the shorter inner lobe; an anterior and a posterior basal ridge bound corresponding depressions divided by the confluence of the apices of the outer and inner divisions at the centre of the crown; a short external basal ridge closes the concavity impressed upon the hind half of the outer surface of the crown. One cannot distinguish, with certainty, the worn enamel from the dentinal tracts in the plaster cast of the answerable tooth of *Nototherium Mitchelli*; nor do the photographs help in this particular; but both concur in demonstrating the differences of size, shape, and proportion of the anterior molar, which I judge to exceed those allowed to sexual or individual variation, without affording ground for inferring generic distinction from the modifications of d_3, represented in Plate IX.

The more constant teeth (d_4–m_3) in figure 5 exemplify the Nototherian characters with the inferiority of size, corresponding with the little that is known of the present species. *Nototherium inerme*, like *Not. Mitchelli*, has the hind lobe of the last molar contracted in breadth, and the antero-posterior extent of the crown is less than that in the opposing molar (m_3) of the lower jaw.

A greater proportion of the enamel of this worn grinder, in the subject of fig. 5, Plate IX., shows the punctate rugous character than in the antecedent teeth.

The specific character of *Nototherium inerme* is well exemplified by the minor relative size of the anterior molar, d_3 (Plate IX. fig. 5), of the upper jaw, as by that of the incisor in the lower jaw.

Of the dentition of this jaw, I commence the description with those in that of the immature specimen of *Nototherium Mitchelli* (Plate VI.), consisting of the right ramus of the mandible with the first three molars in place, the germ of a fourth, and part of the formative cavity of a fifth molar. The tip of a procumbent incisor projects from a socket, close to the symphysis, where sufficient of the cavity was exposed to show that it expanded as it sank in the substance of the jaw.

Putting aside for awhile the evidence of the nature of this specimen afforded by others since received from Australia, I believe it may be of some interest and instructiveness to show how far its determination can be carried on the supposition that it is the sole example of its kind.

The mammalian character is seen at a glance by the complex crowns and rooted implantation of the molars, and by the simple condition of the ramus of the jaw, as of one piece of bone. The nonage of the individual to which the jaw has belonged is recognized at the same moment.

Of *Mammalia* corresponding in size with the parent of a young one having its newly cut milk-series of teeth in a jaw 8 inches long, the number of genera is not great; and we may be excused for thinking that most of those which are now represented by living species must be known. Of these we should be led at once to CUVIER'S Pachyderms by the shape and size of the teeth of our young giant. The broad complex crowns of the molars show its herbivorous nature. The Tapir alone exhibits the bilophodont type of the second and third milk-grinders, with the conical, partly trenchant, partly crushing shape of the first; but it developes, with these in the mandible, eight small front teeth, of which the outermost pair are canines. A Rhinoceros of Sumatra or Java may show a pair of large tusk-like lower incisors, but they are associated, in the milk-dentition, with a smaller pair of mid incisors*.

There is another and more significant difference which the present fossil evidence of a large Herbivore presents in comparison with a specimen of the same age, or with the same phase of dentition, of any existing Herbivore. In the young Tapir, *e. g.*, with three deciduous molars in each mandibular ramus, and the germ of the next molar lying in its formative cavity deeper and less advanced than in the present fossil, the enamel has been worn from the summits of the first and second milk-molars so far as to expose the dentine, and it is abraded obliquely backward from the summits of both ridges of the third molar.

So also in a young Rhinoceros in which the second and third milk-molars are in place, the first and fourth being still "*en germe*," the enamel shows masticatory abrasion at the summits of the two chief lobes of d_2 and d_3. Corresponding signs of the assumption of vegetable nutriment in addition to that afforded by the mother's milk are visible in young Equines and Ruminants with a stage of molar dentition corresponding to that shown by the fossil under consideration.

Now here, although the first, second, and third molars are well in place, and the

* OWEN'S 'Odontography,' p. 591, pl. 138. fig. 15, *d i*, 1 & 2.

basal ridges of the fourth have risen to the brim of the socket, the enamel shows only a linear trace of attrition on the ridges of the second molar (Plate VI. fig. 3, d_4, h, g), with a very feeble trace on the anterior ridge of the third molar (ib. m_1); its hind ridge and the crown of the first molar (ib. d_3) are untouched. The inference is that the young Herbivore represented by the fossil derived a greater proportion of its nourishment from the mother, and much less from extraneous sources, than do the placental Herbivores at a corresponding stage of immaturity.

In this respect the fossil repeats the molar conditions of a young Kangaroo (*Macropus*) at the same phase of dentition†. With this phase the existing marsupial herbivore has attained that size and strength as a denizen of the pouch in which it begins to protrude its head to crop, occasionally, a tender leaf or blade of grass while the mother may be browsing or grazing. In the singleness and size of the sloping incisor, in the shape and proportion of the first molar (d_3), as well as in those of the second and third two-ridged grinders, d_4, & m_1, the fossil more closely resembles *Macropus* than any other known genus, whether marsupial or placental.

I accordingly here pushed the comparative research a stage further, and removed the outer wall of the jaw, as in fig. 5, Plate VI., to see if the large Australian bilophodont fossil carried its correspondence with *Macropus* to the extent of showing the germ of a premolar (p_3)‡; but of this tooth there was no trace. The length and deep implantation of the two fangs of d_3 (l), underlain by the expanded base of the procumbent incisor (ib. i^*), make it very improbable that such germ of a p_3 could ever be developed in the species represented by the fossil.

Thus the results of the above comparisons, independently of other evidences of *Nototherium*, would have led to the conclusion that the young Herbivore, notwithstanding its bulk, belonged to a group of Mammals in which the milk-dentition was not so soon brought into use for grazing or browsing as in the Placental series; that it, therefore, was probably a Marsupial; which conclusion the close concordance in number and shape of grinding-teeth with the largest existing Herbivore of that order (the Kangaroo) would have put beyond doubt.

The lower incisor, in the immature example, had pushed its tip, as has been said, about two thirds of an inch from the socket; it is of a conical form, with an obtuse apex, which has been abraded for the extent of 3 lines (Plate VI. fig. 3, i'). The enamel coats the outer and under part of the tooth, bending up a little way upon the flat inner side, and in an increasing degree as the tooth expands (Plate VI. fig. 4, e): the enamel is not continued to the open base (ib. fig. 5, i^*) as in *Diprotodon*: the line of termination is well defined. A thin layer of cement coats the rest of the tooth's circumference. The fracture of the exposed crown of the tooth gives a subquadrate surface, longest vertically, with the lower and outer angle rounded off. The two diameters are here

† OWEN, Art. "Teeth," Cyclopædia of Anatomy &c., fig. 594, B; and 'Anatomy of Vertebrates,' vol. iii. fig. 296, B.

‡ Philosophical Transactions, 1870, p. 539, fig. 4, p_3.

6 lines and 5 lines; but the vertical diameter of the hollow base exceeds an inch, the length of the entire though incomplete tooth being 2 inches 9 lines. It is directed obliquely forward and upward, at an angle of 140°, with the lower border of the ramus; a rather less open one than in *Diprotodon.*

The socket of the first molar (d_3) begins in this young jaw one inch behind the opening of that of the incisive tooth, which gives the length of the diastema (ib. fig. 1, *k*) at this stage of dentition. The first molar has an anterior and a posterior lobe. The front lobe is highest, and is a three-sided cone, with one angle in front and rather produced or ridge-like; it is subcanaliculate internally: the two posterior angles are continued into the fore and hind borders of the hind lobe; this is transverse, low, flat, inclined from behind forward and rather downward to the base of the front lobe. Both lobes are convex outwardly, and separated there by a shallow depression; the inner side of the tooth is much lower than the outer one. The fore-and-aft diameter of the crown is 9 lines, the transverse diameter posteriorly $6\frac{1}{2}$ lines; it is implanted by two fangs (ib. fig. 5, *l*), one behind the other, and each 10 lines in length; the entire length of the tooth, vertically, is 1 inch 6 lines.

The second molar (ib. d_4) assumes the two transversely ridged or bilophodont type, the lobes being in the form of transverse wedges. The anterior lobe is narrower transversely, broader from before backward than the posterior one. The anterior basal ridge (*f*) is a continuation of the slightly produced fore margins of the outer and inner sides of the front lobe, at their lower ends, into one another, defining below the slightly excavated surface on the fore part of the anterior lobe, the enamel of which is finely rugous. From the junction of the basal with the outer vertical ridge, a similar ridge is continued curving downward and backward, and then rising upon the posterior part of the outer surface of the front lobe (ib. fig. 1, *a*), defining upon that surface a finely rugous tract of enamel. The inner side of the front lobe (ib. fig. 4, *a*) has no such ridge. The hind surface of this lobe is less definitely bounded by a backward prominence of the outer border, and a slight vertical ridge or fold of enamel near the inner border. The valley (*h*) between the lobes has both the outer and inner entry crossed by a short ridge, the outer one being the strongest. The posterior basal ridge (*g*) is the broadest; its outer and inner ends bend up a short way upon the hind surface of the hind lobe. The line of initial abrasion at the edges of the two lobes is from above downward and backward. Both lobes present in profile a slight curve backward. The length (fore-and-aft diameter) of the tooth is 1 inch 2 lines; the breadth (transverse diameter) of the front lobe is 9 lines, that of the hind lobe is 11 lines. It is broader in proportion to its length than in *Diprotodon**. The anterior and posterior basal ridges are narrower, relatively, than in that genus.

The third molar (Plate VI., m_1) has the two lobes of equal breadth save at the summit, where this dimension rather exceeds in the hind lobe: the front lobe rises higher than the hind one. The front basal ridge is continued more abruptly from the anterior

* Philosophical Transactions, *tom. cit.* Plate XI. figs. 2 & 3, d_4.

angle of the inner border of the lobe than in d_4, and it passes outward to the base of the outer end of that lobe, like a "cingulum," without being continued upward into the outer prominence bounding that part of the front surface of the front lobe (fig. 3, m_1). This surface, as in the second molar, is finely rugous; it is concave transversely, convex vertically. The cingulum rises to a point, forming an angle upon the outer side of the base of the anterior lobe (fig. 1, m_1). The closing ridge of the valley is formed by its continuation backward from the angle, and is limited to the outer entry. The hind basal ridge (g) is thicker than in d_4.

The two lobes are not on the same parallel, but rather "*en échelon*," the hind one rising more mesially or internally, and its inner and fore angle looking forward clear of that of the other lobe. The unworn summits are more bent backward than in d_4. The fore-and-aft extent of m_1 is 1 inch 6 lines; the transverse diameter of the base of each lobe is 1 inch.

In the partially exposed calcified germ of m_2 (ib. figs. 3 & 4) the summits of the two lobes are not quite parallel, and the hind border of the hind lobe slopes more backward to a well-developed basal ridge.

The smooth shallow cavity behind the alveolus of m_2 is plainly the beginning of the formative chamber of m_3, calcification of which had probably not begun.

I regret not to possess specimens of *Nototherium* showing stages of mandibular dentition between that above described and the subject of Plate X. fig. 3.

This specimen forms part of a collection of fossils from the deposits of Darling Downs made by Henry Hughes, Esq., and now in the Museum of the Natural-History Society of Worcester, to the Council of which I am indebted for the opportunity of examining, comparing at the British Museum, and figuring instructive evidences of extinct Australian Mammals. The one which is referable to *Nototherium* is the right ramus of the mandible with the last three molars *in situ*, the fangs of the second and part of the alveolus of the first molar. The two fangs of the second molar (ib. d_4) show a fore-and-aft extent of at least 1 inch 2 lines for the crown of that tooth, with an extreme breadth of eight lines. That a still smaller tooth preceded it is indicated, as before remarked, by a part of its socket (d_3). The shape of that tooth, generically distinguishing *Nototherium* from *Diprotodon*, is instructively shown in the preceding specimen (Plate VI.). The antepenultimate tooth, or third counting backward (Plate X. fig. 3, m_1), measures 1 inch 6 lines in long diameter, and 1 inch 2 lines across the hinder lobe; the talon (g) at the back of this lobe is as well developed relatively as in the penultimate molar. The ridge (r) or production of the outer and front angle of the back lobe obliquely toward the middle of the front lobe is conspicuous at this stage of attrition; much of the front lobe has been broken away.

The crown of the penultimate molar (m_2) is in length 1 inch 8 lines, in breadth 1 inch 3 lines, in height 8 lines; the dentine is exposed at the summit of each ridge. The two ridges, or bilophodont type, of the molars of *Nototherium* were indicated rather than demonstrated in the specimens on which the genus was founded. The restoration ventured on in the figures of these fossils* was verified by the molars in the immature jaw subsequently sent by LEICHHARDT. The first complete penultimate molar which I had the opportunity of studying showed the base of the crown girt by a "cingulum," developed behind into a low talon, and interrupted at the outer end and more so at the inner end of the two main lobes, and for a greater extent at the inner than at the outer sides: this character my present series shows to be constant.

The horizontal contour of the crown of the penultimate molar is rather rhomboidal than quadrate; for the hind lobe is more internal in position than the front one, and the ridges run, not in a line directly across the alveolar border, but from without inward and a little backward. The fore part of the outer end of each ridge is a little produced, most so in the hinder one, in which the produced part inclining inward, terminates or abuts below upon the middle of the base of the front ridge: the anterior part of the inner end of each ridge is a little produced forward, in an angular form; the general result is that the summit of each ridge is slightly concave forward, convex backward.

The enamel is for the most part smooth and polished; the delicate striæ of growth are well marked when viewed by a pocket-lens on the outer side of the tooth, and the same power brings into view a few punctations on the hinder slope of each ridge: the enamel is rather thicker on this slope than on the front one, and seems more so from being more obliquely abraded from before downward and backward: so exposed, the coronal surface of the enamel is a line in thickness; the tract of dentine abraded in the present tooth is two lines across. The hinder talon, or part of the cingulum, is most developed; the front one seems as if destroyed by pressure of that of the preceding molar.

Much of the crown of the last molar (ib. m_3) has been broken away; its base measures, in fore-and-aft extent 1 inch 10 lines, in transverse extent 1 inch $3\frac{1}{2}$ lines; this is at the anterior lobe, the posterior one is narrower. Each fang is longitudinally excavated at the surfaces next each other; and the outer part of the root, so defined, is thicker than the inner part.

The next stage of dentition which I have had the opportunity of observing in an original specimen of the present species corresponds with that of the maxillary teeth in the skull (Plate III. fig. 3); it is exemplified in the mandible which is the subject of Plate IV. The crown of the last molar (Plate X. figs. 1 & 2, m_3) is worn to within three or four lines of the transverse valley; those of the penultimate (m_2) and antepenultimate (m_1) molars show increasing degrees of attrition: the first and second molars are gone, but their sockets remain in the left ramus: the crowns are restored in outline, in fig. 1, from the subject of Plate VI.

The anterior fang of the first molar remains in the corresponding division of its socket: the fore-and-aft extent of the socket is 1 inch, being 3 lines more than in the young specimen (Plate VI. figs. 1 to 5, d_3). Now, as the roots of the first molar in that specimen are hollow shells of bone widening to their open base, the crown of the tooth

* "On the Extinct Mammals of Australia," Reports of Brit. Assoc. for 1844, p. 231, plate 3. fig. 1.

may gain increase of support, by enlargement of the fangs before they become solidified, as in the broken one in the present specimen. The difference of size may likewise be referred to difference of sex; it would be hazardous to predicate a difference of species on this ground. In both examples they come near, in size, to the anterior molar (d_3) in the upper jaw of *Nototherium Mitchelli.*

The socket of the second molar (Plate X. figs. 1 & 2, d_4) has a fore-and-aft extent of 1 inch 1 line, which accords closely with that in Plate VI. figs. 1–5, d_4).

The third molar (Plate X. figs. 1 & 2, m_1) shows both lobes abraded to their base; the enamel still crosses the valley, but that between the hind basal ridge and the hind lobe is worn away and a broad smooth expanse of dentine and osteodentine is exposed, 11 lines by 6 lines in diameter. The fore-and-aft extent of the remaining basis of the crown is 1 inch 6 lines; the breadth of the hind lobe is 1 inch. These dimensions accord sufficiently closely for specific identity with those of m_1, in the immature subject of Plate VI.

In m_2 (Plate X. figs. 1 & 2) the enamel of the hind lobe is worn down to the level of the hind basal ridge, which is partly abraded, but not down to the dentine. The narrower and lower anterior basal ridge is intact, and the enamelled crest of the anterior lobe rises 3 lines above it. The anterior productions (*r*, *r*) of the two lobes, rudimentally indicating the linking bars in certain Kangaroos, are instructively marked at the present stage of attrition. The posterior basal ridge of this tooth overlaps the anterior one of the next (m_3), the front lobe of which rises 5 lines above that level. The anterior prominence near the outer end of each lobe repeats the short forward angle in the contour of the enamel as here worn down. The corresponding prominence of the hinder lobe (*r*) inclines toward the middle of the valley; the macropodal affinity, slight as it is, is more strongly marked in *Nototherium* than in *Diprotodon**.

The fore-and-aft extent of m_3 is 1 inch 10 lines, exceeding by 2 lines that of the opposing molar above (Plate IX. fig. 4, m_3): in this, also, a macropodal character is repeated. The transverse extent of the front lobe of m_3, fig. 3, is 1 inch 4 lines; that of the hind lobe is less.

The entire extent of the lower molar series is 7 inches 2 lines, about 2 lines less than that of the upper molar series in the skull of *Nototherium Mitchelli* (Plate II. fig. 1).

In the series of sockets of the lower jaw of possibly the same individual, the partition between the fore and hind fangs of each tooth is much thicker than that between the sockets of distinct teeth. The transverse space between the hind lobes of the right and left last lower molars is 2 inches 9 lines; between the front lobes of the first molars 1 inch 5 lines. Each mandibular series describes a very slight curve as it advances forward, with the convexity outward. The base of the socket of the incisor, which does not extend beyond that of the first molar, is 1 inch 2 lines in vertical diameter, 8 lines in transverse diameter.

In the specimen of the mandible with the symphysis entire, or nearly so (known to

* Compare figures 11 & 18, Plate XL. Philosophical Transactions, 1870, with figures 1, 2, & 3 in Plate IX.

me by the cast, Plate V.), the molars show almost the same stage of attrition as in the preceding specimen. The first and second molars are retained on the left side. The crown of the first (d_3) is worn down to a flattened uniform surface, showing the same posterior breadth as in the entire crown in the immature jaw. The two roots supporting it have now risen nearly half an inch above the socket. The dimensions and proportions of the following four grinders closely accord with those in the mandible, the teeth of which are figured of the natural size in Plate IX. fig. 3.

In the part of the right ramus of *Nototherium Mitchelli* with the three last molars and the back part of the symphysis, the molars are worn nearly to the same degree: their antero-posterior extent is 5 inches 2 lines. The left ramus of the same species, more mutilated anteriorly, but with a greater proportion of the ascending branch, shows the last two molars similarly worn. The enamel in these Nototherian specimens is as thick as in *Diprotodon.*

In a mandibular fragment with the lobes of the last molar worn down to the valley, the anterior root of the penultimate molar is exposed, showing a strong curve convex forward, with a deep anterior longitudinal indent almost dividing the implanted end (Plate X. fig. 8). The fine rugosity of the cement, repeated on the closely clasping wall of the socket, is here well shown.

The molars (Plate X. figs. 4, 5, 6) in the mandible of *Nototherium Victoriæ* (Plate VII.) show nearly the same stage of attrition as in the Worcester specimen of *N. Mitchelli* (Plate X. fig. 3).

As already stated, they are limited to the last three teeth and a fragment of the one in advance. In m_1 the ridge closing the outer entry of the valley (*h*, figs. 4 & 5) developes an enamel tubercle; and there is a smaller one at the inner entry (*h'*, fig. 6). Of this there is no trace in the perfect specimen of that molar in the immature jaw of *Nototherium Mitchelli* (Plate VI.), and only a very feeble indication of such on the outer side. The rudiment of the "link" or ridge (*r*) from the hind lobe to the middle of the base of the hind surface of the front lobe is well marked in *N. Victoriæ.* The hind talon (*g*) closely overlaps so as to interlock with the front talon (*f*) of the penultimate molar, m_2. The abraded surfaces of the two lobes slope from before downward and backward. The fore-and-aft diameter of m_1 is 1 inch 6 lines.

The fore part of the penultimate molar (fig. 4, *a*, m_2) rises half an inch above the overlapping talon (*g*) of the antecedent tooth, at the outer and inner ends of which the front talon of m_2 appears. Externally it curves up to terminate near the base of the fore and outer part of the front lobe; on the inner side it sooner subsides. The greater breadth, as compared with m_1 of the front lobe, is gained chiefly by extension of the inner part. A ridge, beginning at the back part of the outer end of the front lobe, curves down to the outer entry of the valley, developes there a tubercle, and curves up the outer side of the hind lobe, whence a similar ridge curves downward and backward to the hind talon; the middle and thickest part of this is undermined by the smooth surface which overlies the front talon of the last molar (*f*, m_3).

The fore-and-aft extent of m_2 is 1 inch 9 lines; the transverse breadth of the front lobe is 1 inch $2\frac{1}{2}$ lines, that of the hind lobe is 1 inch 1 line. The abraded surfaces of the summits of these lobes slope, as in m_1, in the same direction but in a greater degree. The hind root of m_2 is exposed by the fracture shown in figs. 1 & 2, Plate VII.; it inclines somewhat backward as it sinks in the socket; its basal breadth at the outlet of the socket is 1 inch; it contracts, in the same direction, to 7 lines; much of its surface shows minute granulate longitudinal striations.

The last molar (Plate X. figs. 4, 5, 6, m_3) rises above and projects inwardly beyond the preceding, in the same degree as m_2 does in relation to m_1. The festoon character of the ridges curving toward the outer entry of the valley and to the hind talon is repeated in greater strength; the outer closing tubercle (fig. 4, *h*) is less marked than in m_1, but is conspicuous, as is that in the ridge closing the inner entry (fig. 5, *h'*). I incline to regard these tubercles as constant, and as differentiating the last two molars of the present species from those of *Nototherium Mitchelli*. A mere linear tract of dentine is exposed on the obliquely worn apices of the transverse ridges of m_3. The fore-and-aft diameter of this molar is 1 inch 10 lines; the transverse extent of the abraded summit of the hind lobe is 10 lines, but that of its base is $13\frac{1}{2}$ lines, the same diameter of the front lobe being 15 lines. The enamel in *Nototherium Victoriæ* is not so thick as in *N. Mitchelli*; its surface is similar.

When the skull, or upper jaw, of this species may be found in South Australia, it will yield, as in the case of the Queensland specimen, the characters ascribed by MACLEAY to *Zygomaturus*, with, probably, better marked specific characters than those of the lower jaw.

No mandible or mandibular teeth, referable or adaptable to those of the maxilla in the unique subject of Plates II. & III., have yet been discovered, save those which yield the characters of the genus *Nototherium*. No skull adaptable to the mandible and mandibular teeth of *Nototherium* has yet been discovered, save that to which the name *Zygomaturus* was given. The admission, therefore, into palæontological catalogues of two genera of bilophodont *Marsupialia* of the bulk of *Nototherium* awaits the discovery of fossils demonstrating the distinctive characters of such.

Taking a retrospect of the dental characters of the genus *Nototherium* with reference to a comparison with those of the genus *Diprotodon*, we find that the indications, few and feeble though they seemed in the mutilated mandibles and mandibular dentition first received *, have been supported and the inferences therefrom verified in a striking and unexpected degree by the characters of the rest of the skull and of the maxillary dentition.

The first molar, for example, does not give, in miniature, the bilophodont character of the other and larger molars; its crown answers rather to the outer half of the two-ridged grinder with a rudiment of the inner half of the hinder transverse ridge or lobe.

* *Op. cit.*

This tooth, in fact, exemplifies the final stage of modification converting the longitudinally trenchant type of the premolar in existing Carpophagous and Poëphagous Marsupials into the crushing character shown in the homologous tooth of the larger marsupial Herbivores. The rest of the molar series in *Nototherium* differs from that in *Diprotodon* by the smaller size and in the smoother enamel; and, perhaps, in a little stronger indication of the production of the hind part, near the inner end, of the transverse lobes, especially of the front one.

In the incisor series the generic character of *Nototherium* is strongly marked by the form, structure, and nature of the front upper incisor, as before described: and in this character we see a nearer approach of *Nototherium* to *Macropus*, while the characters of the front upper incisor in *Diprotodon* approximate that genus to *Phascolomys*. But in the number and disposition of the upper incisors, as in the bilophodont molars of limited growth, both the large extinct genera retain the poëphagous character, as contradistinguished from the rhizophagous modification shown by the Wombats among the existing marsupial Herbivores.

The lower incisor of *Nototherium* shows more of the scalpriform character, at least in the young individual, than does the upper one; but, in the full-grown animal, this tooth is far from having the proportions and depth of implantation which make it resemble, in *Diprotodon*, the lower pair of scalpriform teeth of the Wombats. In *Nototherium* the lower incisor differs from that in *Diprotodon* in being narrower, with the enamel continued less far or high upon the inner side: this tooth in the young specimen increases more rapidly as it sinks in the socket; but this may be a repetition of an immature character, which is shown, in a minor degree, in the jaw of the young *Diprotodon* described and figured in a former Paper*. The widely open base of the growing incisor does not, however, extend backward beyond the first molar; and as this part contracts and solidifies in the adult, the base of the tooth and its socket are moved more forward, and in one species of Notothere (*N. inerme*) to the anterior half of the symphysis in advance of the roots of the first molar.

I have described, in former works, some detached bones† which from their size might, and probably do, belong to the genus *Nototherium*; but I have since received evidence of extinct species of nearly equal size, and more nearly akin to the Wombat and Kangaroo families, to which some of the fossil limb-bones from Nototherian localities might possibly belong. I may venture to state that the olecranon of *Nototherium* is as little produced as in the ulna of *Diprotodon*. But I deem it better to defer further illustrations of the osteological character of the present genus until the discovery of some portion of the skeleton, under circumstances of juxtaposition, which would warrant such further communication to the Royal Society.

* Philosophical Transactions, 1870, p. 533, Pl. XLII. fig. 5, *i*.

† An astragalus, *e. g.*, in "Report on the Extinct Mammals of Australia," *op. cit.* p. 233, plate 5. figs. 1–6.

Table of Localities of *Nototherium*, showing:—

Where found.	By whom.	Date.
Freshwater deposits, Darling Downs, Queensland	Sir Thomas Mitchell, C.B.	1842
" " Ib. ib. "	Ludwig Leichhardt, M.D.	1845
" " King's Creek "	Mr. Turner*	1846
" " Gowrie "	Henry Hughes, Esq.	1856
" " King's Creek "	Fred. Neville Isaac, Esq.	1856
" " Eton Vale "	Edward S. Hill, Esq.	1863
Breccia-cavern, Wellington Valley, New South Wales....	Gerard Krefft, Esq..................	1869
Freshwater deposits, near Lake Victoria, South Australia	Fr. Tilgate, Esq....................	1869
" " King's Creek, Queensland	W. B. Tooth, Esq.	1870
" " Gowrie Creek "	George King, Esq.	1870
" " Worra-worra Station "	Dr. Geo. Bennett, F.L.S.	1871
" " Jimbour "	G. Morris Simpson, Esq...............	1871
" " Chinchilla Station "	G. F. Bennett, Esq...................	1871
" " Queensland	H.R.H. the Duke of Edinburgh, K.G. ..	1871

Description of the Plates.

PLATE II.

Fig. 1. Side view of skull of *Nototherium Mitchelli*:—one third nat. size.
Fig. 2. Front view of skull of *Nototherium Mitchelli*:—one third nat. size.
Fig. 3. Side view of skull of *Phascolarctos fuscus*:—one half nat. size.
Fig. 4. Front view of naso-premaxillary end of skull of *Phascolomys latifrons*:—nat. size.

PLATE III.

Fig. 1. Back view of cranium of *Nototherium Mitchelli*:—one third nat. size.
Fig. 2. Upper view of skull of *Nototherium Mitchelli*:—one third nat. size.
Fig. 3. Under view of skull of *Nototherium Mitchelli*:—one third nat. size.
Fig. 4. Back view of skull of *Phascolomys platyrhinus*:—three fourths nat. size.

PLATE IV.

Fig. 1. Oblique side view of mandible of *Nototherium Mitchelli* (male ?):—half nat. size.
Fig. 2. Upper view of the same mandible and teeth:—half nat. size.
Fig. 3. Under view of the same mandible:—half nat. size.

* "In 1845 or 1846, Mr. Turner, Superintendent of a Sheep-station on the Condamine, brought to Sydney a large collection made by himself after various 'freshets' or floods in the creeks of the river had left the fossils bare and protruding from the sides of the gulleys; he disposed of them to a Mr. Benjamin Boyd, a merchant, who soon after got embarrassed; he sent the fossils to Europe for sale, but suffered our Museum to take casts of all of them."—Letter from W. S. Macleay, Esq., F.R.S., to the author, dated 9th March, 1858. The lower jaw of *Nototherium Mitchelli* (Plate IV.) formed part of this collection, which was purchased for the British Museum.

PLATE V.

Fig. 1. Side view of mandible of *Nototherium Mitchelli* (female ?):—half nat. size.
Fig. 2. Under view of the same mandible:—half nat. size.
Fig. 3. Upper view of the same mandible and teeth:—half nat. size.
Fig. 4. Front view of symphysis and broken incisors of the same mandible:—nat. size.
Fig. 5. Back view of part of rising ramus of the same mandible:—nat. size.

PLATE VI.

Fig. 1. Outer side view of right mandibular ramus and teeth of a young *Nototherium Mitchelli.*
Fig. 2. Under view of the same ramus.
Fig. 3. Upper view of the same ramus and teeth.
Fig. 4. Inner side view of the same ramus and teeth.
Fig. 5. Outer side view of fore part, with alveoli of the incisor and of the first two molars exposed, of the same ramus.

All the figures are of the natural size.

PLATE VII.

Fig. 1. Outer side view of part of mandibular ramus and teeth of *Nototherium Victoriæ*:—half nat. size.
Fig. 2. Inner side view of the same ramus and teeth:—half nat. size.
Fig. 3. Under view of back part of symphysis of the same ramus:—nat. size.
Fig. 4. Front view of fractured symphysis of the same ramus:—nat. size.

PLATE VIII.

Fig. 1. Outer side view of mutilated right mandibular ramus and teeth of *Nototherium inerme*:—half nat. size.
Fig. 2. Upper view of mutilated mandible and teeth of *Nototherium inerme*:—half nat. size.
Fig. 3. Inner side view of mutilated left mandibular ramus of *Nototherium inerme*:—half nat. size.
Fig. 4. Fractured surface of the symphysis:—two thirds nat. size.

PLATE IX.

Fig. 1. Side view of first incisor, upper jaw, of *Nototherium Mitchelli.*
Fig. 1 *a*. Base of the same tooth.

Fig. 1 *b*. Side view of crown of the same tooth.
Fig. 2. Front view of the same tooth.
Fig. 3. Outer side view of the right upper molars of *Nototherium Mitchelli* (male?).
Fig. 4. Grinding-surface of the same teeth.
Fig. 5. Grinding-surface of the right upper molars of *Nototherium inerme*.
Fig. 6. Outer side view of a portion of the right maxilla, with three molars (d_4, m_1, m_2) *in situ*, of *Nototherium Mitchelli* (old male?).
Fig. 7. Grinding-surface of the same molars.
Fig. 8. Front view of an upper molar (m_1), with the two anterior roots exposed.

All the figures are of the natural size.

PLATE X.

Fig. 1. Outer side view of right lower molars of *Nototherium Mitchelli* (male); the worn crowns of d_3 and d_4 are restored in outline.
Fig. 2. Grinding-surface of the last three teeth of the same jaw, with outlines of that of d_3 and d_4.
Fig. 3. Grinding-surface and parts of right lower molars of *Nototherium Mitchelli* (female?).
Fig. 4. Outer side view of the last three lower molars (m_1, m_2, m_3), with the mutilated hinder half of the second (d_4), of *Nototherium Victoriæ*.
Fig. 5. Grinding-surface of the same teeth (of d_4 only the hinder half is preserved).
Fig. 6. Inner side view of the same teeth.
Fig. 7. Back view of the penultimate lower molar, with the hind fang exposed *in situ*, of *Nototherium Mitchelli*.
Fig. 8. Roots and remnant of crown of a much-worn lower molar of *Nototherium Mitchelli*.

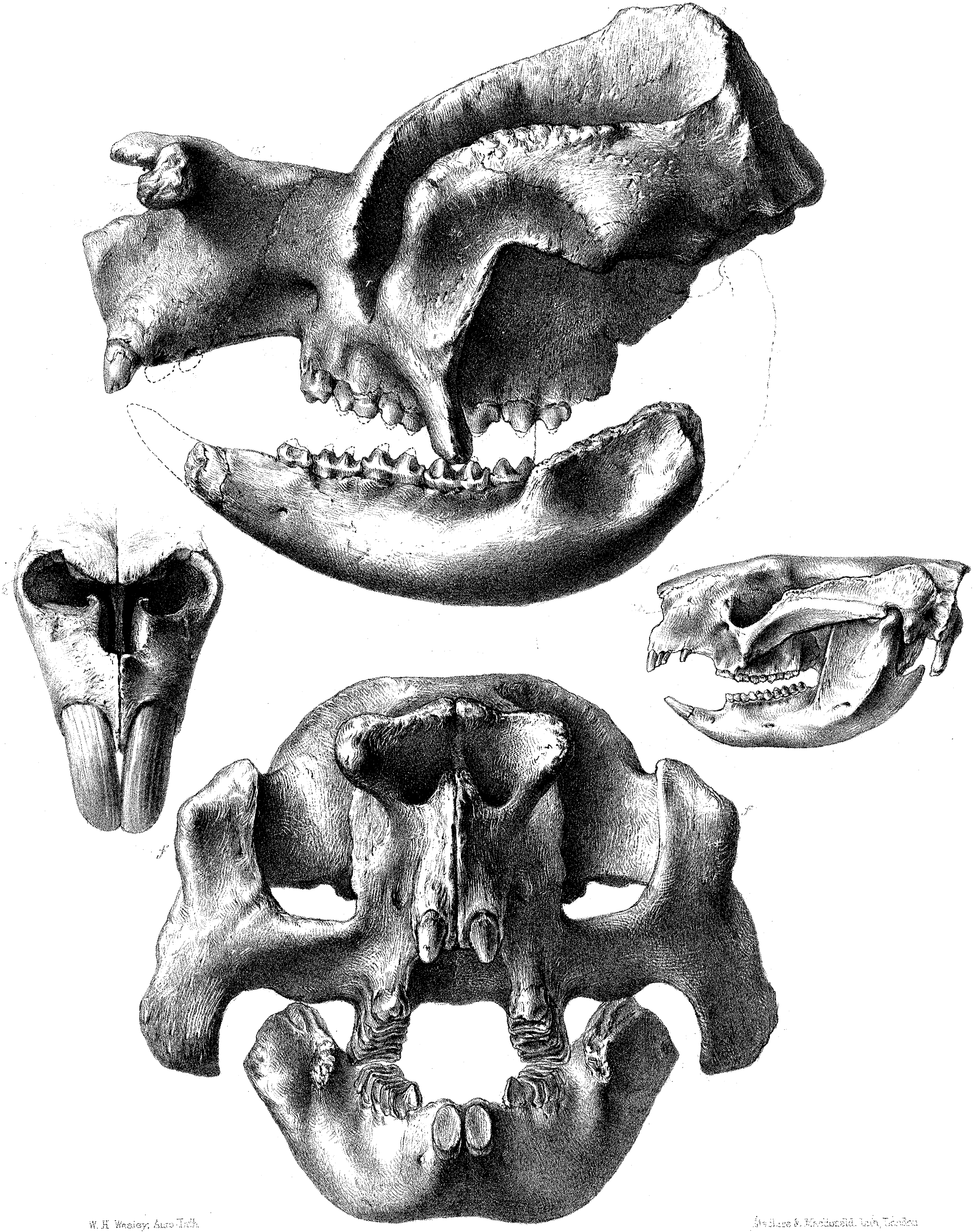
All the figures are of the natural size.

PLATE XI.

Fig. 1. Portion of mandible with three last grinders ($m_{1, 2, 3}$) of *Nototherium Mitchelli*; inside view: nat. size.
Fig. 2. Outside view of the grinders of the same jaw.
Fig. 3. Upper view or working-surface of the same grinders.

[Since the foregoing pages were in type, the Trustees of the British Museum have received, as a Donation from His Royal Highness the Duke of Edinburgh, K.G., the specimen which forms the subject of the above Plate, which the Council of the Royal Society have ordered to be added to the illustrations of the present paper. The fossil, obtained by His Royal Highness in the Province of Queensland, Australia, is part of the collection of interesting and instructive specimens brought home from the Circumnavigatory Voyage of Her Majesty's Ship 'Galatea,' under the command of His Royal Highness, and exhibited in the South Kensington Museum. The molar teeth in this fossil are in a more perfect state of preservation than in any other Nototherian jaws which had previously come under my observation; and, being from an individual of the same age as that to which the jaw and teeth of *Nototherium Victoriæ* from South Australia belonged, they exemplify more plainly and completely the differential characters of that species and of the *Not. Mitchelli* from the Province of Queensland.

The teeth ($m_{1, 2, 3}$) of *Nototherium Mitchelli* differ from those of *Not. Victoriæ* in the presence of a "cingulum" on the outer side of their base (comp. figs. 2 & 3, *c*, Plate XI. with figs. 4 & 5, Plate X.). In m_1 the cingulum is continued from the prebasal ridge (fig. 2, *f*) along the base of the anterior lobe to the outer tubercle (*h*), closing the valley, upon the outer surface of which the cingulum subsides; but it resumes its course behind the tubercle along the outer side of the posterior lobe (*b*), where it is continued upward along the middle of that side; but from the base of this vertical prominence (*d*, fig. 2, Plate XI.) the cingulum is continued to the postbasal ridge (*g*), which, like the prebasal one, is a more developed part of the cingulum. In *Nototherium Victoriæ* the cingulum is represented only by the pre- and postbasal ridges (Plate X. figs. 4, 5, 6, *f*, *g*), and by the closing tubercles (ib. *h*, *h'*) before mentioned (p. 77), at the outer and inner ends of the transverse valley. The penultimate molar (m_2, Plate XI.) presents the same differential characters. In m_3 of the present specimen of *Nototherium Mitchelli* the vertical continuation from the cingulum upon the outer side of the hinder lobe is not present (Plate XI. fig. 2, m_3); but in *Not. Victoriæ* the outer closing tubercle (Plate X. fig. 4, m_3, *h*) and the postbasal ridge (ib. *g*) are both extended, converging, to curve up along the outer side of the hinder lobe of m_3, without crossing its base, as does the cingulum (Plate XI. fig. 2, m_3, *c*) in *Not. Mitchelli.* All the molars in *Not. Victoriæ* differ from those in *Not. Mitchelli* by the greater breadth or thickness of the postbasal ridge.—July 23, 1872.]



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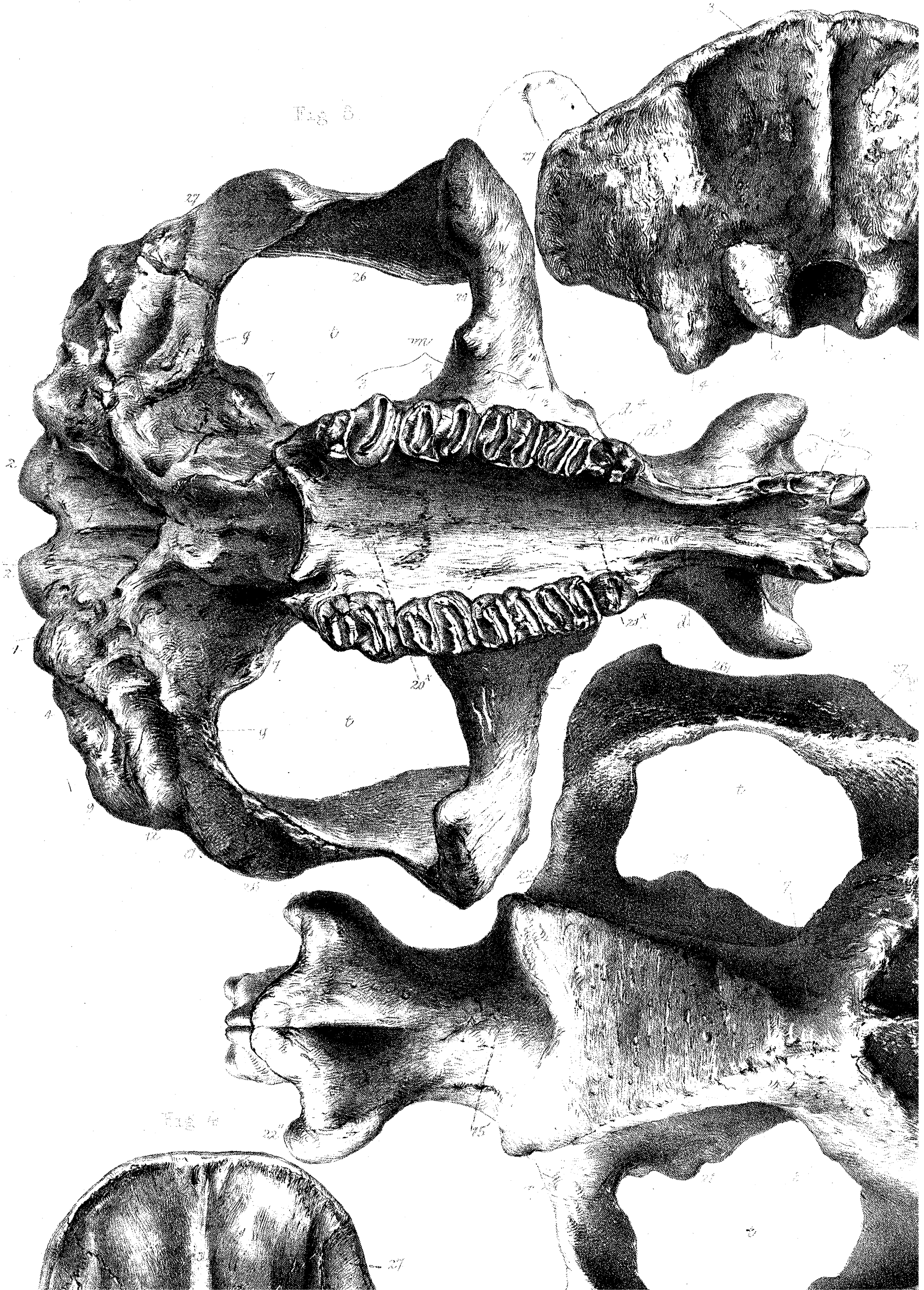

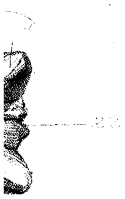

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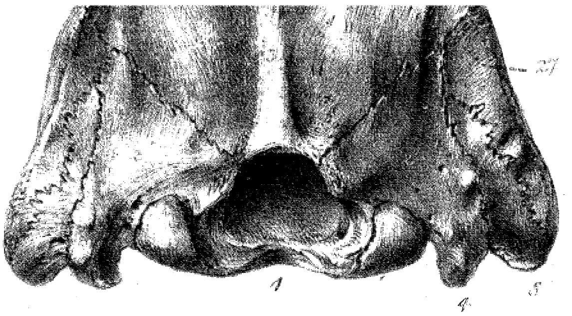

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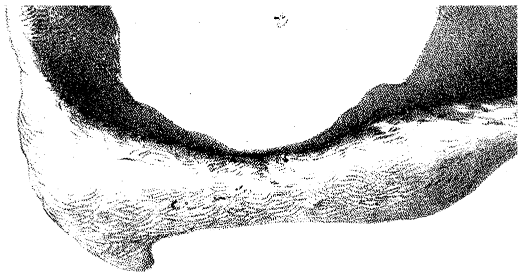

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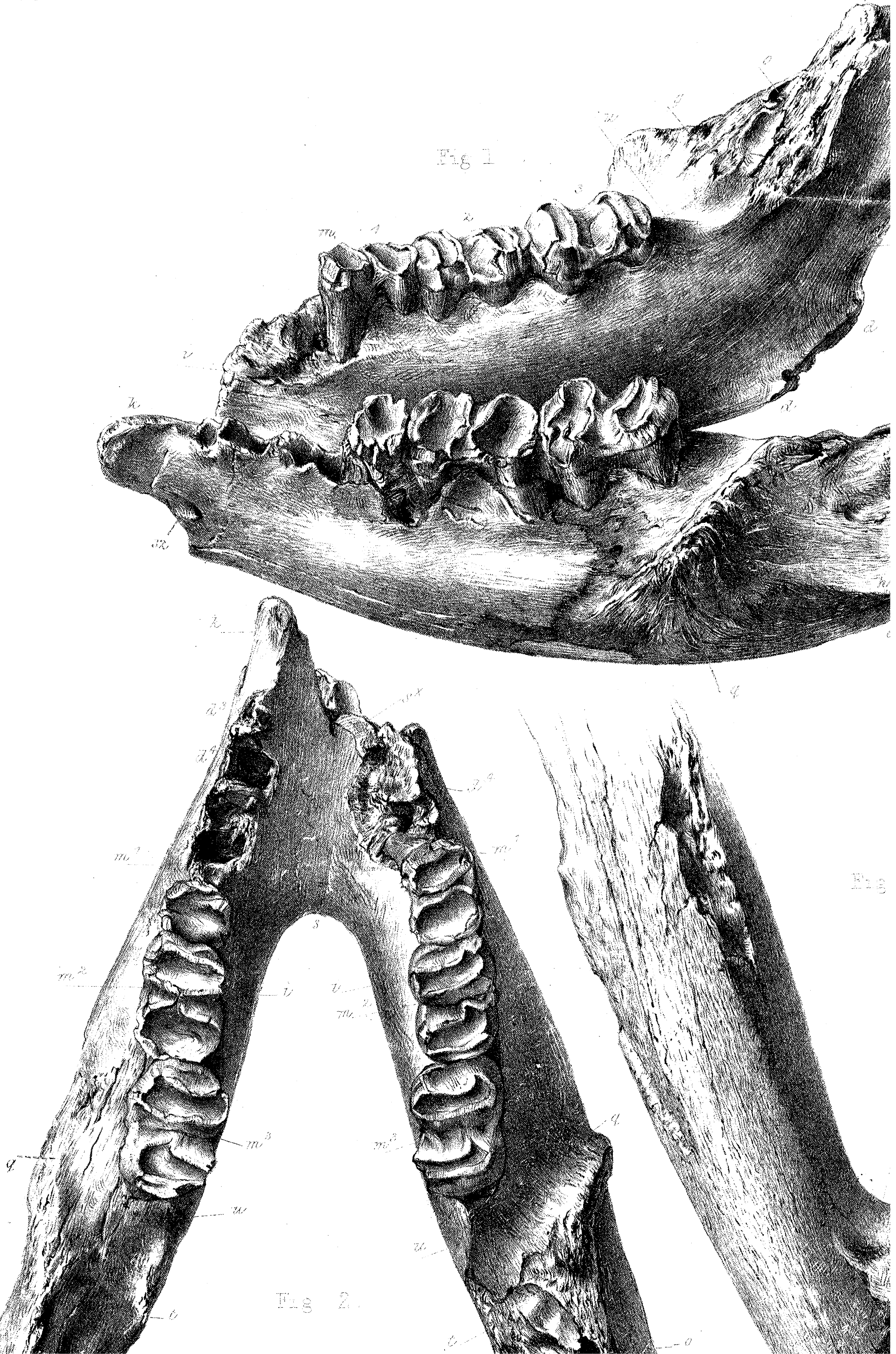

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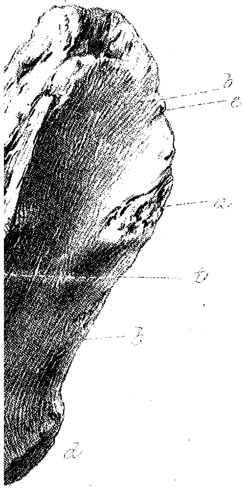

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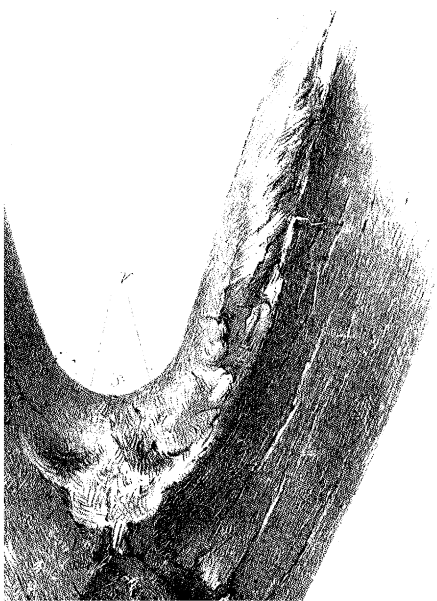

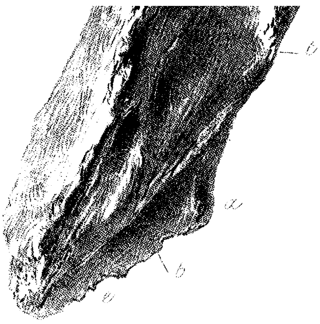

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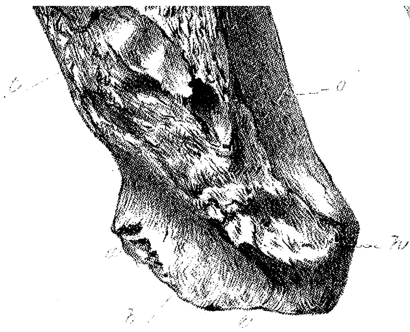

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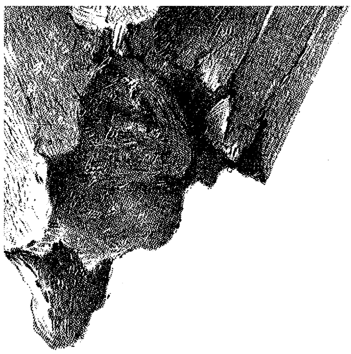

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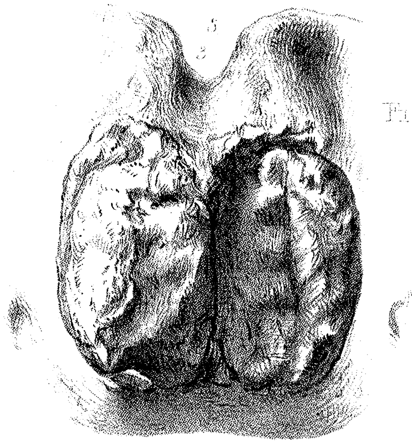

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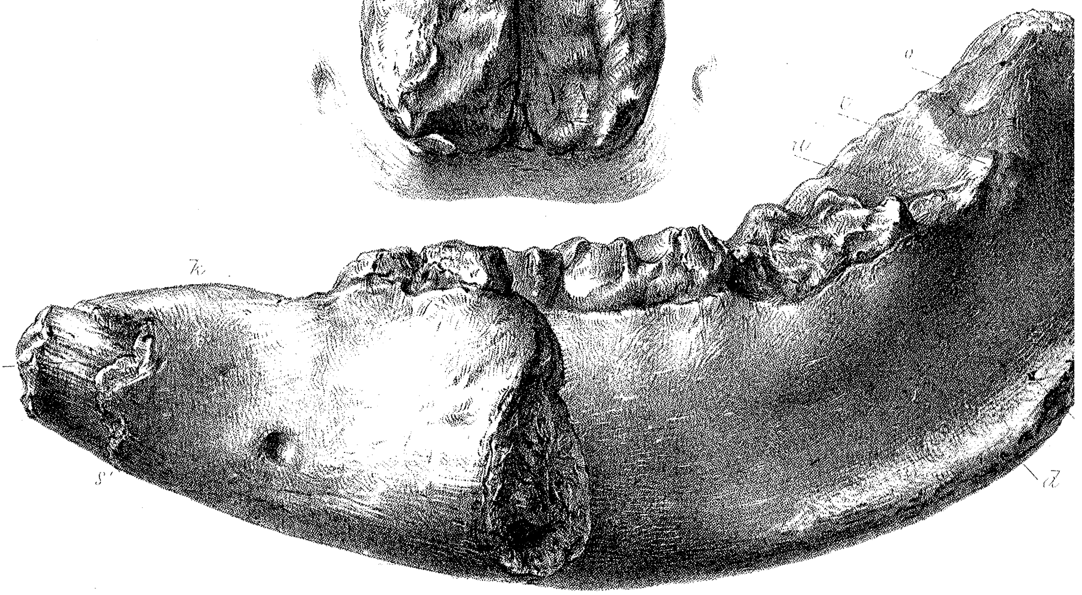

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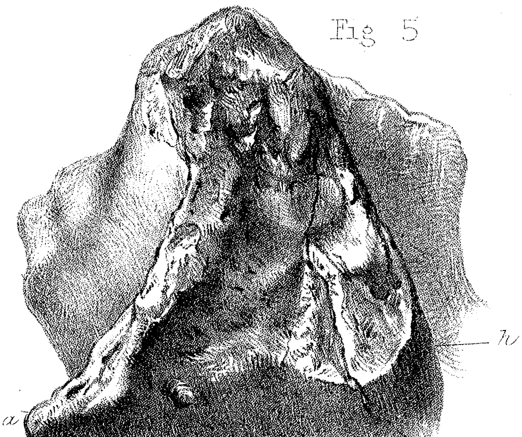

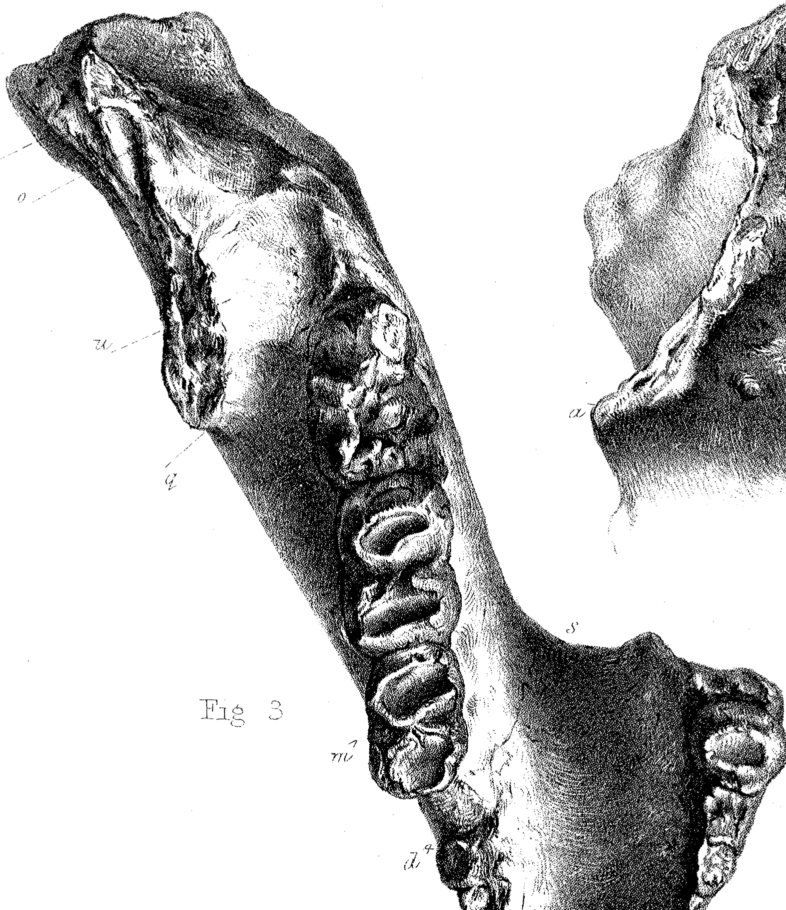

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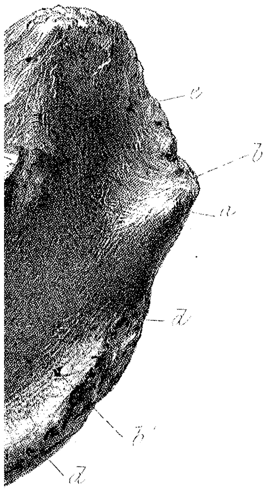

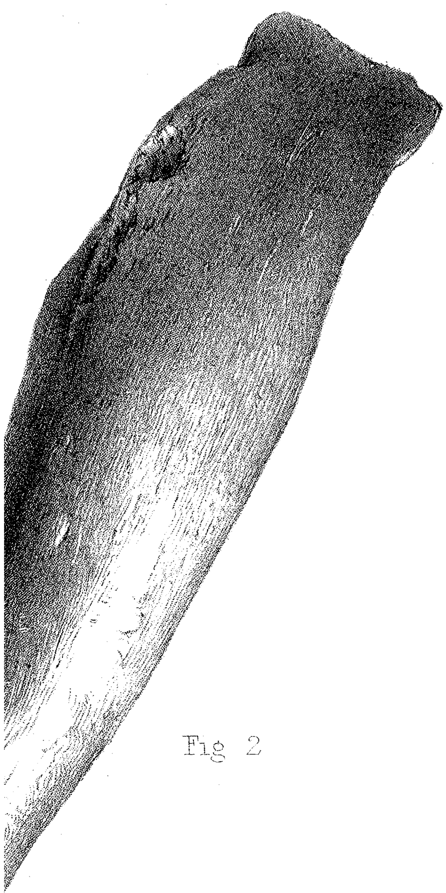

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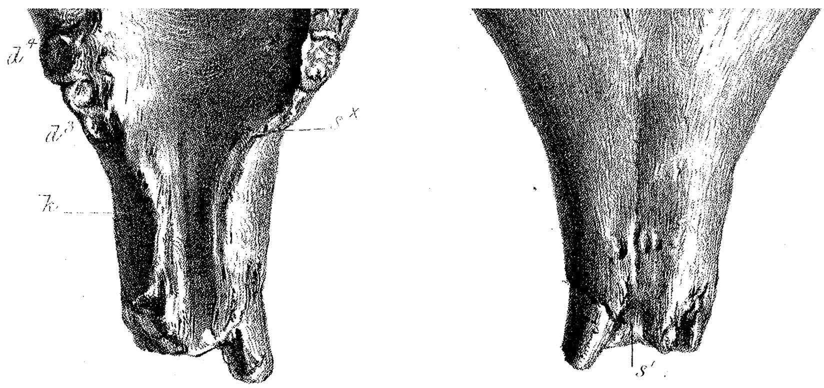

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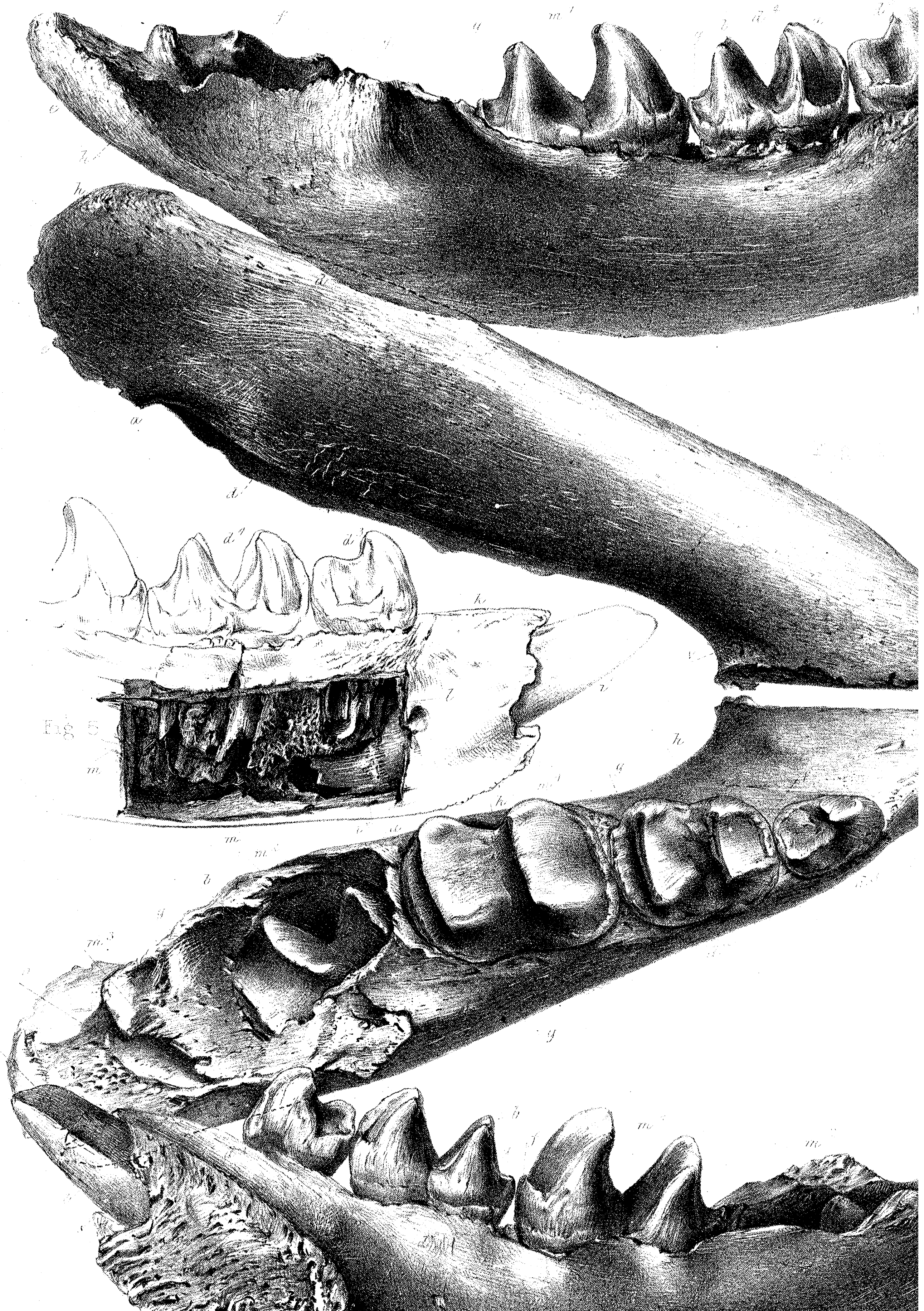
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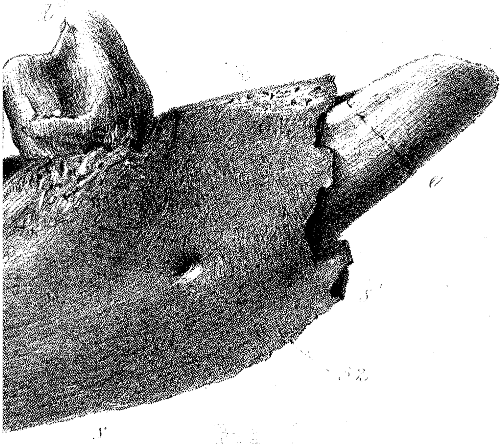

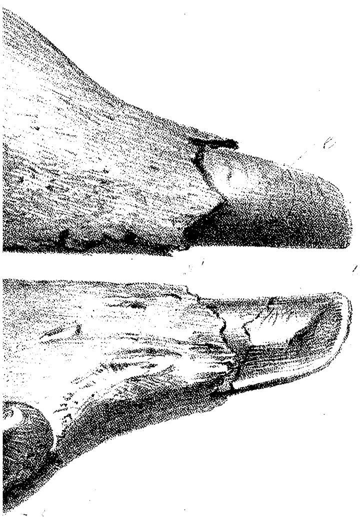

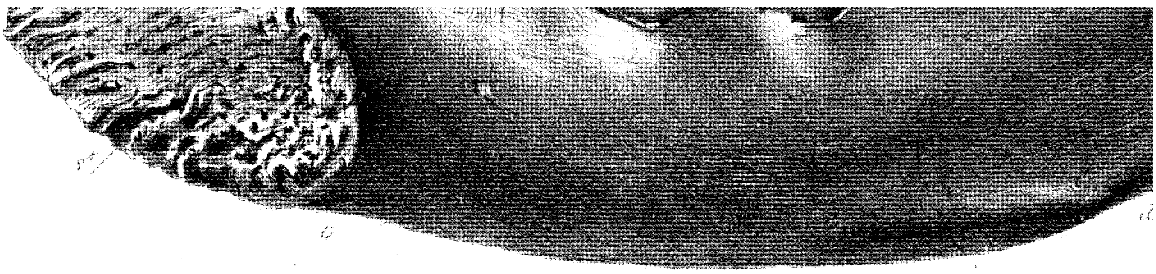

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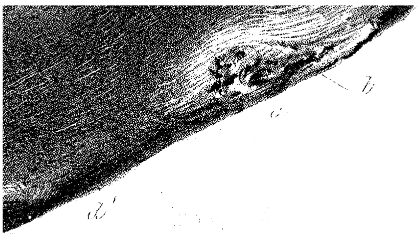

b
a
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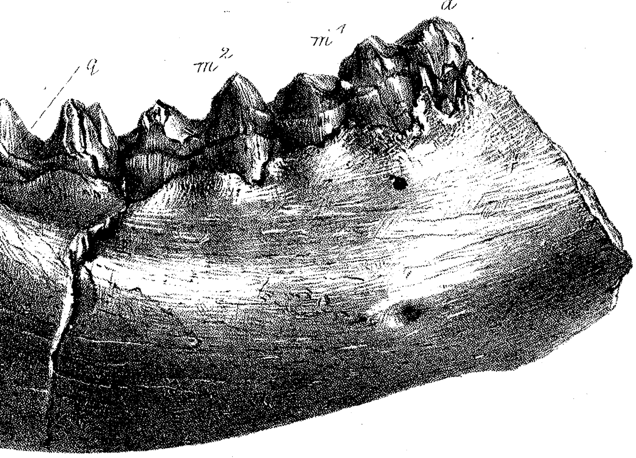

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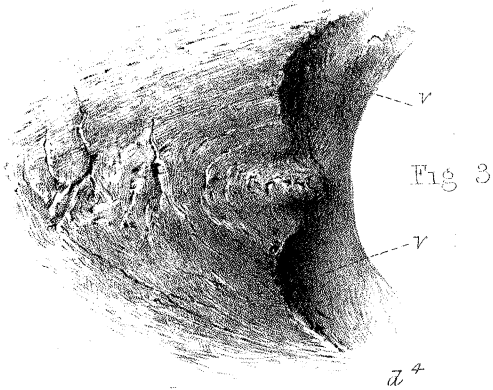

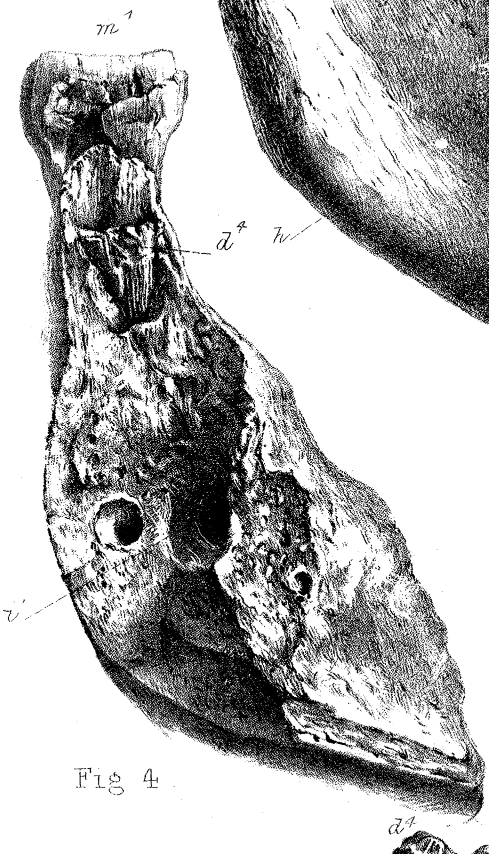

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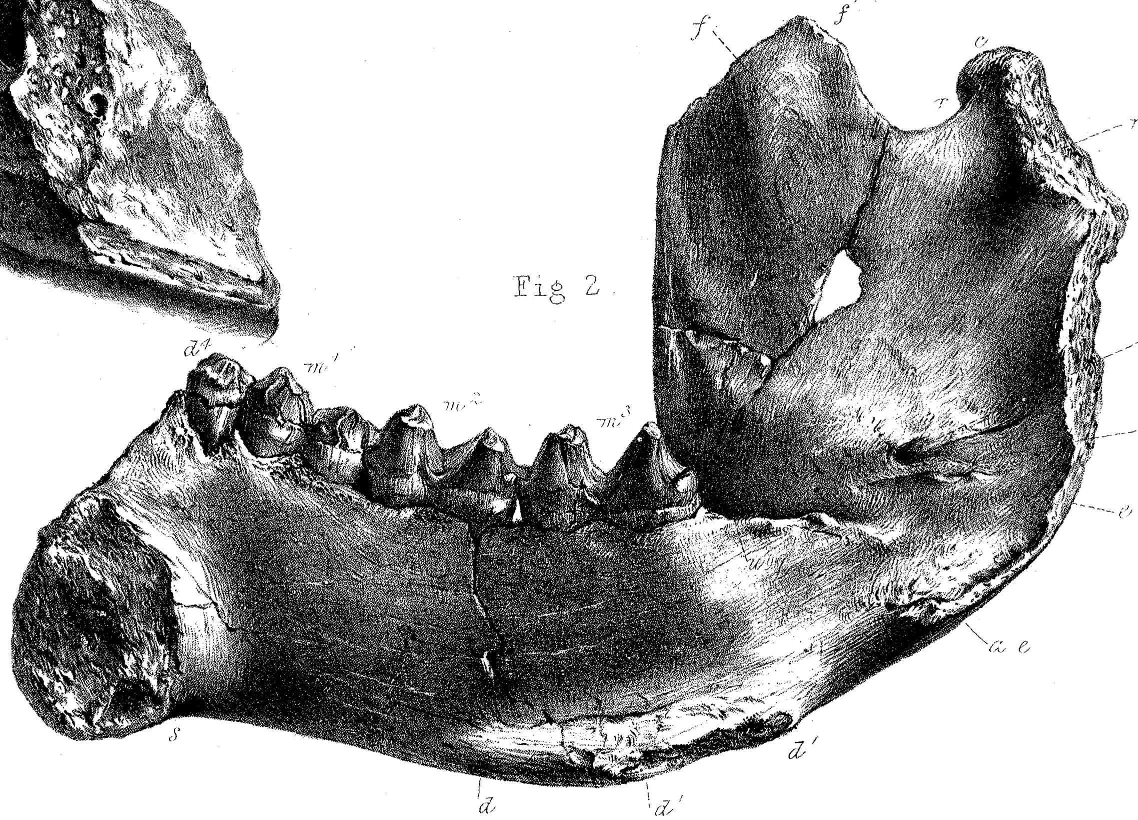

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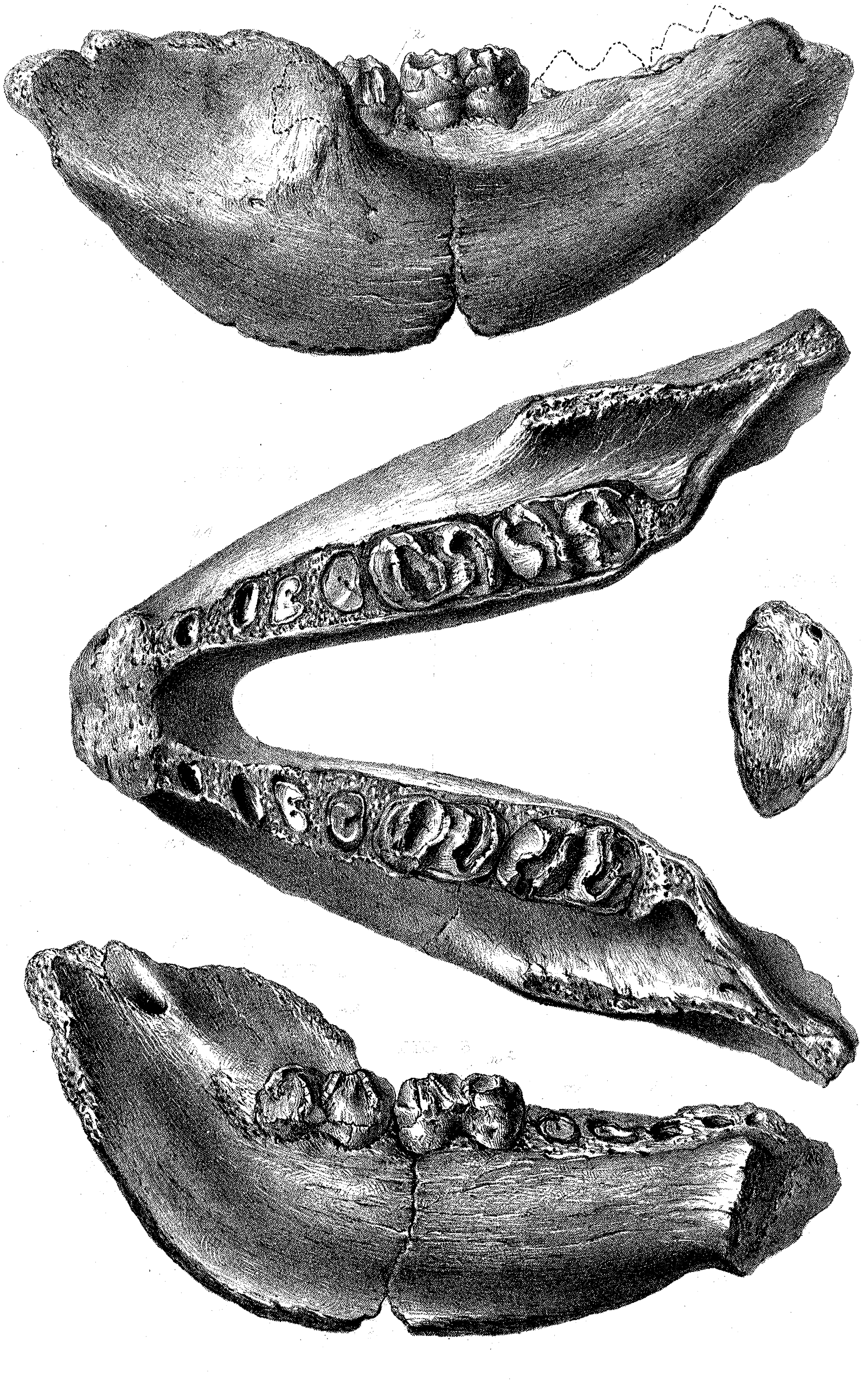

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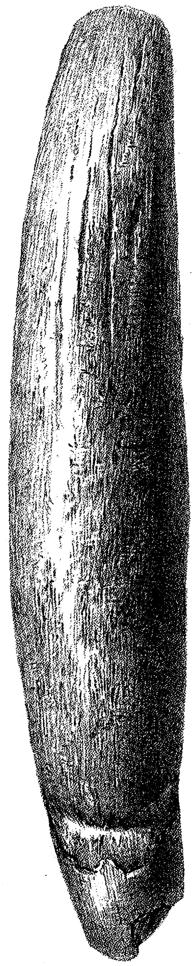

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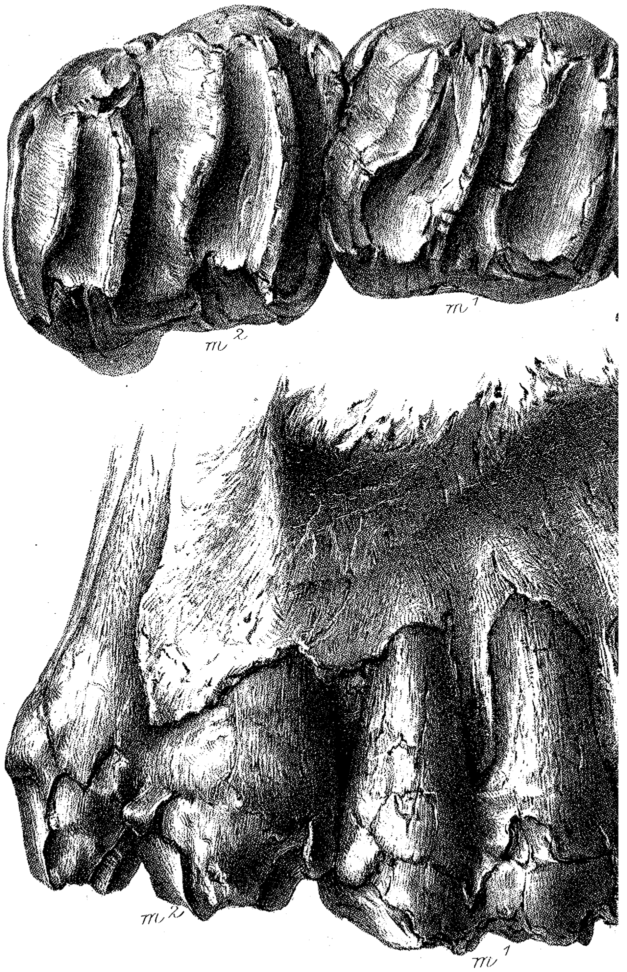

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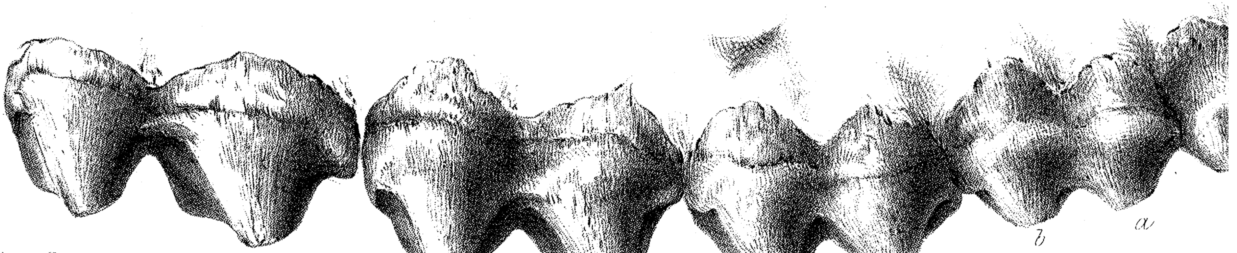

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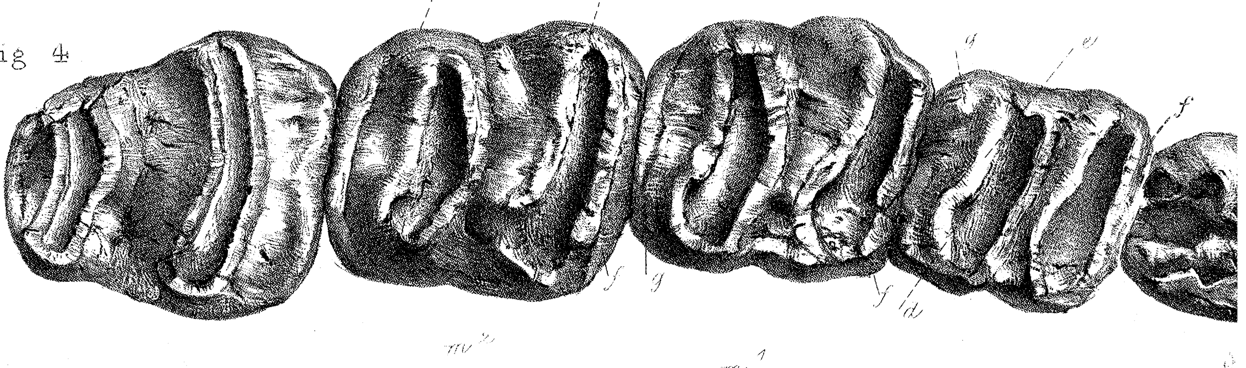

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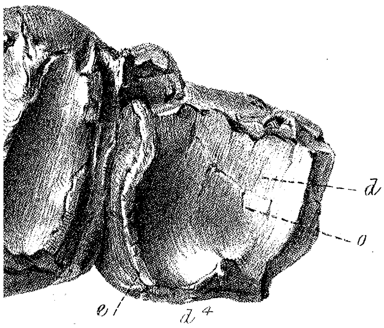

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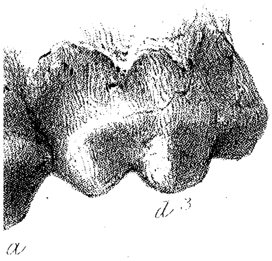

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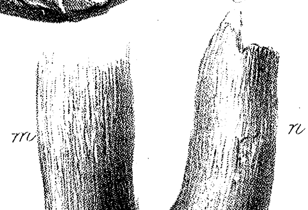

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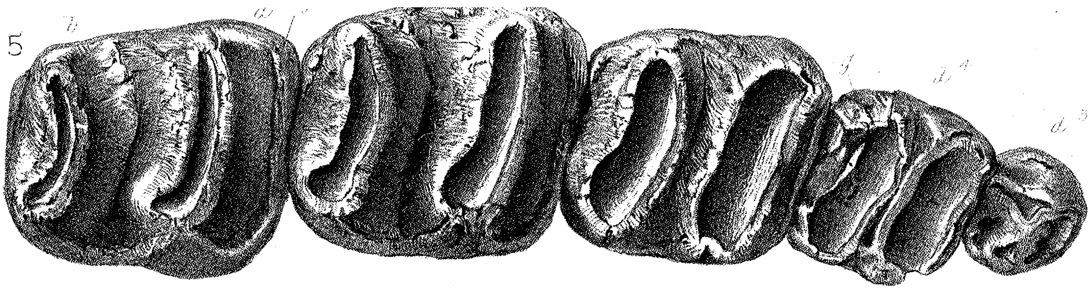

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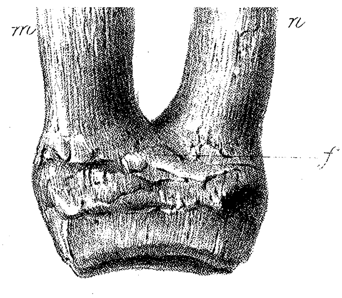

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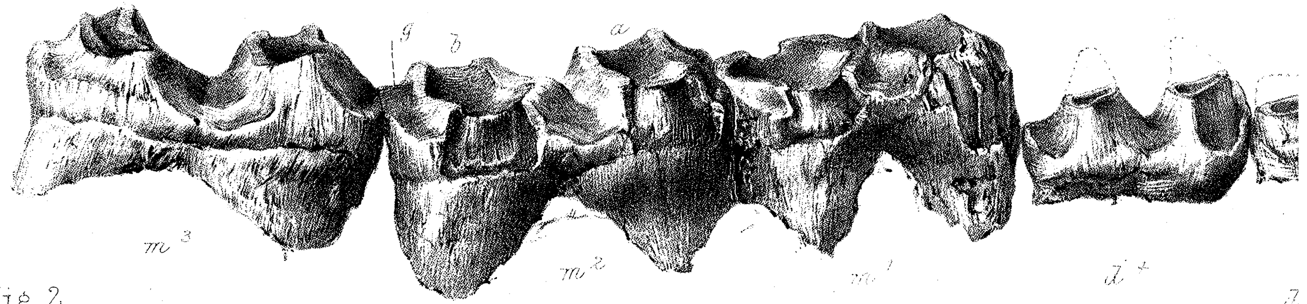

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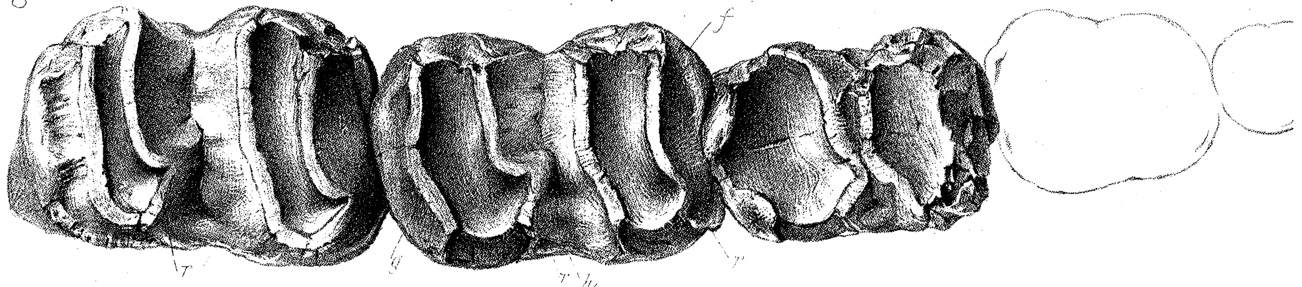

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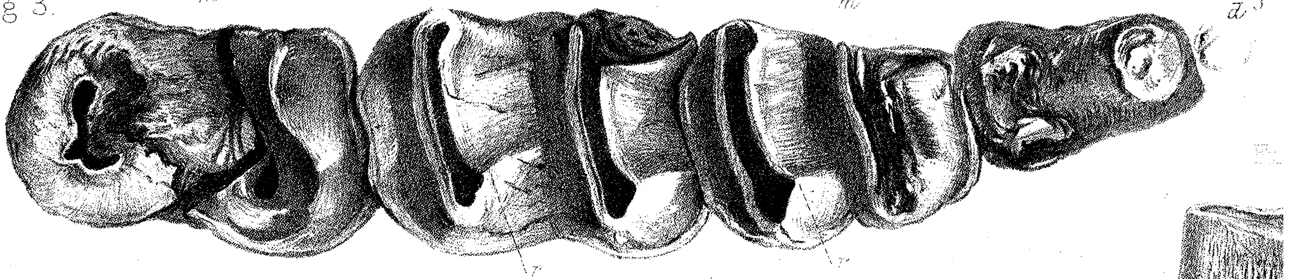

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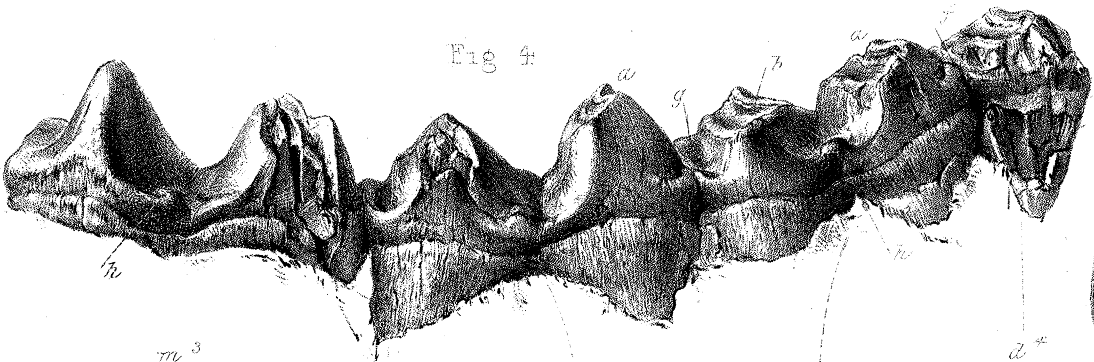

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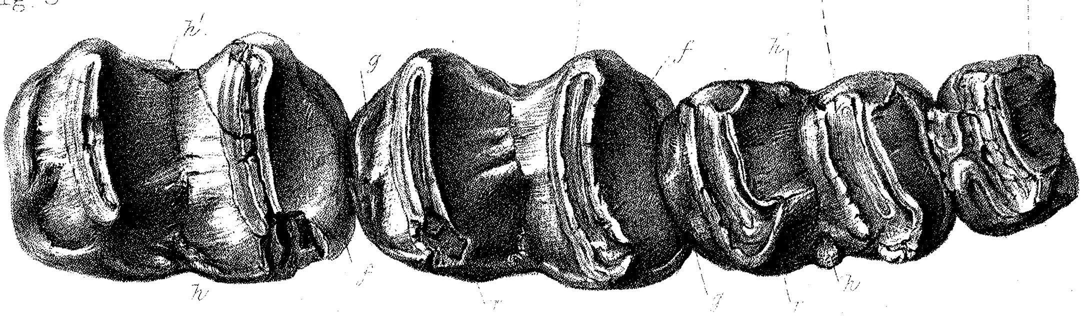

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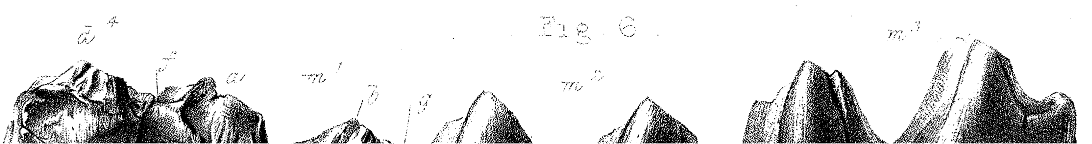

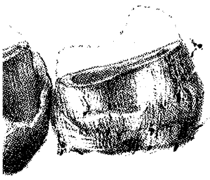

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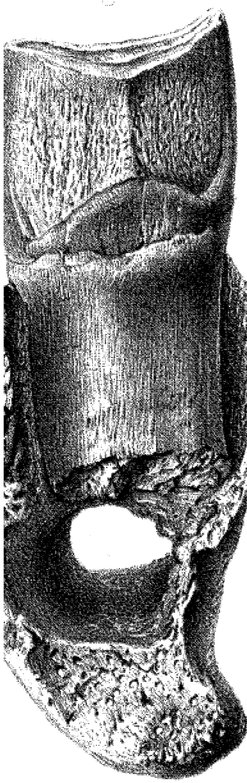

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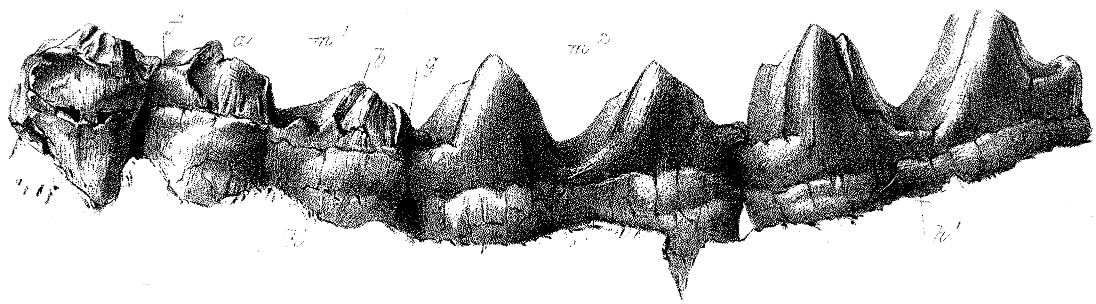

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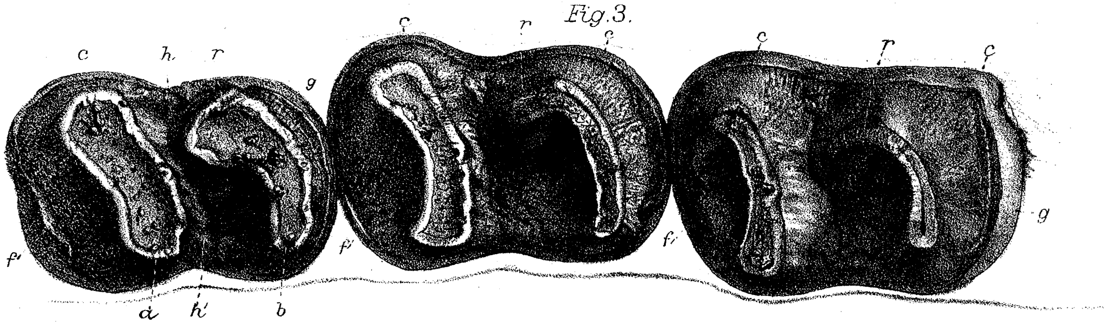

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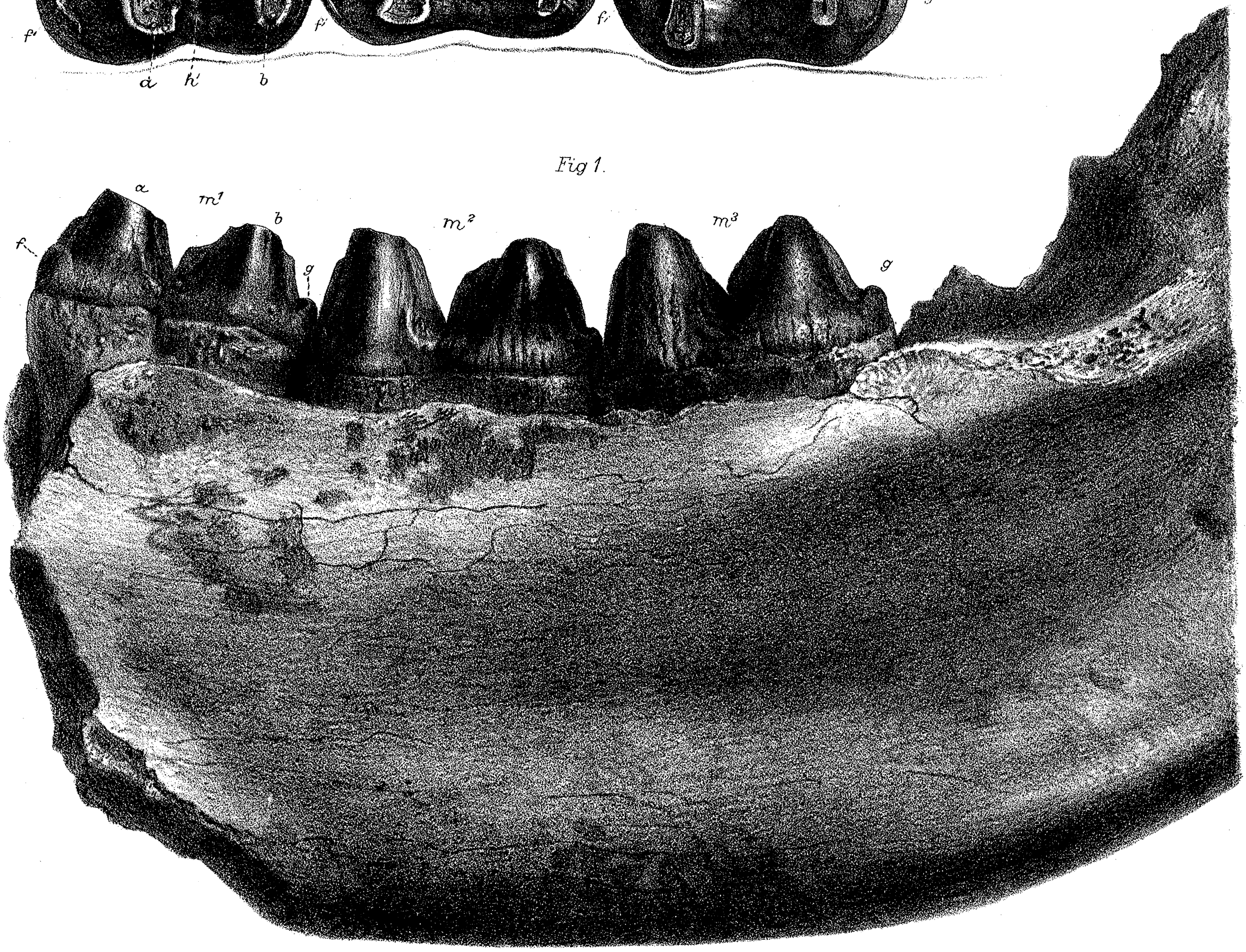

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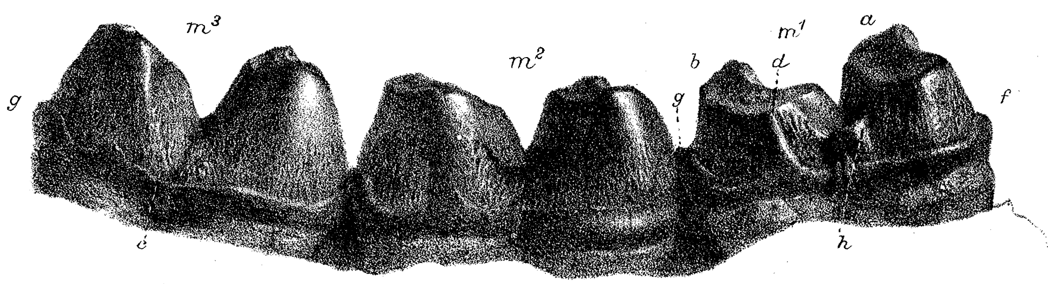

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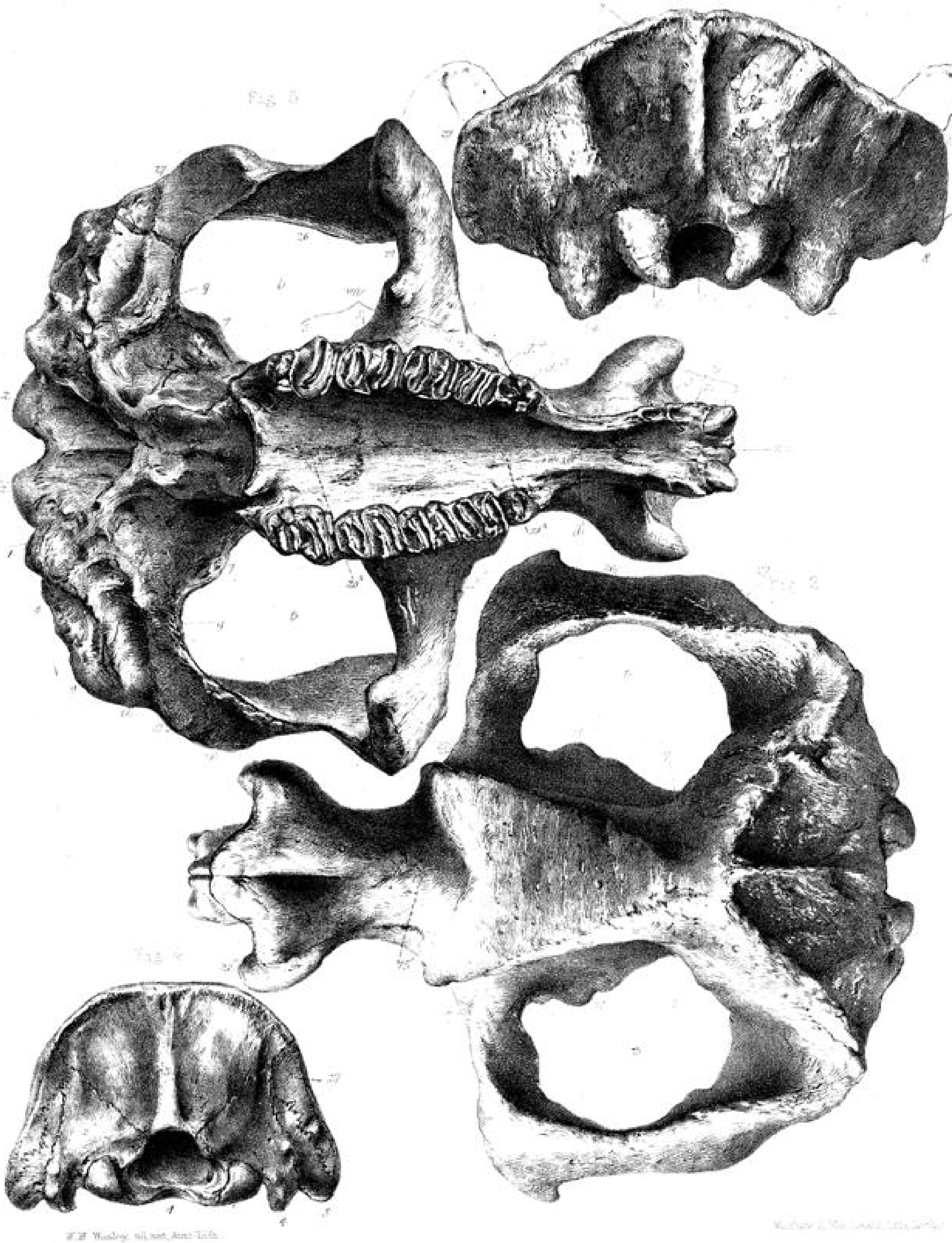

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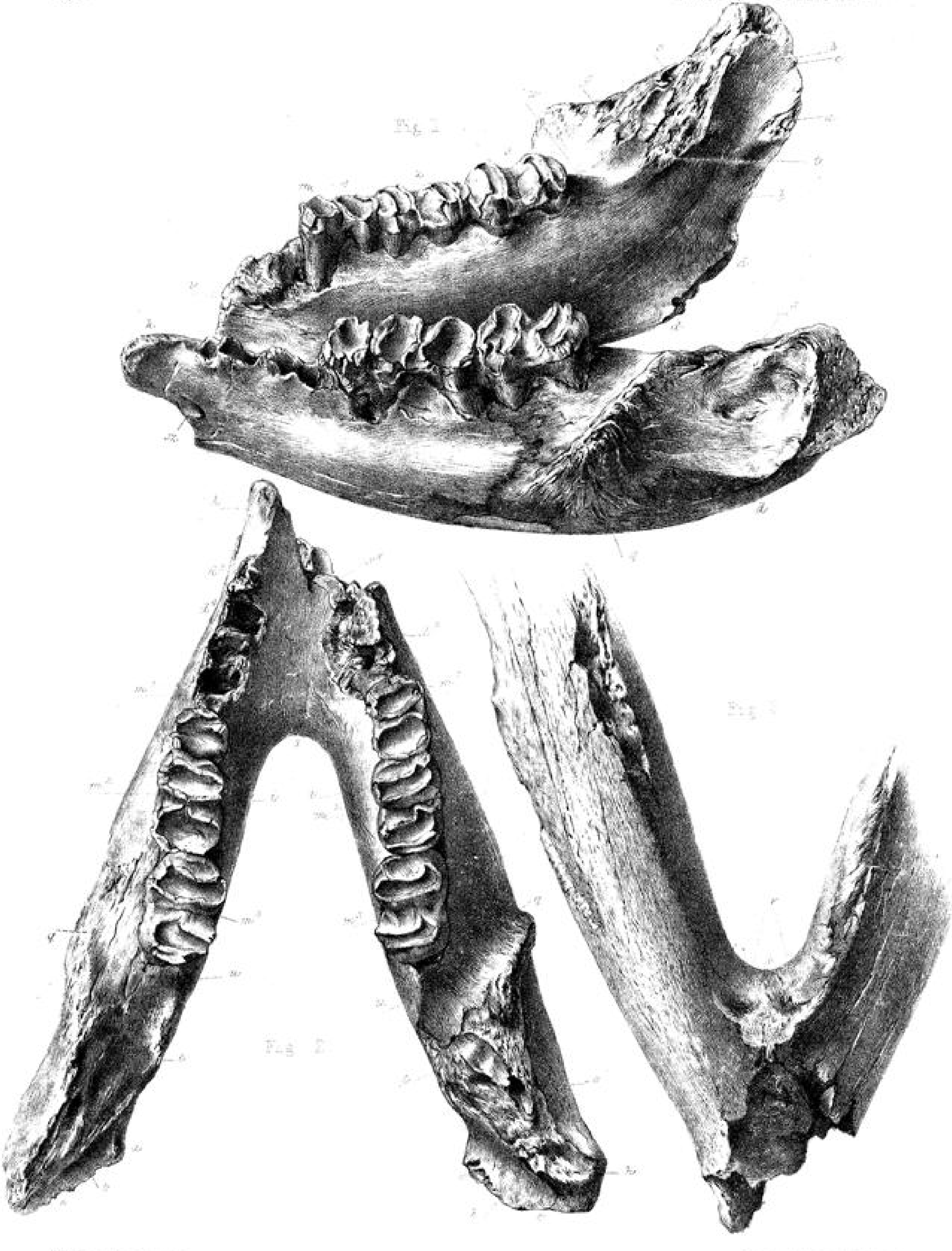

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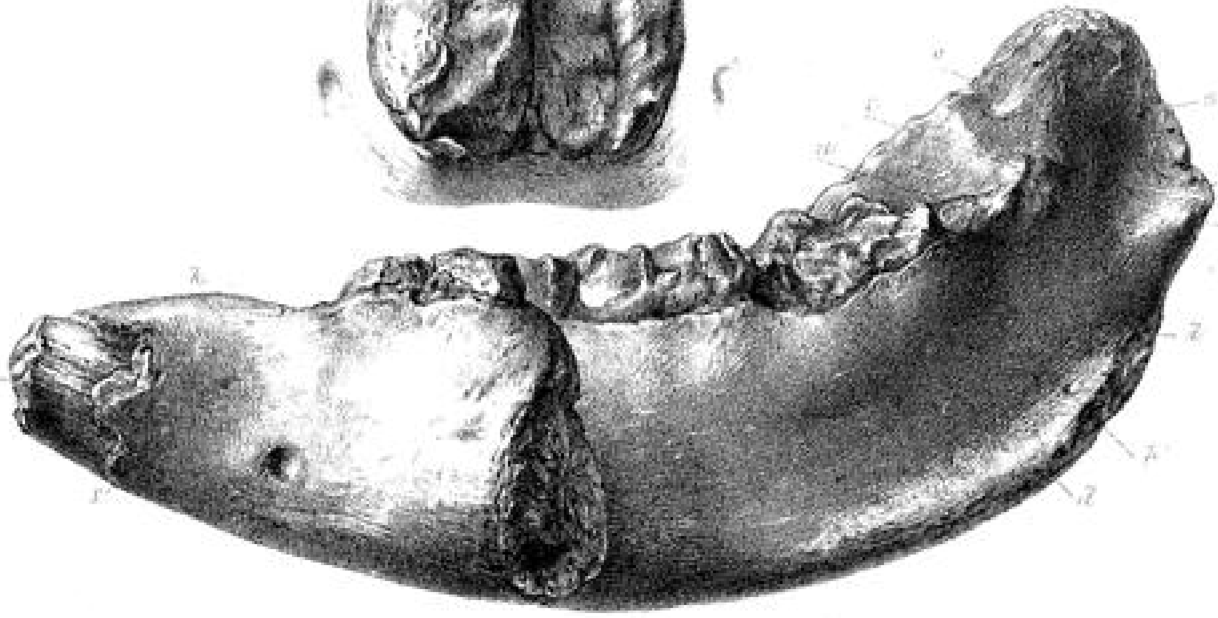

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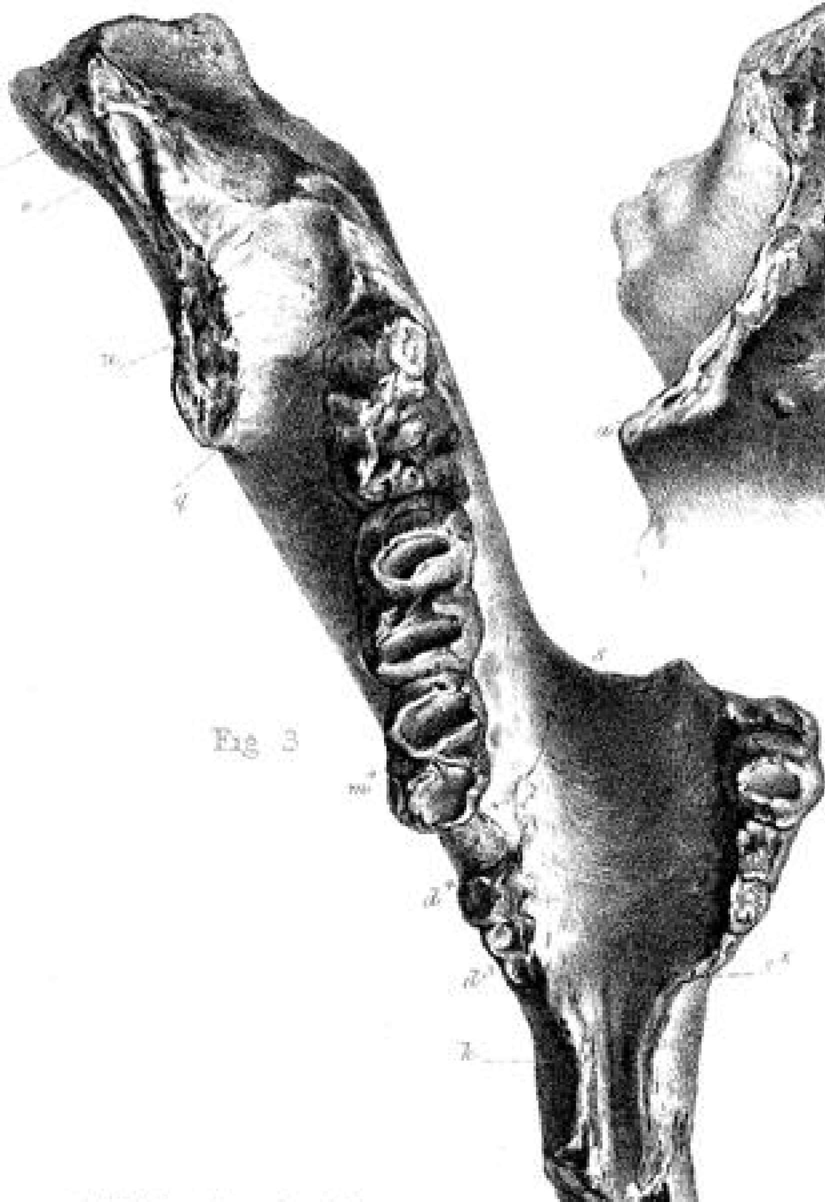

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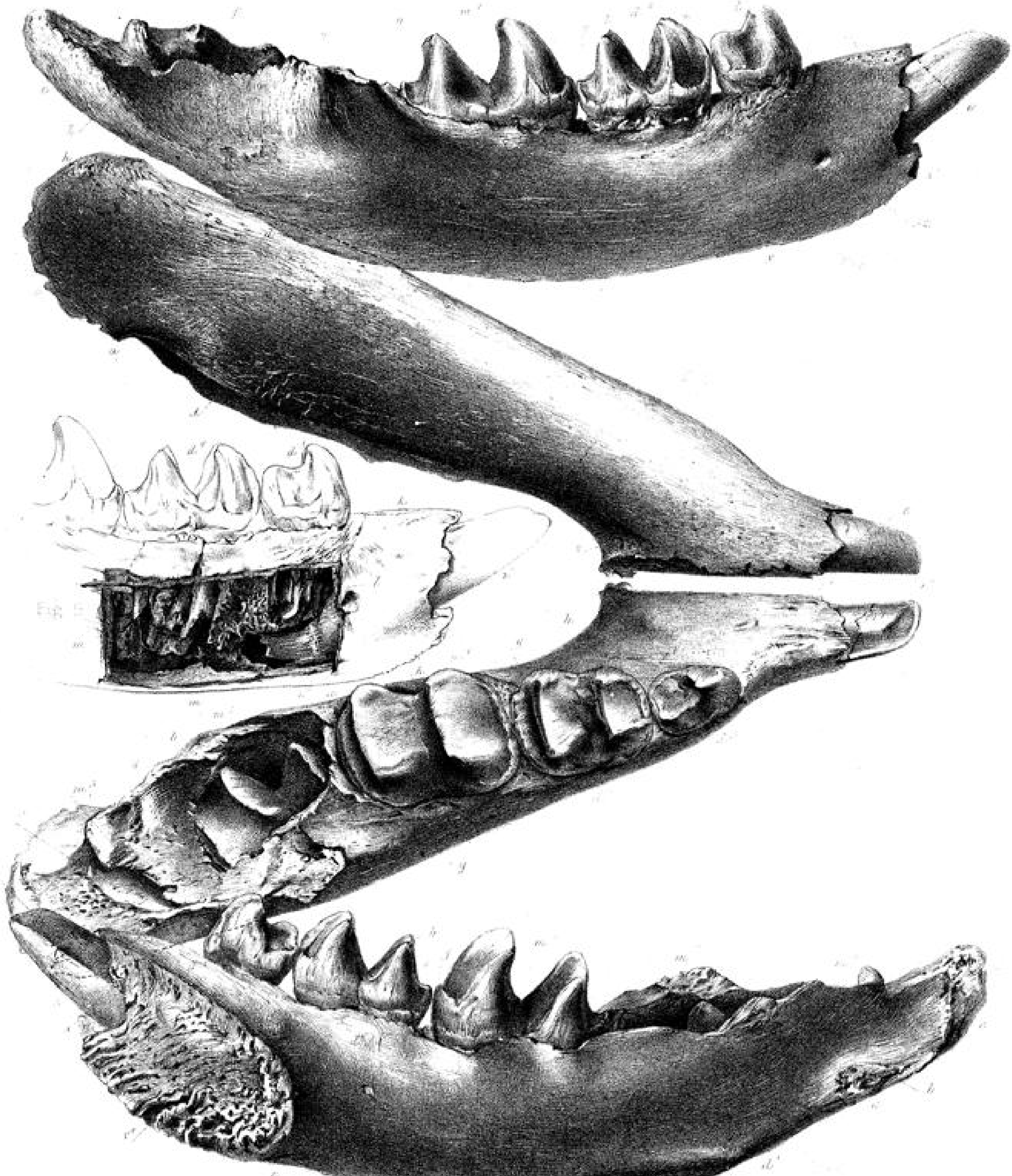

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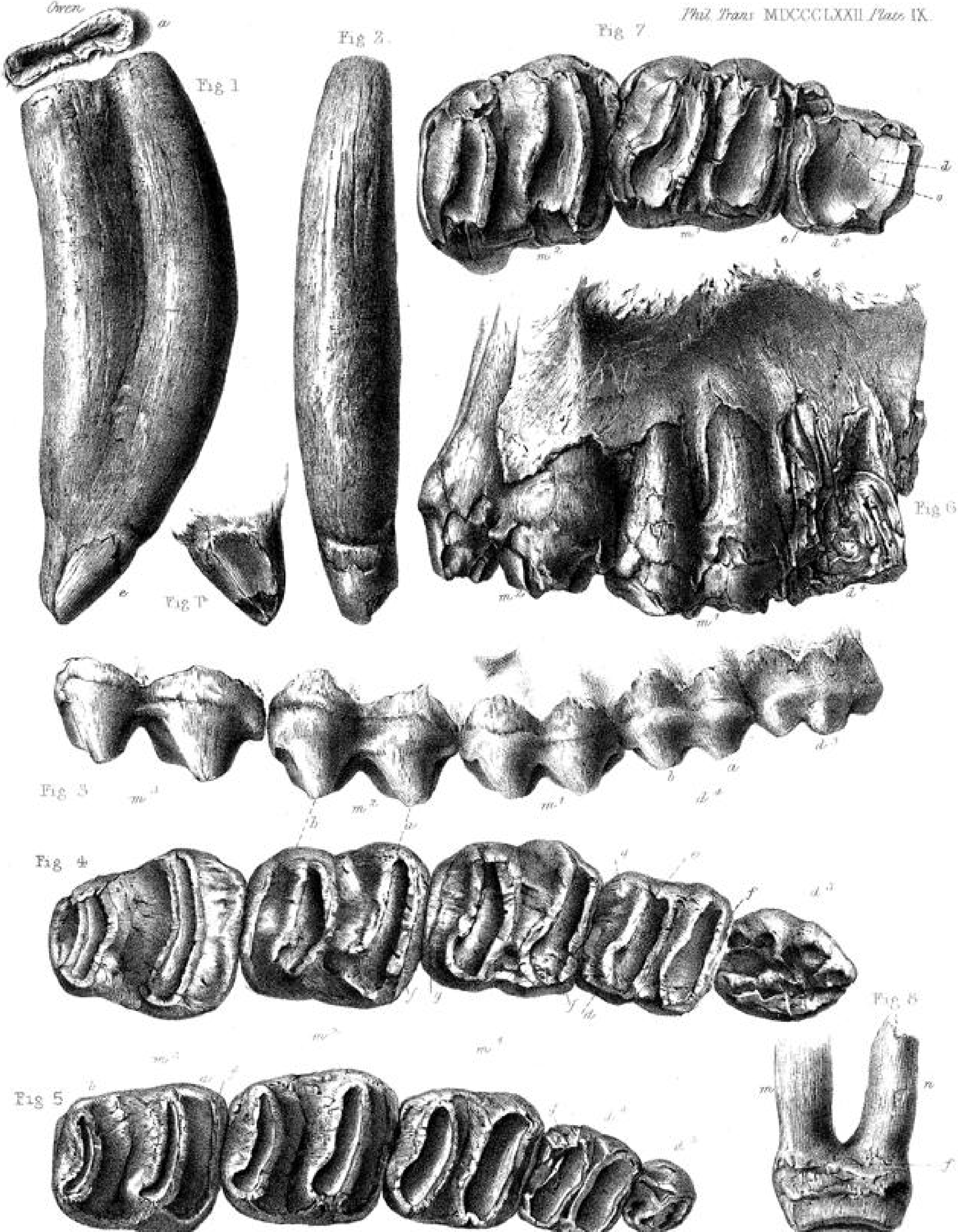

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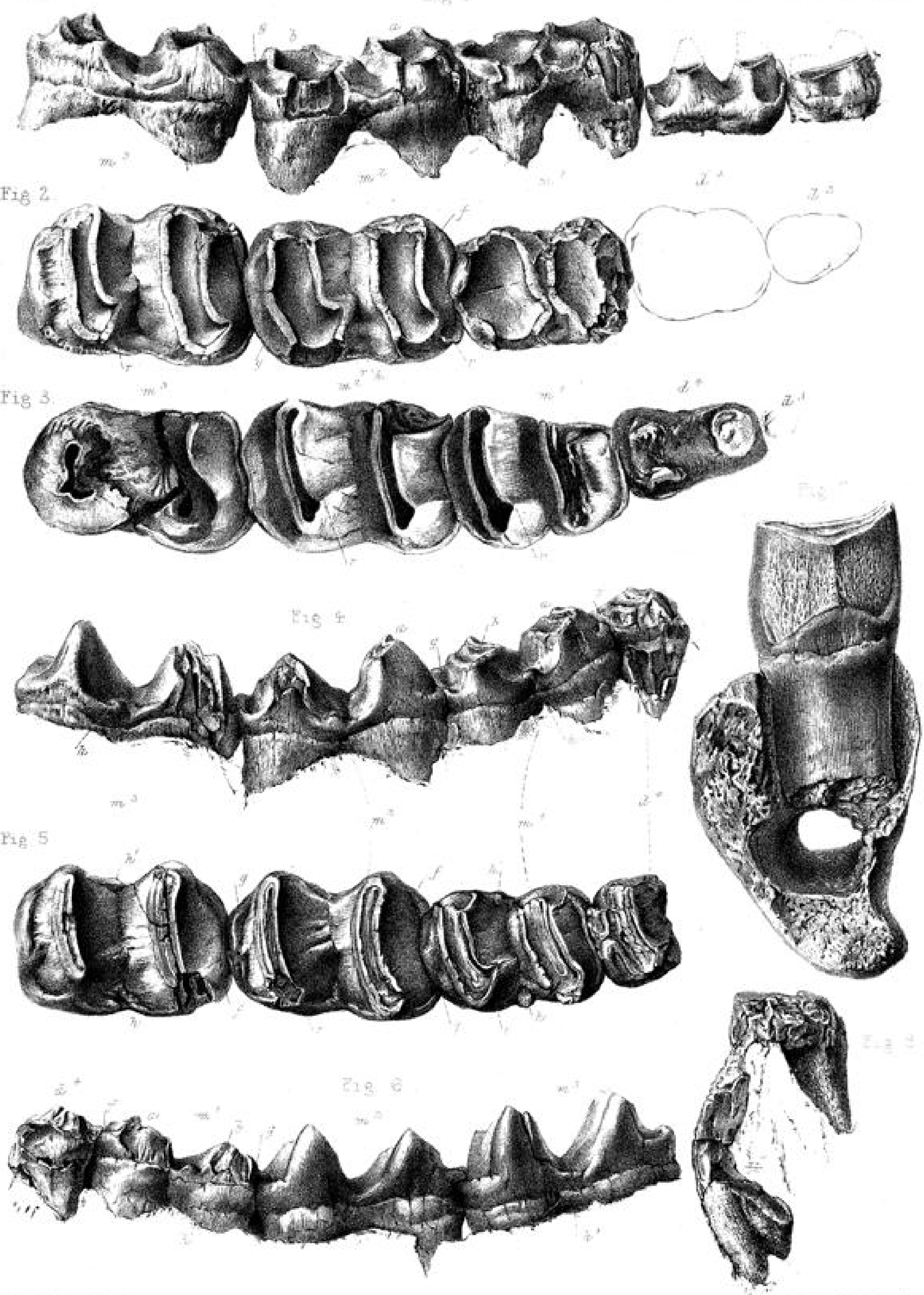

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