VIII. *On the Fossil Mammals of Australia.*—Part X. Family MACROPODIDÆ: *Mandibular Dentition and Parts of the Skeleton of* Palorchestes; *additional evidences of* Macropus Titan, Sthenurus, *and* Procoptodon. *By Professor* OWEN, *C.B., F.R.S., &c.*

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§ 1. *Introduction.*—The evidences of these extinct Mammals which have been made known through the 'Transactions' of the Royal Society have stimulated the search and transmission of additional fossils, from which are selected for the present communication those tending to complete the restoration of the gigantic kind of Kangaroo indicated by the portion of skull described and figured in the volume for 1874*, and others adding to the knowledge of the dental system and osteology of *Sthenurus*, *Procoptodon*, and *Macropus Titan.*

To E. S. HILL, Esq., of Woollahra, Sydney, I am indebted, through his brother-in-law Sir DANIEL COOPER, Bart., for the portions of mandible adding to the dental characters of *Palorchestes*; and to GEORGE FREDERIC BENNETT, Esq., of Darling Downs, Queensland, I chiefly owe, through his father Dr. BENNETT, F.L.S., of Sydney, the parts of the skeleton of the same extinct species about to be described, and the remaining subjects of the present paper.

§ 2. *Palorchestes Azael* (Mandibular Characters and Dentition).—So much of the dental characters of the genus and species as could be defined from the condition of the maxillary teeth, described and figured in the above-cited volume, concurred with the cranial characters in showing that such large extinct Kangaroo deviated less from the type of the existing bilophodont *Macropodidæ* than did the species of the genus *Procoptodon*, some of which (*Proc. Goliah*, for example†) rivalled *Palorchestes* in bulk.

This conclusion is sustained by the evidence afforded by the subjects of Plate 19.

The chief of these is a portion of the right mandibular ramus (fig. 1) with the teeth symbolized as d_4, m_1, m_2, and part of m_3. A smaller portion of the left ramus of the same jaw (ib. fig. 5) contained the molar (m_1) entire, a portion of m_2, and the sockets of the teeth (d_4 and p_3).

The depth of the ramus at the interval between p_3 and d_4 is 3 inches 3 lines; at the socket of the last molar (m_3) it is 2 inches 8 lines. Such gain of depth as the

* Phil. Trans. 1874, p. 797, plates lxxxi.–lxxxiii.

† *Tom. cit.* p. 791, plates lxxix., lxxx.

mandible extends from the back to the front of the molar series is a character of the lower jaw of *Macropus**, which contrasts with the uniformity of depth in that of *Sthenurus*† and *Protemnodon*‡.

The socket of the premolar (ib. fig. 5, p_3) shows the two roots of that tooth to have been simple; the hinder one, in section circular, with a diameter of 3 lines, was larger than the fore root, which was compressed and elliptic in section. The fore-and-aft length of the crown of this tooth is indicated to have been between 8 and 9 lines. This accords with the same admeasurement of the upper premolar (p_3) of the fossil from another and remote locality, figured in plate lxxxii. of the Phil. Trans. *tom. cit.*

The fore root of the next molar in the mandibular fossil from Darling Downs (Plate 19. fig. 5, d_4) is transversely elliptic, 5 lines in long diameter, with a mid groove along its hind surface. The hind root, with a larger and deeper longitudinal groove on its fore surface, is also transversely elliptical, with a long diameter of $6\frac{1}{2}$ lines. The crown of this tooth, preserved in the right ramus (ib. figs. 1 & 2, d_4), shows a low, short prebasal ridge (f), upon which the exposed dentine is continuous with that of the much-worn surface of the fore lobe (a), indicative of a linked connexion therewith. Along the mid link (r), also, a linear tract of dentine extends to the hind lobe (b). The postbasal ridge is feebly indicated at this stage of wear by a narrow fold of enamel, which extends from the dentinal tract at the back of the grinding-surface of the hind lobe, downward and outward to near the base of the crown. The fore-and-aft diameter of d_4 is $10\frac{1}{2}$ lines (23 millims.), the transverse diameter of the hind lobe is $7\frac{1}{2}$ lines (15 millims.).

The chief difference in size of d_4 in the upper jaw§ is in the greater proportional breadth of the crown—a characteristic of the upper molars in *Macropodidæ*: so much as remains of the prebasal ridge and of the two main lobes in the maxillary tooth conforms to the character of the mandibular homotype.

The third molar (m_1) is well preserved in both rami of the present lower jaw. A continuous tract of dentine is exposed, by wear, from the fore lobe along the mid link to the postbasal ridge (g). The prebasal ridge is limited to the inner half of the fore surface of the fore lobe, where, also, it is alone visible in m_1 of the upper jaw. The postbasal ridge (g) is more developed on the inner side of the hind link, where it is divided from the hind lobe by a fossa; on the outer side of the link the ridge rapidly sinks and subsides near the base of the crown; the mid part of the postbasal ridge is half an inch above the basal line of the enamel (fig. 8, g). The main valley expands as it descends from each side of the mid link (r), and is closed by a low bar on both the outer (ib. fig. 6, v) and inner (ib. fig. 7, v') sides of the tooth. The fore-and-aft extent of the mandibular tooth (m_1) is 1 inch, as in its homotype of the upper jaw; the transverse diameter of the hind lobe is 8 lines, in the upper tooth 9 lines.

The less-worn crown of m_2 shows more of the true pattern of the grinding-surface

* See Phil. Trans. 1874, plate xxii. figs. 13, 15.

† Ibid. figs. 5, 6.

‡ *Tom. cit.* plate xxv. figs. 7, 8.

§ *Tom. cit.* plate lxxxii. fig. 1, d_4.

in the lower molars of the present species. The vertical indent (Plate 19. fig. 1, m_2) on the inner fore part of the crown, leading to the better developed inner part of the prebasal ridge, is deeper than in m_1, and causes a concave contour of the anterior enamel-border of the fore lobe.

The mid link projects from the middle of the hind enamel-border of that lobe, touches, but is not continuous with, the hind part of the link sent off from the outer side of the fore part of the hind lobe. The vertical prominence from the corresponding part of the crown of the lower molars in *Nototherium* is the homologue of this part of the mid link in *Palorchestes*.

The inner concave part of the fore surface of the hind lobe shows two fine vertical fissures in m_2. From the low link at the back of the hind lobe the postbasal ridge sinks toward the base, thicker and shorter on the inner than on the outer side. The fore-and-aft extent of m_2 is 1 inch $1\frac{1}{2}$ line (29 millims.); the transverse breadth of the hind lobe is $8\frac{1}{2}$ lines (18 millims.). Here the lower penultimate molar is longer in the first diameter by 1 line than the corresponding tooth above, the breadth being the same.

The breadth of the fore lobe of m_3 (ib. fig. 2) is 9 lines; the length of the crown, if entire, would seem to have been, as in the perfect tooth in figure 4, 1 inch 2 lines, or 1 line longer than the corresponding molar above. The proportions of the upper and lower last two molars in *Macropus Titan* are repeated in *Palorchestes Azael.*

The fracture of the molar (m_3, *in situ*) in figs. 1 & 2 shows the continuous part of the mid link to be 3 lines in vertical extent, the whole height of the link being 5 lines where it rises from the valley (fig. 3, *r*). The exposed hind root of this molar curves outward as it descends, and is bifurcated at the extremity. Beneath it the fracture shows the dental canal (fig. 3). The inner bar in m_3, as in m_2, is feebly marked at the inner entry of the valley (fig. 4).

The enamel near the base of the crown and at parts of the outer surface shows, as in the upper molars, the fine rugæ and punctations like those in the molars of *Nototherium* and *Diprotodon*; and the generic pattern of the molars of *Palorchestes* among the *Macropodidæ* indicates a transitional condition between the Kangaroos and those more gigantic extinct Marsupials.

The outer surface of the mandibular ramus of the species, for which grounds are above assigned to justify its reference to *Palorchestes Azael*, shows a vascular or nervous outlet some way below the interval between m_1 and m_2; but this may be an individual and inconstant character.

The depth of the horizontal ramus being given in fig. 1, I have restored the entire skull in outline (Plate 20), with a finished view of the left side of the original and still unique fossil, not figured in my former Memoir.

§ 3. *Palorchestes* (Sacrum).—From the same formation in Darling Downs, Queensland, I have received portions of the pelvis and of the hind limbs with macropodal characters, and of a size corresponding with that of the above-described portions of mandible.

The sacrum (Plate 21. fig. 1) consists of two vertebræ with the characters of those of *Macropus rufus**, but with a difference of size shown in the following admeasurements:—

	Macropus rufus.		*Palorchestes.*	
	in.	lines.	in.	lines.
Length of sacrum (at zygapophyses)	3	2	4	10
Breadth of sacrum (across fore part)	3	5	5	6
Breadth of centrum of first vertebra	1	7	2	6

The Kangaroo yielding the recent bone compared was the largest example seen by Mr. GOULD in his travels in Australia†, and no specimen of *Macropus major* has yet been recorded of superior size.

The comparatively gigantic leaper yielding the fossil seems to have been an aged individual, for so much anchylosis has taken place between the second sacral (*c* 2) and first caudal (*cd* 1) as to have kept those vertebræ in natural connexion during the period of petrifaction.

The transverse processes of the second sacral take a greater relative share in the formation of the sacro-iliac symphysis in *Palorchestes* than in the above-named recent species, and the shape is rather more subquadrate than triangular. The joint between the first and second sacral is not obliterated. The intervertebral foramina (ib. *i*, *i*) are rather smaller, relatively, than in *Macropus rufus*, and suggest that the hind limb may not have predominated over the fore limb in so great a degree in the larger and heavier Kangaroo. The pair of ridges on the hæmal surface of the centrum of the second sacral (ib. *k*, *k*) are better marked in the fossil. In this the neural arch of the first sacral has been broken away.

The first caudal vertebra of *Palorchestes* (ib. figs. 2, 3) is 2 inches 11 lines in length, 1 inch 6 lines across the hinder articular end of the centrum. The base of the lamelliform depressed transverse process (ib. *d*, *d*) is 1 inch 8 lines in extent, reaching within 2 lines of each articular end of the centrum. The longitudinal extent of the base of the neural spine is 1 inch. The characters of the corresponding vertebra in *Macropus rufus* are closely repeated, with the difference of size and slight increase of breadth over length, as in the sacrum; and these permit an inference that the tail in *Palorchestes* corresponded in strength, if not quite in relative length, to that in *Macropus*.

§ 4. *Palorchestes* (Os innominatum).—The pelvis of the Kangaroo is characterized by a long prismatic ilium, an oblong tuberosity above or anterior to the acetabulum, a "pectineal" or "ileo-pubic" process, the articular surfaces for the marsupial bones, the broad, compressed, subprismatic form of the ischium, the slenderness of the pubis, and the great length of both those elements of the pelvic arch.

The length of the pelvis due to the great extension of the os innominatum both in front and behind the acetabulum is a well-marked feature of resemblance to the same

* "Osteology of Marsupialia.—Part V.," Trans. Zool. Soc. vol. ix. p. 429, pl. lxxvi.

† Phil. Trans. 1874, p. 253.

part of the skeleton in the Bird, and similarly relates to the faculty of station and progression on the hind pair of limbs—the movement being, in the Kangaroo, as in some tribes of birds, by a series of hops, the fore limbs, however, in the mammal taking also an occasional share in progression on land, which is not permitted to the volant class.

The portion of pelvis (Plate 22) corresponding in size with the sacrum (Plate 21), although reduced to the parts immediately surrounding the acetabulum, includes the base of the ilium, showing its three-sided prismatic form, the precotylar tuberosity, and, above all, the "pectineal process" (ib. *e*), in size, shape, and position closely corresponding with that in *Macropus rufus* †.

The anterior or hæmal facet of the ilium (ib. fig. 1, 62) is more deeply excavated than in the recent Kangaroo; the rounded angle (*a*) dividing that facet from the inner or median facet (ib. fig. 2, 62′) is relatively thicker. The precotylar tuberosity (*d*) is more prominent, is relatively nearer the acetabulum; and a ridge is continued from the fore part of the tuberosity to the brim of that cavity, which more definitely or abruptly there defines the hæmal from the neural facets of the ilium than in recent Kangaroos.

The contour of the acetabulum is more ovate, the smaller end, at the fore part of the brim, being narrower in the larger fossil. The notch (*y*) at the hind part of the brim is narrower, and is nearly bridged over by the extension of the ischial (63*) toward the pubic (64*) border of the notch; the depression (*x*) into which the notch expands at the bottom of the cup is relatively narrower in *Palorchestes* than in *Macropus*.

These characters would have indicated specific distinction if the present fossil had not exceeded in size the corresponding part in the largest living Kangaroos; the degree to which *Palorchestes* surpassed them is exemplified in the pelvis as in the skull.

Admeasurements of Pelvis.

	Palorchestes.		*Macropus rufus.*	
	in.	lines.	in.	lines.
Breadth of hæmal surface of ilium above the precotylar tuberosity	3	0	1	0
Breadth of neural surface of ilium above the precotylar tuberosity	3	3	1	3
Breadth of median surface of ilium below symphysial surface	2	0	1	0
Length of acetabulum	2	8	1	7
Breadth of acetabulum	2	6	1	4
Breadth of ischium behind the lower part of acetabulum	2	2	1	3

§ 5. *Palorchestes* (Femur).—The fossil thigh-bone, of which the two extremities are figured in Plate 23. figs. 1 & 2, shows an articular head (*a*) fitting the acetabulum of the pelvic fossil (§ 4). The height of the trochanter major (*f*), the length and backward position of the narrow trochanter minor (*n*), the depth of the cavity (*l*) under-

† Mem. cit. Trans. Zool. Soc. vol. ix. plates lxxix., lxxx., *e*.

mining the hind extension of the great trochanter, and the ridge (*p*) at the back part of the upper half of the shaft, bespeak the macropodal characters of the present fossil in the upper portion of the bone, as the partial division of the outer condyle (fig. 2, *v*) by the channel (*w*), and the deep rough oblong fossa (*y*) above that condyle, do in the lower portion *.

Guided by the proportions of the femur in *Macropus major* and *Macropus rufus*, I estimate the subject of fig. 1, Plate 23, to include the proximal third of that bone in *Palorchestes Azael*; and suspect, as the upper portion of the great trochanter is still epiphysial, or but partially united to the shaft, that this thigh-bone may have come from a not fully mature individual.

As in *Macropus rufus* the extreme breadth of the proximal end of the femur exceeds that of the distal end by 3 lines, I estimate the difference in those admeasurements of the ends of the fossil femur in Plate 23 to be within the limits of individual character in *Palorchestes*, the breadth of the shaft, where broken across, in both upper and lower portions being the same; and the circumference in both is 5 inches. The somewhat larger proportional proximal end, due to the development of the great trochanter, may be taken as one of the differential characters of the present huge femur as compared with that bone in the largest living Kangaroos.

The great trochanter is continued as a strong ridge (ib. fig. 1, *g*) $5\frac{1}{2}$ inches along the outer border of the bone; but the trochanter itself (*f*) is, relatively, less raised above the head (*a*) than in *Macropus major*. The articular surface of the head is less convex than in *Macropus rufus*, and the anterior concavity between it and the trochanter is less marked. The demarcation of the summit of the trochanter by the antero-internal channel is more feebly given in *Palorchestes*. The upper surface of the neck of the femur (*c*) is relatively broader in *Palorchestes* than in *Macropus*.

The lesser trochanterian ridge (*n*) is more posterior in position than in *Macropus rufus*, in which its free margin just comes into view when the femur is seen from the front †; this is not the case in *Palorchestes*, in which the ridge descends to the parallel of the beginning of the posterior ridge, which resembles at its most prominent part (*p*) a third trochanter ‡. The trochanterian fossa (fig. 1, *l*) has the extreme generic or family depth in *Palorchestes*; it forms a long narrow cavity, undermining the hinder basal part of the great trochanter.

From the summit of this trochanter (*f*) to the third trochanter (*p*) being $6\frac{1}{2}$ inches, the total length of the femur of *Palorchestes* may be reckoned, from the analogy of *Macropus rufus*, to have been not less than 18 inches; in that recent species it is $10\frac{1}{2}$ inches. The epiphysial line of the great trochanter is distinct, but confluence of the central part has kept the process in place in the present fossil.

The upper end of the linea aspera is preserved, expanding to form the process *p*.

* See the characters of the femur of *Macropus* described and figured in the Mem. cit. in Trans. Zool. Soc. vol. ix. p. 437, plate lxxxi.

† Mem. cit. *tom. cit.* plate lxxxi. fig. 1, *n*.

‡ See ibid. fig. 2, *p*, in *Osphranter rufus*.

At the distal end of the femur (ib. fig. 2) the chief distinction of *Palorchestes* from *Macropus* is in the relatively narrower postintercondylar fissure (*u*) and its minor expansion, where it is closed anteriorly*. The depression (*y*) is strongly marked in *Palorchestes*. The epiphysial line is traceable in the fossil; a wedge-shaped process at both the outer (*z*) and the inner (*z'*) borders rises as if to clamp more securely the epiphysis to the shaft.

The following admeasurements exemplify the difference of size between *Palorchestes Azael* and *Macropus rufus*, the measured femur of the latter being of a full-grown male:—

	Palorchestes Azael.		*Macropus rufus.*	
	in.	lines.	in.	lines.
Extreme breadth of proximal end of femur . . .	4	9	2	9
Extreme breadth of middle of shaft of femur . .	1	8	1	0
Extreme breadth of distal end of femur	3	9	2	5

§ 6. *Palorchestes* (Tibia).—If the fine fragment of this bone figured in Plate 24 be compared with the corresponding views of the entire tibia of the large male Red Kangaroo figured in vol. ix. of the 'Zoological Transactions,' plate lxxxii., the association of the peculiar characteristics of the macropodal tibia with the grand proportions of that bone in *Palorchestes* will be readily appreciated.

The length of the present fossil remnant from the proximal end of the bone to the subsidence on the shaft of the procnemial plate is $7\frac{1}{2}$ inches. The fore-and-aft diameter of the tibia, at the upper part of the plate, is 3 inches 5 lines; the span of the excavation between the procnemial and ectocnemial plates or ridges is 2 inches 4 lines; the antero-posterior diameter of the head of the tibia is 3 inches 10 lines; the breadth of the back part of the tibia, at 5 inches below the articular head, is 1 inch 6 lines. The head of the tibia is in a state of epiphysis; its undulatory course along the inner side of the bone is shown in fig. 4, but partial confluence, as in the case of the epiphysis of the femur of probably the same individual *Palorchestes*, has tended to retain the epiphysis in place, notwithstanding the movements and shocks of alluvial transport through which, seemingly, the fractures of the fossil are due.

The inner articular facet (ib. fig. 5), the only one preserved on the head, is relatively more extensive and more concave transversely than in *Macropus rufus*. The hind surface of the shaft, continued down from that articular surface, is thicker and more convex across; it contracts in the large recent Kangaroo to an angular ridge, sharply dividing the hinder from the antero-internal surface of the shaft of the bone.

The following are a few comparative dimensions of the tibia:—

* Compare fig. 2 with fig. 2, *u* (*Macropus rufus*) in plate lxxxi. of Mem. cit. Zool. Trans. vol. ix.

	Palorchestes Azael.		*Osphranter rufus.*	
	in.	lines.	in.	lines.
Length from head to subsidence of procnemial ridge .	7	6	5	3
Fore-and-aft diameter at upper part of procnemial ridge	3	5	2	0
Transvere diameter of shaft halfway down procnemial ridge	1	7	1	0
Span of excavation between procnemial ridge and fibular ridge	2	4	1	6
Fore-and-aft diameter of head of tibia	3	10	2	8

§ 7. *Palorchestes* (Calcaneum).—In *Macropus* (*Osphranter*) *rufus* the length of the calcaneum exceeds the transverse breadth of the distal end of the femur by two sevenths; the extreme breadth of the calcaneum is one third greater than that of the middle of the shaft of the femur. By these proportions I am guided in the choice of the two fossil calcanea (figs. 4 & 5, Plate 23), and refer the longer bone to *Palorchestes.*

The length of the subject of fig. 5, Plate 23, exceeds the transverse breadth of the distal end of the femur (ib. fig. 2) by two sevenths. The length of the calcaneum (ib. fig. 4) exceeds the transverse breadth of the distal end of the femur (ib. fig. 3) by one fourth. The breadth of the calcaneal process of fig. 4 is equal to that of the longer calcaneum, fig. 5.

On the grounds subsequently to be adduced for concluding the leg and foot of *Procoptodon* to have been shorter in proportion to its length than in *Macropus*, I therefore assign the shorter and thicker calcaneum to that genus, together with the portion of femur (fig. 3), which shows more generalized characters, or those less strictly macropodal, than the femora assigned to *Palorchestes*, *Macropus*, and *Sthenurus.*

§ 8. *Macropus Titan* (Skull).—Of this species I am now enabled to add to maxillary and mandibulary evidences adduced in former Parts some instructive cranial characters.

The specimen yielding these was found by W. F. Tooth, jun., Esq., at King's Creek, near Clifton, Darling Downs, at a part of the bed which Dr. Bennett, F.L.S., had pointed out to his friend as being likely to yield fossils after a flood*. To these gentlemen the British Museum is indebted for the specimen. On receiving it as much of the adherent matrix was cleared away as could safely be meddled with; and the present state of the fossil is given in side and base views, of the natural size, in Plates 25 and 26.

It is a great part of the skull of a Kangaroo, wanting the lower jaw, but including the cranium proper, the interorbital and the hinder part of the facial division of the skull; also great part of the left zygomatic arch, with the included orbit and temporal fossa, the bony palate, and the molar dentition, of which the two hindmost teeth are sufficiently entire to afford the means of specific determination.

Other projecting parts and processes have suffered fracture, and the region of the

* See "A Trip to Queensland in search of Fossils," by Dr. George Bennett, F.L.S., in 'Annals and Magazine of Natural History,' April 1872.

large frontal sinuses has been obliquely crushed. The specimen is in the usual heavy petrified condition of fossils from the freshwater drift; it shows the effects of transport and attrition during the movements of this matrix before reaching the locality where it was found.

The first attention being directed to the teeth, of which the three last left molars and the four last right molars were in place, the characters of transverse lobes, links, and prebasal ridge were seen to be those of the genus *Macropus*, while the size and the sculpturing of the hind surface of the last molar (Plate 26. fig. 2) determined the species.

In *Macropus major* that surface (ib. fig. 3) is moderately hollowed lengthwise and thickly coated with cement, which partly fills the triangular transverse concavity, the apex of which shallows to the ordinary level of the hind surface before reaching the base of the crown. When the cement is removed the inner enamel boundary (fig. 3, *g*) is sharper and more produced than the outer one (ib. *h*).

In *Macropus Titan* the enamel, after coating the inner border of the hinder lobe, extends backward, downward, and outward, projecting as a sharp-edged ridge (ib. fig. 2, *g*), defining a deeper depression on the hinder surface of the tooth. There is also a shallow vertical groove (*h*) continued from the hind part of the apex of the inner border of the hind lobe downward toward the base of the crown, which groove seems to define the inner limit of the oblique posterior ridge. One sees that this groove repeats the deeper cleft that defines the mid link internally from the inner end or border of the anterior lobe. The oblique hind ridge (*g*) is indeed a serial repetition of the mid (*r*) and fore (*s*) links, but subsides with a more oblique course downward toward the base of the outer border of the hind lobe, having no other division of the molar to connect with such lobe. From the fore part of the base of the inner end of the hind lobe a low ridge defines the anterior surface of that lobe to the inner side between it and the mid link; this defining ridge is not present in the upper molars of *Macropus major*, but there is a small tubercle at the inner entry of the valley between the two main lobes of the upper molars in *Macropus major* which is not present in *Macropus Titan*.

The fossil skull, with the molars agreeing in the above characters and in size with those of more fragmentary examples of *Macropus Titan**, is of a mature and somewhat aged individual. The summits of both lobes of the hindmost grinder are worn so as to expose a linear tract of enamel, widest of course on the anterior lobe. In the penultimate grinder a broad field of dentine is exposed on this lobe, extending backward by a linear tract along the base of the mid link (*r*), but not so far as the transverse tract of dentine exposed on the hind lobe. In the antepenultimate grinder (m_1) both lobes are so worn that the lozenge-shaped fields of exposed dentine touch and communicate at the base of the worn-down link. The foremost grinder (d_4, Plate 26) is retained on the right side, worn down to its base; but this tooth has been shed on the left side, and

* Phil. Trans. 1874, plate xxi. figs. 8, 10, 15, 16; plate xxii. figs. 10, 12.

the grinding series reduced to the three true molars, as in old individuals of *Macropus major*.

The skull of this large existing species of Kangaroo which I have to compare with the present fossil retains the last deciduous molar (d_4) on both sides of the upper jaw, without any trace of the socket of the premolar which had worked in advance of the four retained grinders (d_1, $m_{1,2,3}$). In the maxillary fossil of *Macropus Titan* (figured in plate xxi. fig. 10, Phil. Trans. 1874) the two roots of p_3 are retained, the crown having been accidentally broken away. That of the last molar (m_3) had not come into place, although the front lobe had pushed its way out of the formative cell. The two lobes of m_2 in the same fossil show attrition of the enamel ridge, but not so as to reach the dentine.

In the younger subject of figs. 6, 7, 8 of the same plate and volume, the four teeth in place are d_3, d_4, m_1, and m_2; above the first of these is exposed the crown of p_3 in its formative cell, and part of that of m_3 is shown behind m_2.

The series of changes of the upper molar dentition of the extinct *Macropus Titan* are thus as instructively and almost as completely displayed in petrified specimens as in the existing species (*Macr. major*), of which I have obtained specimens in number and periods of age sufficient to exemplify these phases *. I have previously described a mandibular specimen of *Macropus Titan*, with the molar dentition reduced to m_2 and m_3 †, as in the latest phase hitherto observed in *Macropus major*.

The cranial specimen exemplifying the reduction of molars to three on the left and four on the right side, lacks, unfortunately, the part of the upper jaw which supported the incisor teeth. Nearly two inches of the diastemal tract, however, is preserved in advance of d_4 on the right side. A fossil mandible of another individual of *Macropus Titan*, with a similar stage of dentition as the right side in Plate 26, fortunately gives the extent of the diastema between the molars and incisors‡; and guided by the proportion which this part bears to the upper diastema in *Macropus major*, I have restored in outline in Plates 25 and 26 what is wanting in the present fossil, together with an outline of the mandible and mandibular teeth.

The length of the mandibular diastema in *Macropus major* is 1 inch 9 lines, that of the maxillo-premaxillary one is 2 inches 6 lines. The length of the mandibular diastema in *Macropus Titan* being 2 inches 6 lines, that of the maxillo-premaxillary diastema, according to the pattern of the recent species, should be 3 inches 6 lines. There are indications, however, that the muzzle was relatively rather shorter in the larger extinct Kangaroo, and I have restored it with an interval of 3 inches 3 lines between the foremost molar and hindmost incisor.

Of this characteristic tooth fossil specimens reveal two patterns of the outer surface of the crown in examples indicative of species as large as *Macropus Titan* and *Sthenurus Atlas*.

In one type (Plate 25. fig. 4) the outer surface of the crown is divided into three

* See notes, p. 245, Phil. Trans. 1874. † *Tom. cit.* plate lxxvi. fig. 3. ‡ *Tom. cit.* plate xxvi. fig 11.

unequal convex tracts by two oblique grooves, of which the hinder one extends nearest to the base or root of the tooth; in the other type (ib. fig. 3) a deeper oblique fissure subequally bisects the crown; it marks off a more prominent fore part of the outer surface from a lower and vertically shorter, but rather more longitudinally extended, hind tract. As the first of these patterns is repeated in the third upper incisor of Kangaroos with a small premolar (*Macropus major**), and the second pattern is found in Kangaroos with a large trenchant premolar (*Halmaturus ualabatus*, *H. ruficollis*)†, I refer the fossils of the second pattern to *Sthenurus Atlas* and those of the first pattern to *Macropus Titan*.

The skull in this extinct species has the triangular form of occiput as in *Macropus major*, the apex of which, forming the summit of the superoccipital ridge, is somewhat rounded off. The upper and larger ends of the condyles subside more gradually into the occipital surface, and are not defined by a depression there as in *Macropus major*. The channel or concavity between the condyle and paroccipital is relatively wider in *Macropus Titan*. In this species the foramen magnum seems as if it had been notched at its upper border, where the exoccipitals may not have met, and where the foramen may have been bounded by an intercalated portion of the superoccipital.

As in *Macropus major*, also, a second inner ridge from the base of the paroccipital converges towards its fellow as it rises, parallel with the outer ridge, from the mastoid, but subsides before attaining the summit of the exterior ridge.

The crown of the superoccipital arch projects rather more backward in *Macr. Titan* than in *Macr. major*; it is not on a vertical plane with that of the occipital foramen, nor does it slope, as in many recent Kangaroos, forward from that foramen. The surface below the arch is traversed by a less prominent median vertical ridge in *Macropus Titan* than in *Macr. major*.

The upper border of the occipital foramen is mutilated in the fossil, but seems to have been more arched, less regular, than in *Macr. major*.

The basioccipital (Plate 26. fig. 1, i) is carinate below, as in *Macr. major* ‡; but there is more tumefaction at its suture with the basisphenoid in *Macr. Titan*.

A low crest runs along the line of the sagittal suture in the fossil, which bifurcates anteriorly, the divisions diverging to the postorbital prominences, which, as usual in the genus, are feeble. In *Macropus rufus*, at a similar phase of dentition with the fossil, the sigittal suture persists, and the low ridges bounding above the crotaphyte surfaces have not met at the mid line.

The fore part of the glenoid surface for the mandibular joint, in *Macropus Titan*, is contributed by the malar as in other Kangaroos. The outer surface of the zygoma seems not to have been so deeply impressed or concave as in *Macropus major* and *Macr. rufus*. The facial part of the skull anterior to the orbits is relatively broader in *Macr. Titan* than in either of the above-named existing species. The antorbital foramen is

* *Tom. cit.* plate xx. fig. 17.

† Ibid. figs. 20, 21.

‡ Also as in *Macropus rufus*: see "Osteol. of Marsupialia.—Part V.," Zool. Trans. vol. ix. pl. lxxiv. fig. 3.

relatively further from the orbit in *Macropus Titan* than in *Macr. major*; and in this character *Macr. rufus* more resembles the large fossil Kangaroo. The front pier of the zygoma springs from the side of the skull more posteriorly in *Macropus Titan* than in either of the large existing Kangaroos.

The bony palate (Plate 26) is extended further back, and the production of the alveolar border of the maxillary behind the last molar is more convex transversely than in *Macr. major* or *Macr. rufus*. The bony palate is entire in the fossil as in *Macr. major*, but is relatively wider than in that species; it has not the reticularly disposed small perforations shown by the specimen of *Macropus rufus* described in the 'Zoological Transactions'*. The interspace between the right and left ultimate molars in *Macr. Titan* is twice and two thirds of the fore-and-aft diameter of that tooth; in *Macr. major* that interspace equals two diameters and one fifth of the last molar.

The lower area or outlet of the zygomatic arch (Plate 26. fig. 1, *z*) is relatively larger in *Macr. Titan* than in *Macr. major*; it exceeds the length of the molar series of four teeth (d_4, m_1, m_2, m_3) by the length of m_3 in *Macr. Titan*, while in *Macr. major* the outlet does not equal in length the same series of teeth by one half of the anterior molar (d_4).

The diastemal border is less obtusely rounded in *Macr. Titan* than in *Macr. major*; it resembles more that border in *Macr. rufus*† and in some of the smaller existing Kangaroos (*Phascolagus erubescens*, e. g.). The extent of the diastemal interval in the upper jaw of the fractured fossil has been approximately estimated on the grounds above defined.

Subjoined are admeasurements of the fossil skull above described, and of that of a male at the same phase of dentition of a large existing Kangaroo.

	Macropus major.		*Macropus Titan.*	
	in.	lines.	in.	lines.
Length of skull from superoccipital ridge to fore part of d_4	4	9	6	6
Breadth of skull at widest span of zygomata	4	3	5	9
Breadth of cranium at postorbital constriction	1	0	1	6
Breadth of cranium at the mastoids	2	11	3	8
Breadth of foramen magnum	0	10	0	11
Length of cranium from superoccipital ridge to post-orbital constriction	2	7	3	2
Length of cranium from superoccipital ridge to fore border of orbit	4	3	5	8
Length of orbito-temporal vacuity, lower opening	1	9	2	6
Breadth of orbito-temporal vacuity, lower opening	1	4	1	8
From hind border of palate to fore border of d_4	2	4	3	0
Breadth of palate between the right and left molars (m_2)	1	4	1	10
From alveolus of m_3 to hind border of palate	0	6	1	1

* Vol. ix. plate lxxiv. fig. 3.

† *Tom. cit.* plate lxxiv. fig. 3.

	Macropus major.		*Macropus Titan.*	
	in.	lines.	in.	lines.
From lower border of orbit to alveolar border at m_1	1	0	1	6
Length of series of four molars (d_4 to m_3)	1	10	2	2
Length of m_2 and m_3	1	1	1	3
Breadth of fore lobe of m_3	0	$4\frac{1}{2}$	0	6

§ 9. *Macropus Titan* (Femur).—An almost entire thigh-bone, in the same petrified condition as the skull above described, and from the same freshwater drift in King's Creek, offers the same proportions to that skull and to the mandible and teeth of *Macropus Titan* as the femur of *Macropus major* does to the same parts in that species. It is of the right side, in length 11 inches 6 lines; but would equal, if not exceed, a foot in length were the summit of the great trochanter entire. The bone is figured, of the natural size, in Plate 27, $2\frac{1}{2}$ inches of the middle of the shaft being omitted in figs. 1 and 2 to bring them into the quarto form. The macropodal characters of this fine fossil femur, and the deviations, besides size, from the femur of the largest existing Kangaroos, will be readily appreciated if Plate 27 be compared with plate lxxxi. Zool. Trans.* of the femur of *Macropus* (*Osphranter*) *rufus*.

A trace of the antero-internal groove, defining in that recent species the supertrochanterian tuberosity, is plain in the fossil at *e*, figs. 1 & 2, Plate 27, where that tuberosity has been broken away. Compared with the femur of *Macropus rufus* that of *Macropus Titan* shows a relatively wider and shallower concavity (ib. fig. 1, *d*) between the fore part of the great trochanter and the head (*a*) of the bone. The "cervix femoris" (*b*) is relatively thicker. The transverse diameter below the head is relatively greater, mainly through the greater extent of the bone internal to the "small trochanter" (ib. fig. 2, *n*), whereby that outstanding ridge-like process does not appear in a direct front view (ib. fig. 1). The same relative position of *n* in the femur of *Palorchestes Azael* is also due to the inward extension of the support of the neck and head of the bone.

The femoral shaft in *Macropus Titan* is relatively thicker, especially from before backward, than in *Macropus major* and *Macr. rufus*. The rough depression (ib. fig. 4, *y*) above the outer condyle is relatively larger, deeper, more sharply defined. The inner condyle (ib. figs. 1 & 2, *t*) has its inner (tibial) border better defined and produced so as to give a slight concavity, transversely, to that half of the back part of the condyle. This character is more marked in *Palorchestes* (Plate 23. fig. 2, *t*); but there is no trace of it in the inner femoral condyle of the large existing Kangaroos. The intercondylar notch (*u*, fig. 2, Plate 27) is narrower and deeper in *Macropus Titan* than in *Macropus rufus*, again repeating a femoral character of *Palorchestes*, but not in so marked a degree. The ectocondylar pit (ib. fig. 4, *v*) is equally well marked.

The broad shallow vertical groove at the back part of the outer condyle, which in *Macropodidæ* offers so interesting an approach to the characteristic structure of that

* Vol. ix.

part of the thigh-bone in Birds, is well shown in the femur of *Macropus Titan* (ib. fig. 2, *w*) as in that of *Palorchestes* (Plate 23. fig. 2, *w*).

The epiphyses are confluent with the shaft at both ends of the femur, but the line of separation is traceable in the fossil as in the figured femur of *Macropus rufus* above referred to.

I may here refer to portions of fossil femora which depart from the type of the two already described by deviating further from the characters of the femur in the existing species of *Macropus*. The chief difference is in the smaller and shallower depression (*y*) above the outer condyle, such depression being filled up, as it were, by a rough and thick ascending process of the distal epiphyses, of which a rudiment only exists in the femur of *Macropus Titan* (Plate 27. fig. 4, *z*) and of *Palorchestes Azael* (Plate 23. fig. 2, *z*). The femora with the larger and longer "clamping" process are thicker in proportion to their length than in the above-cited fossils, and still more so than in the recent Kangaroos. This stronger type is manifested by full-sized or mature femora of three dimensions, of which the distal end of the largest is figured in Plate 23. fig. 3. I shall at the conclusion of the present "Part" adduce evidence which leads me to deem these fossils to belong to the genus *Procoptodon*; and I, provisionally, refer the portion of femur figured and the shorter type of calcaneum in the same Plate (fig. 5) to *Procoptodon Goliah*.

§ 10. *Sthenurus Atlas* (Restoration of the teeth and part of the skull).—Confirmation of the ascription of the second type of upper third incisor to an extinct species of Kangaroo with a large premolar tooth has been had by the reception of a specimen of that part of the skull and dental system which, as a rule, is wanting in cranial fossils of these extinct Marsupialia.

This specimen consists of the facial part of the skull, from the anterior halves of the orbits to the ends of the premaxillaries, with their incisor teeth (Plate 25. fig. 2, Plate 26. fig. 4).

The molar dentition is represented by an anterior tooth of trenchant character (d_3), followed by three double-ridged molars on the left (Plate 25. d_4, m_1, m_2) and two on the right side (Plate 26. fig. 4, d_4, m_1). The third on the left (m_2) is emerging from its socket with the ridged summits of the lobes narrow; a portion of a formative cavity of a larger molar is preserved behind that tooth. This evidence of immaturity is supported by the incomplete exclusion of the crown of the third incisor (ib. ib. i_3); and the correspondence of the stage of dentition with the second (B) of the series in *Macropus major*, figured in my 'Anatomy of Vertebrates'*, was demonstrated by the usual test, viz. the exposure of the crown of the replacing tooth (Plate 26. fig. 4, p_3) in its formative alveolus above the deciduous teeth (d_3, d_4) in place and use. The third bilophodont tooth (m_2) on the left side is not so far advanced as its homologue in the jaw showing the third stage (*op. cit.* ib. C) of the dentition of *Macropus major*.

The germ of the premolar and the crowns of the deciduous teeth in place (d_3, d_4,

* 8vo, 1868, vol. iii. p. 380, fig. 296.

fig. 2, Plate 25, and fig. 4, Plate 26) accord with the characters shown in more fragmentary specimens of *Sthenurus Atlas*. Consequently can be added by means of the present fossil the characters of the first and third upper incisors to the previous knowledge of the dentition of that large extinct species.

The fossil evidence of this young individual of *Sthenurus Atlas* presents a condition which significantly points to the nature of its violent death, and to the operation of the powerful jaws and teeth of its carnivorous destroyer.

The upper jaw, anterior to the orbits, has been nipped in by a cross bite; another grip in a vertical or obliquely vertical direction in the orbital region has crushed the right half in the course of the interfrontal and internasal sutures to a lower level than the left half, with a similar degree of forward dislocation. The skull has been subject to this violence in its fresh state, and the matrix has subsequently become petrified about it, and has preserved the dislocations.

If they had been due to movements of the matrix after fossilization, the petrified head would show fracture corresponding to the bone; but no such evidence of posthumous crushing of matrix and fossil being present, I presume that the skull, if it had been imbedded uninjured, would have retained its form when petrified, and conclude that the actual state of the fossil was that in which it was interred before petrifaction began.

The anterior incisor (Plate 25. fig. 2, i_1) is curved, as in most existing Kangaroos; but besides its superiority of size to that in the largest kind, as shown by the breadth of the crown*, the exserted and enamelled portion is both absolutely and relatively longer, and thus makes a nearer approach to the character of the first upper incisor in *Diprotodon*†. The convex or fore surface of the crown of i_1 in *Sthenurus Atlas* is traversed longitudinally by a shallow and rather wide groove behind the mid line of that surface, which groove deepens near the cutting-edge, and thus marks it with a feeble notch. The enamel also shows some fine longitudinal striations. This wrap of the tooth is uninterrupted, but becomes much thinner at the back part. A transverse section of the crown would give a long, narrow oval, rather broader at the outer and hinder end.

The breadth of the tooth, or length of the oval, is 10 millims., or $4\frac{3}{4}$ lines; the thickness or antero-posterior extent is 4 millims., or $2\frac{1}{2}$ lines. The hind margin of the tooth, near the cutting-edge, shows the shallow indent caused by the crown of the second incisor; but this tooth in both premaxillaries has been displaced by the lateral crushing of these bones in the recent state, and was probably lost prior to the imbedding of the skull. The second incisor is the smallest and least deeply implanted in most Kangaroos.

The third incisor (Plate 25. fig. 2, i_3) had not been fully developed; its crown had only partially emerged from the socket, whence its preservation. It is in the form of a

* Compare with Phil. Trans. 1874, plate xx. fig. 17 (*Macropus major*).

† Phil. Trans. 1870, plate xxxv. fig. 1, i_1.

scalene triangle; the shortest side is turned forward, the longest side forms the cutting-edge, which is notched anteriorly by an oblique groove extending from near the middle of the outside of the crown down to the cutting-edge, then inward and forward along that edge to near the antero-inferior angle of the crown. The grooved part of the edge in its present narrow condition thus presents two trenchant borders. The fore side or border of the crown shows an anterior low convex ridge through the subsidence of the enamel between this and the mid groove; the enamel behind this groove is again at a lower level, thus the antero-posterior lay of the outer enamel is undulated. The fore-and-aft extent of the exposed crown is 6 lines, the front border or side of the triangle measures 5 lines.

The indent caused by the missing second incisor is present on both right and left anterior incisors; the interspace between the first and third incisors, from which the second has been pushed, is greater in the left than in the right premaxillary.

A detached fully developed third incisor of a full-grown *Sthenurus Atlas* is figured in Plate 25. fig. 3.

In the lower jaw of this species* the interval between the molars and procumbent incisor is less than in *Macropus Titan*†. The present specimen shows that a similar character marks the upper jaw. The extent of the maxillo-premaxillary diastema is here 10 lines, but would be of course greater in the full-grown Kangaroo.

The anterior molar (Plate 25. fig. 2, Plate 26. fig. 4, d_3), with a crown 6 lines in antero-posterior extent, shows a depressed middle tract of the outer surface traversed by two vertical ridges. The inner surface, which forms posteriorly a prominent convex lobe, sinks rapidly to a basal ridge as it extends forward to a low angle on the inner side of the anterior division of the tooth. The second molar (d_4) has a prebasal ridge without the fore link; the mid link is small and low placed, in chief continuation with the inner angle of the fore lobe. The hind surface of the hind lobe has a triangular excavation.

These characters are repeated in m_1 and m_2; the crown of the latter is protruding from the formative cell, and is unworn. The crown of the premolar, exposed in its formative cavity (Plate 26. fig. 4, p_3), is incomplete with the concomitant wide and deep excavation at the basal part for the unexhausted pulp. The longitudinal grooves and ridges of the trenchant apical border, part of which are visible in the worn premolar of the subject of a former Part‡, are well shown in the germ of the premolar in the fossil now described. The fore-and-aft extent of the crown agrees with that of the fully developed homologue, viz. 9 lines=18 millims.

The bony palate, so far as it is preserved, appears to have been entire.

§ 11. *Sthenurus Brehus* (Restoration of dentition and part of the skull).—This species was founded on a maxillary portion of cranium with the left molar series, in part mutilated, and with the last two molars of the right side (Phil. Trans. 1874, plate xxvii. figs. 5 & 6); also on a fragment of the left maxillary with the premolar and contiguous

* Phil. Trans. 1874, plate xxii. fig. 5. † Ib. ib. fig. 13. ‡ Ib. plate xxiv. fig. 4, p_3.

molar entire (ib. figs. 7, 8, & 9) from a younger individual. Both fossils were from MITCHELL'S Breccia-cave in Wellington Valley, New South Wales, and formed the first evidence of this extinct species which came to my hands.

Since the publication of the paper (*loc. cit.*) illustrative of these fossils I have been favoured, through the persevering and successful quest of GEORGE F. BENNETT, Esq., with portions of the skull and lower jaw of older and younger individuals of the same species from the freshwater drift at Clifton, Queensland. One of these specimens exhibits the entire molar series, left side upper jaw, with that of the right side, less the last molar; another fossil includes the premaxillaries and upper incisors; and a third consists of the fore part of the mandible with the lower incisor and with the first three molars of the right side. All three specimens are parts of the same skull.

A fourth lot consisted of four portions of the upper jaw of a mature but younger individual than the subject of plate xxvii. *loc. cit.*, and included the incisors and premolars of both sides, and the entire molar series of the right side.

A fifth specimen consisted of the fore part of the upper jaw of an aged individual with much of the crowns of the incisors worn away, and the smaller ridges on the inner side of the premolars rubbed smoothly down.

These specimens instructively exemplify the constancy of the maxillary molar characters of the genus and species as shown in the type specimen, and add those of the mandible and the characters of both upper and lower incisors.

Of the upper incisors the first or foremost (Plate 28. figs. 1, 2, & 3, i_1) has a greater relative superiority of size over the second and third than in any existing species of Kangaroo that has come under my observation; in this character *Sthenurus* approaches the Koalas and Potoroos among existing, and the colossal Diprotodonts among extinct Marsupials.

The transverse diameter of the crown of i_1 is 8 lines (17 millims.); it nearly equals that of the two following incisors, of which the third (i_3) is broadest, viz. 5 lines (10 millims.) along the oblique trenchant or working border; the thicker, triturant surface of the second incisor is 4 lines (8 millims.) in longest diameter. The crowns of the six incisors describe a semicircle (ib. fig. 3); those of the anterior pair, separated by a line's breadth in the fossil, evidently touched each other in the living animal at their median angles, which show the effects of mutual pressure.

Each incisor is curved lengthwise, with a strong outward or forward convexity; the exposed enamelled crown of the first measures in a straight line 1 inch 1 line (27 millims.), that of the second incisor $7\frac{1}{2}$ lines (15 millims.), that of the third incisor the same; this, as usual, expands to the working surface; its outer enamel is bisected by a feeble linear longitudinal groove. The transverse interval between the two incisors of the third pair is $1\frac{1}{2}$ inch.

The outer half of the fore surface of the crown of the second incisor (i_2) is prominent, and is pressed into a corresponding channel of the hind surface of the first incisor; the channelled part of the contiguous surface of the second incisor reciprocally receives

the prominent part of the opposed first incisor; the crown of the third incisor (i_3) presses closely against that of the second: thus firmly interlocked the three incisors in each premaxillary worked as one tooth. The enamel of the second and third incisors is continued from the outer or fore part of the crown upon part of the hind or inner surface; but the enamel of the large anterior incisor is limited to the fore part. In both proportion and curvature the large incisor resembles the homologous tooth in *Nototherium* and *Diprotodon*; but it is an incisor of limited growth, and its implanted fang tapers to the end, as in the rest of the family *Macropodidæ*.

From the back of the median border of the front incisor (Plate 28. fig. 3, i_1) to the fore border of the "foramen incisivum" (ib. *a*) is 1 inch 6 lines; from this border a groove is continued forward, shallowing, to near the tooth.

The breadth across the outsides of the last pair of incisors is 1 inch 11 lines; the breadth of the palatal part of the premaxillaries at the fore part of the prepalatal or incisive foramina is 1 inch 10 lines. From the third incisor to the premolar is 2 inches 1 line; in other words, this is the extent of the diastema or toothless space (Plate 28. fig. 1, *d*, i_3) between the incisors and the molars. The breadth of the bony palate anterior to the premolars is 2 inches 1 line.

To the objection that the species *Atlas* and *Brehus* of the genus *Sthenurus* might have been based, in Part VIII., on parts derived from the female and male of the same species, the reply is that, although the males exceed in size the females in most, if not all, Kangaroos, the difference is chiefly shown in the bones of the trunk and limbs, less so in the skull, and little, if at all, in the teeth.

Now the third incisor is, relatively to the first incisor, smaller in *Sthenurus Brehus* than in *Sthen. Atlas*. In the larger species the length of the molar series (Plate 28. fig. 1, p_3–m_3) is 3 inches 6 lines, in *Sthenurus Atlas* it is 2 inches 9 lines. The premolar (p_3) exceeds the rest in fore-and-aft diameter, which, as in the cave specimen (*loc. cit.* plate xxvii. fig. 7, p_3), is $9\frac{1}{2}$ lines (20 millims.); the three low transverse ridges which connect the inner with the outer wall are well marked in the present comparatively young though full-grown individual. These ridges become less salient in the course of the oblique wear of the crown of the premolar from the outer to the inner ridge, and in old individuals they are polished off. But all the generic and specific characters of the premolar of *Sthenurus Brehus* from MITCHELL'S Breccia-cave in New South Wales are repeated in the present specimens from the fluviatile beds of Queensland. The same may be said of all the succeeding molars which in the type specimen are sufficiently complete for comparison. The last molar in the present example (Plate 28. fig. 3, m_3) has not quite come to the grinding level, and its ridges are untouched. The enamel-fold from the inner angle to the hind ridge, which defines by its oblique tract along the hind surface the angular depression there, seems as if it were folded on itself or notched at its basal termination.

The descending process of the zygoma is more perfectly preserved than in any other fossil hitherto transmitted to me of the genus *Sthenurus*; it terminates below the level

of the grinding-surface of m_2; in older examples it would show the same relation to m_3, as the grinders move, or seem to move, forward.

I next proceed to notice the portions of skull of a more aged individual of *Sthenurus Brehus* from Clifton, Queensland. The laterally crushed maxillary part of the skull includes, with the incisors, the entire molar series of the left side and the major part of that of the right side. The premolar with a fore-and-aft length of 10 lines (20 millims.) in the type specimen (*loc. cit.* plate xxvii. fig. 7, p_3) is but half a millimetre less in the present fluviatile fossil; and this seems due to the wear of the anterior prominence. But all the formal characters are closely repeated. I have had no evidence from the spelæan haunt of the Thylacoleons of a giant Kangaroo which had attained the experienced age of the original of the present Queensland fossil. The molar contiguous to p_3 contrasts, as usual, its great degree of wear with the fresher crown and higher level of the antecedent subsectorial tooth; the fore-and-aft diameter, 6 lines (12 millims.), is the same in both fossils; the minor transverse breadth in the Queensland specimen is due to the wearing down of the outer angles of the transverse lobes or ridges, which are prominent in the cave fossil. The superiority of size, slight as it is, in m_1 of the type subject of plate xxvii. figs. 5 & 6 (*loc. cit.*) is chiefly due to the minor wear of the crown of that tooth in the cave fossil. The last two molars occupy a longitudinal extent of 1 inch 6 lines (37 millims.) in both specimens. The linkless prebasal ridge is transverse, not curving at either end to be continuous with the corresponding angles of the fore lobe; the low, short mid link is less distinctly continued to the inner angle of the fore lobe than in *Sthenurus Atlas*; the depression on the hind surface, due chiefly to the ridge curving from the inner and hinder angle of the hind lobe toward the outer side of the base of the crown, with the lower and shorter ridge from the outer angle, are all characters of *Sthenurus Brehus*, repeated in the present as in the preceding Queensland sedimentary fossil.

The left molar series in this instructive specimen occupies a longitudinal extent of 3 inches 3 lines.

The dentine is exposed on the fore lobe of the last molar, and the fore part of the enamel ridge of the hind lobe is nearly worn through; the prebasal ridge also shows abrasion. A hollow transverse field of dentine is exposed on both lobes of the penultimate molar. With these indications of greater age the maxillary pier has retrograded and projects on the transverse parallel chiefly of the last, instead of the penultimate, molar as in the younger specimens (plate xxii. *loc. cit.*). In all the bony palate is entire.

The fore part of the present skull shows a diastema 2 inches in extent. From the back of the socket of the third incisor to the fore part of the crown of the first is 1 inch 3 lines. Of the third incisor, the seat of variety in existing Kangaroos, the left is lost, and of the right one only the fang remains. The crown of the second right incisor is worn nearly to its base. The first or front incisor is present in both premaxillaries, with its fang exposed in the left one. The crown is worn to the level of the palate;

the smooth and polished surface (Plate 28. fig. 5) presents an oval figure, the great end outward; the long diameter is $7\frac{1}{2}$ lines (15 millims.), the short diameter, near the outer side of the worn surface, is $5\frac{1}{2}$ lines (11 millims.). The enamel, nearly 2 millims. in thickness, is limited to the anterior surface, bending slightly back at the outer and inner margins; not more than 9 lines in length of the enamelled crown remains. The whole incisor, as usual, is curved lengthwise, with the greater convexity anterior; the root contracts to its implanted end; the length of the incisor, in a straight line, as here worn, is 1 inch 8 lines. The portion of cranium preserved, from the fore part of the front incisor to the back of the last molar, measures 6 inches 8 lines. About 2 inches of the facial part of the premaxillaries are preserved, bounding by a curved and obtuse border, thinning as it rises, the anterior nostril (Plate 28. fig. 1, 22). According to the proportions of some existing Wallabies, which retain the premolar with the last molar in use, 5 inches may be added for the extent of skull behind the last molar, and the total length of the skull in *Sthenurus Brehus* may be moderately estimated at 12 inches.

The skull, so far as it is shown in the present specimen, has been crushed sideways, not partially as in the cave fossil, but by a pressure operating along a more extensive plane, and which I deem to be due to movement of the matrix, rather than to the jaws of a destroyer or devourer.

The lower jaw, which appears to have been imbedded originally in connexion with the upper one, has suffered similar lateral compression. Only the fore part of the mandible has been obtained or transmitted: it includes the pair of lower incisors with the premolar and two following molars of the right side; these are much worn. The length of the diastema is 2 inches: in *Sthenurus Atlas*† it is 1 inch 3 lines. In the course of the pressure to which this mandible of *Sthenurus Brehus* has been subject, the attachment of the broad symphysis has been overcome, and the right ramus has been moved a little in advance of the left.

The thin alveolar sheath does not extend to, or has been lost from, the end of the cement-clad root next the enamelled crown. This expands as it extends forward, and terminates in a polished worn surface, 10 lines in long diameter (obliquely transverse), 5 lines in fore-and-aft diameter. The length of the enamelled (under or outer) part of the crown is 8 lines, that of the entire tooth is $2\frac{1}{2}$ inches. The fang, as usual, tapers as it recedes in its socket (Plate 28. fig. 1, *i**). The narrow symphysial border sinks from the premolar alveolus with a sharp curve before extending forward to expand upon the terminal part of the socket of the incisor. The outlet of the dental canal (*v*) is nearer the molars, and the diastema, with the symphysial part of the ramus, is longer, relatively, than in *Sthenurus Atlas*.

A third example of the premaxillary part of the skull with the fore part of the right maxillary, of a still older individual of *Sthenurus Brehus* from Queensland deposits, shows the six incisors *in situ*, much worn, and the form and transverse extent of the palate between those teeth and the molars. The length of the diastema is 2 inches

† Phil. Trans. 1874, plate xxii. fig. 5.

1 line, the breadth of the palate at the prepalatal foramina is 1 inch 9 lines. These foramina are elongate, from 2 to 3 lines broad, about 6 lines long, and continued forward by a groove (ib. *b*), which shallows out when parallel with the third incisors. These are much worn; the working-surface of the third is 7 millims. by 6 millims. The enamel, which is continued from the outer upon the hinder surface, is impressed, as in the less-worn tooth of the younger *Brehus*, by a longitudinal groove almost equally bisecting the outer surface. The second or mid incisor is worn almost to the stump. The first pair of incisors, being more worn than in the subject of figure 4, show a working surface of similar shape but rather smaller dimensions; the anterior coat of enamel is reduced to a length of 4 lines (10 millims.).

In the collection of Marsupial fossils from Queensland in the Museum of the Natural-History Society at Worcester, I noted, in 1858, the left lower incisor of a Kangaroo, of which I made drawings of the under or outer side (Plate 28. fig. 4). This tooth best agrees with the corresponding incisor of *Sthenurus Brehus*. It had preserved an extent of enamelled crown of 8 lines, the breadth being that of the more worn incisor of Plate 28. fig. 5. In the large existing Kangaroo (*Macropus major**) the breadth of the crown of the lower incisor is $4\frac{1}{2}$ lines, in *Macropus* (*Osphranter*) *rufus* it is barely 4 lines.

The portion of skull of a *Sthenurus Atlas* (Plate 25. fig. 2, Plate 26. fig. 4) permits comparison to be made of the first and third incisors with those teeth in *Sthenurus Brehus*. The first incisor is but half the size of that in the larger species, while the third incisor presents a crown of equal size. The generic character of equal division of the crown by the longitudinal groove is retained, but the anterior border of the groove is produced at the lower part of the crown. Such character, however, may have existed in the part of the crown worn away in the subject of Plate 28. fig. 1, *i* 3. But the difference of proportion in the upper incisors is, at least, specific. In *Macropus Titan* (Plate 25. fig. 4) the modification of the pattern of the third incisor is associated with generic distinction in other parts of the dental system and in the skull itself.

§ 12. *Macropus affinis* (Metatarsus).—The hind foot in *Macropodidæ* exhibits an extreme modification of its bony structure. The inner toe (I) is suppressed; the metatarsals of II & III are long and filamentary, supporting a pair of small pendent fur-cleansing claw-toes; that of IV is both long and large, with characteristic modifications of its proximal end; that of V is much less, the shaft compressed, but supporting, like that of IV, a toe with a *quasi* hoof for station and progression.

In Plate 29. fig. 4 is given a view of the fourth and fifth metatarsals, natural size, of the right hind foot of the large male *Macropus* (*Osphranter*) *rufus*, already referred to. Two other views of the same bone will be found in the paper "On the Osteology of the Marsupialia" in the Zoological Transactions†.

In the task of determining the fossil specimens of the homologous bones, those best agreeing in proportions with the corresponding metatarsals of existing Kangaroos were set apart from the fossils deviating in a marked degree from such proportions.

* Phil. Trans. 1874, plate xx. fig. 15.

† Vol. ix. plate lxxxiii.

In the first group was the upper two thirds of a left fourth metatarsal (Plate 30. figs. 7, 8, & 9) with a proximal articular surface of the same breadth as in *Macropus rufus* and *Macropus major*, but with a markedly thicker shaft, being broader from side to side in proportion to the depth from before backward. The smooth tendinal groove answering to that marked *n* in figure 4, Plate 29, on the fore part of the shaft in *Macropus rufus*, was bounded in the fossil (which I have noted, for convenience, as from a *Macropus affinis*) by stronger ridge-like risings, and the groove does not reach so far down the fibular half of the anterior surface of the bone. On the tibial side of the tibial ridge of this groove the fore part of the shaft shows a slight concavity in *Macropus affinis*, whereas in both cited species of the large existing Kangaroos the answering part of the metatarsal is transversely convex. At the back part of the proximal third of the shaft the rough surface or ridge for muscular attachment is more prominent, better defined, yet less extended longitudinally, in the fossil. This specimen is from King's Creek, Darling Downs, Queensland.

§ 13. *Phascolagus altus* (Metatarsus).—A right fourth metatarsal (Plate 30. figs. 1–5) from the same formation and locality has come from a larger kind of Kangaroo than *Macropus affinis*. It is an inch longer than the subject of figure 4, Plate 29 (*Macropus rufus*), is relatively thicker, and, like the previous fossil, differs in presenting a stronger ridge bounding the fibular side of the anterior surface of the shaft. This part of the bone is also more prominent, giving a convexity to the outline of a side view (ib. fig. 3) not present in the fourth metatarsal of *Macropus major* or *Macr. rufus**. The present fossil likewise shows a relatively broader distal end (ib. fig. 6), which is barely 1 line less in transverse diameter than is the proximal end (ib. fig. 5). On this surface, as in *Macr. rufus* and *Macr. affinis*, the hinder prominence shows the oblique tendinal groove (ib. fig. 4, *g*) and the flat inferior facet (*h*) for the articulation of the large tarsal sesamoid†. The fibular or outer side of the proximal end, in both fossils, shows, as in the recent Kangaroos, the antero-posteriorly prolonged, bilobed, articular surface (ib. fig. 2, *m*, *n*) for the side of the head of the fifth metatarsal. Below this surface is the depressed rough tract (ib. *k*), continued down nearly three fourths of the back third of the fibular side of the shaft, for the ligamentous attachment of the smaller compressed shaft of the fifth metatarsal. The posterior ridge in the present metatarsal, which I refer to a *Phascolagus altus*, answering to that marked *o'* in Plate 29. fig. 6 (*Macropus affinis*), is continued lower down, nearly to the end of the shaft. The hinder half of the distal articular surface (Plate 30. fig. 6) is fashioned by a mid rising into a double trochlea, as in existing Kangaroos.

§ 14. *Palorchestes* (Metatarsus).—The breadth of the middle of the shaft of the fourth metatarsal of *Macropus rufus* is two thirds that of the same part of the femur. The breadth of both fourth and fifth metatarsals, naturally united one third down, is nearly equal to three fourths of the breadth of that part of the femur.

The breadth of the middle of the shaft of the fourth metatarsal, the subject of

* See figs. 1 & 2 of plate lxxxiii. Zool. Trans. *tom. cit.*

† See Cut, fig. 2, p. 441, Zool. Trans. *tom. cit.*

Plate 29. fig. 1, is two thirds that of the same part of the femur, as shown at the broken ends in figs. 1 & 2 of Plate 23. The breadth of the naturally united fourth and fifth metatarsals (Plate 29. figs. 1 & 2), one third from their proximal ends, equals four fifths of the same part of the femur of *Palorchestes Azael.*

To this species, therefore, I provisionally refer the fossil subjects of figs. 1, 2, and 3 of Plate 29. The length of the fourth metatarsal in those figures is restored in outline from an entire homologous bone of the same extinct species which had become detached from the contiguous metatarsals, and which I have not thought necessary to figure.

In the fossil under description, to the great fourth metatarsal lacking the distal end there remained attached the fifth metatarsal (ib. figs. 1 & 2, v), wanting only a portion of the plantar or posterior wall of the proximal end; and, similarly attached, the proximal half of the third metatarsal (ib. ib. III), exhibiting the characteristic macropodal slenderness. It is interesting to note, however, that the fifth metatarsal in the huge extinct Kangaroo shows more nearly the normal proportions of the bone than in the existing species, even the largest, as, e. g., *Macropus rufus* (Plate 29. fig. 4, v); and the more slender third metatarsal bone of *Palorchestes* (III, fig. 2, Plate 29) is relatively less atrophied than in existing Kangaroos. Its proximal end (ib. fig. 3, III) presents an oblong, subquadrate, almost flat surface for the ectocuneiform, and a triangular surface on the inner side (ib. fig. 2, *b*) of the proximal end for part of the head of the second metatarsal, which bone is wanting in the fossil. It articulates with the tibial side of the proximal end of the fourth metatarsal by a surface which is extended by the backwardly directed process (ib. fig. 2, *c*). Below the articular head (ib. *a–c*) the shaft narrows and becomes compressed in its upper third, below which it assumes a subtrihedral figure, with a trenchant margin both before and behind along its upper fourth.

The shaft does not exceed 2 lines in breadth at the point of fracture (*d*). The bone closely adheres, either by anchylosis or matrix, to the shaft of the great fourth metatarsal, inclining from the inner (tibial) side to the plantar aspect of the shaft, as does the corresponding metatarsal in *Macropus rufus**. The proximal articular surface of the fourth metatarsal (Plate 29. fig. 3, IV) presents an undulating tract adapted to the distal surface of the cuboid; its broadest rotular (anterior) half is gently convex transversely at the fibular half, concave at the tibial half; the narrower plantar or posterior subquadrate tract is feebly concave rotulo-plantad, almost level transversely; this tract extends plantad, or backward, so as to overhang the shaft; it is grooved at *e*, fig. 3, by the "peroneus" tendon, which runs across the back or under (plantar) aspect of the tarsus to be inserted into the entocuneiform bone; also, as in existing Kangaroos and in *Macropus affinis*, it has a flat articular surface at the underside of the overhanging part for the large tarsal sesamoid. The inner or tibial side of the proximal end of the fourth metatarsal shows the two small vertical facets for the ectocuneiform, and a well-marked rough depression for the proximal ends of the third and second slender metatarsals.

* Zool. Trans. *tom. cit.* plate lxxxiii. fig. 1, III.

The shaft of the great metatarsal of *Palorchestes* is subtrihedral; the rotular surface (ib. fig. 1, IV) is slightly concave transversely along its middle third as in *Macropus Titan*, not prominent as in *Macropus rufus* (ib. fib. 4). The plantar side (ib. fig. 2) is produced into a ridge, broad along the upper third (*o*), becoming sharper (*h*, *h*) as it descends, and subsiding about one half of the length of the bone (*o'*) from the distal end. The corresponding portion of the metatarsal of *Macropus rufus* (ib. fig. 6) is widely channelled where in the fossil it is angularly convex. The greatest rotulo-plantar thickness of the shaft in *Palorchestes* is 1 inch 4 lines, the greatest transverse thickness is 1 inch; that of the proximal end is 1 inch 6 lines, its rotulo-plantar thickness is 1 inch 5 lines.

The fifth metatarsal of *Palorchestes Azael* (Plate 29. figs. 1, 2, 3, v) is relatively much stronger than in *Macropus major* or *Macr. rufus* (ib. fig. 4, v). The plantar part of the proximal end, broken away in the fossil figured, is entire in a later acquired homologous bone of *Palorchestes*. This presents a small, oval, flat, vertical surface for the fourth metatarsal, a broader subtriangular one for the backwardly extended process of the cuboid*, and a larger horizontal facet for the surface, marked *l*†, of the same tarsal bone. The proximal articular surface of the fifth metatarsal is very small in proportion to the bone in *Palorchestes*. External (fibulad) to that surface the bone rises above the proximal end of the fourth metatarsal in the form of an antero-posteriorly extended thick round edge.

The shaft of the fifth metatarsal is subcompressed along the proximal three fourths; it measures 13 lines in rotulo-plantar thickness, one third down; and here, near the plantar side, its thickness (or tibio-fibular breadth) is 6 lines. The opposite (rotular) border is not sharp, as in *Macropus major* and *Macr. rufus*; but though thin, in comparison with the plantar surface, the border is rounded off. The shaft loses rotulo-plantar thickness and gains transverse breadth as it approaches the trochlear articular surface (v); this is 1 inch transversely, 10 lines where thickest from before backward. The surface is not simply convex, as in *Macropus rufus* (Plate 29. figs. 4 & 5, v), but is made trochlear by a plantar median ridge, on each side of which the surface, transversely, is feebly concave. The outer (fibular) side of the shaft has a feeble median longitudinal channel along the middle of the proximal two thirds. The upper half of the shaft shows in fractured portions of homologous fossils a small medullary cavity.

Thus we learn that in the large extinct Kangaroo of the genus *Palorchestes* the fourth and fifth digits were less unequal in strength, and the fifth took more share in station and locomotion than in the largest existing kinds. The metacarpal segment and the rest of the foot were proportionally broader; but the length of the fourth metatarsal in *Palorchestes* indicates, nevertheless, that it was a powerful leaper.

§ 15. *Procoptodon* (Metatarsal and Femoral Characters).—In deprecation of the foregoing details, more wearisome perhaps to the reader than the inditer, I may plead the

* "Osteology of Marsupialia," Zool. Trans. *tom. cit.* plate lxxxiii. fig. 11, *k*.

† Ibid. fig. 10.

great proportion of fragmentary evidences of the hind feet of large extinct Kangaroos as compared with entire or nearly entire bones. The grateful aid which such rare specimens have yielded has impressed me with the desirability, if not duty, of defining and recording all characters which may help future collectors, especially in Australia, in determining such fossil fragments which are likely to accumulate in the public and private museums of that great colony.

I refrain from trespassing on the time and means of the Society with the results of comparisons by which metatarsals of *Macropus Titan*, of the two dentally determined species of *Sthenurus*, and of some species of *Protemnodon* have been worked out. But, in regard to the extinct form of Kangaroo which has most interest in relation to its aberrant or transitional character, I cannot withhold evidences which give some clue to the characters of the hind limbs, and I finally pass to the result of the present researches which has yielded me perhaps most satisfaction.

I have alluded to the primary step in the survey of the vast series of metatarsal fossils which led to setting apart those indicative of a hind foot shorter in proportion to its breadth, and yet retaining unmistakable macropodal characters.

In the specimen, for example, of the naturally united fourth and fifth metacarpals figured in Plate 31. figs. 1–5, the fourth is thicker than, but is little more than two thirds the length of, the homologous bone in *Macropus rufus* (Plate 29. fig. 4). The fifth metatarsal (Plate 31. figs. 1, 2, 3, v) shows a greater degree of thickness, in proportion to its length, than in *Palorchestes Azael* (Plate 29. figs. 1 & 2, v).

The proximal end of the fourth metatarsal (Plate 31. fig. 4, iv), though somewhat mutilated, exhibits the characteristic modifications of the articular surface in the normal Kangaroos; and these characters are shown more plainly in the homologous bone of a larger kind of *Procoptodon* (ib. fig. 8, iv), viz. the non-articular peninsula (*f*), the backward or plantar production (*e*), with the terminal groove (*g'*) for the tendon before mentioned; but this groove is less deep than in the type Kangaroos: the flat surface beneath (fig. 6, *h*) indicates a larger proportional sesamoid than in the species of *Macropus*.

The fore surface of the shaft of the fourth metatarsal (ib. fig. 2) is more even or flattened than in *Macropus affinis*, *Macr. Titan*, and the great recent kinds of Kangaroo. The distal end is more expanded, surpassing the proximal end in breadth. The ridge on the back part of the shaft (ib. fig. 1, *o*) is broader, less produced, and less extended downward than in *Macropus*, *Sthenurus*, or *Palorchestes*.

The well-preserved proximal end of the fifth metatarsal shows its apophysial production (ib. figs. 1 & 2, *z*) proximad of the articular surface of the fourth metatarsal. This process is absolutely as well as relatively longer than in *Palorchestes Azael*. As in that species three articular facets are present at this end of the bone, two for the cuboid and one for the contiguous (fourth) metatarsal, the cuboidal surfaces being relatively larger than in *Palorchestes*, and the tubercle projecting tibiad beyond the metatarsal surface is more developed in *Procoptodon*.

At the distal articular surface the chief difference is seen in the greater production of the tibial convexity of the trochlea. By reason of this prominence its preservation is rare in the rolled fossils of the present form of metatarsal from the creek-beds of Queensland.

Of the metatarsals of this shorter type three modifications are shown by the fossils that have reached me, which are indicative of three species of *Procoptodon*. The metatarsal (Plate 31. figs. 10–12), of equal length with that (ib. figs. 1, 2) of *Procoptodon Pusio*, but more slender, I take to be from a female Kangaroo of that species.

Deeming it probable that the form (family or genus) of Macropodal Marsupials which, by dental and mandibular characters, offered the nearest approach to the large isopodal or gradatorial family (*Diprotodontidæ*) would present a corresponding approach thereto in the form and proportions of the hind foot, I refer the present type of metatarsal bones to the genus *Procoptodon*.

In this genus the above-described representative of the smallest known species would answer, as to size, to the evidences which have been given of the maxillary, mandibular, and dental characters of *Procoptodon Pusio**.

The specimens next in size (Plate 31. figs. 6–9) I refer, on similar grounds, to *Procoptodon Rapha*†.

Parts of a hind foot of a still larger species similarly relate to *Procoptodon Goliah*‡. Save in size, the characters of the metatarsal about to be described so essentially resemble those of the homologous bone in Plate 31, that I have not thought it reasonable to devote to it an additional Plate.

This metatarsal, the fourth, is 5 inches 3 lines in length, with a proximal breadth of 1 inch $5\frac{1}{2}$ lines, the opposite dimension being 1 inch 3 lines. The fore part of the cuboidal surface is relatively broader from before backward than in *Procoptodon Pusio*. There is no indication of the proximo-tibial ridge (*x*, fig. 10, Plate 30), in which character the present bone resembles its homologue in *Procoptodon Rapha*.

The posterior angle at the proximal half of the shaft is less marked and less produced than in *Procoptodon Pusio*. The posterior depressions above the distal trochlea are deeper and better defined than in *Procoptodon Rapha* or *Procop. Pusio*.

The fifth metatarsal of *Procoptodon Goliah* is 5 inches in length; the greatest diameter of the shaft is 1 inch, equalling that of the homologous bone in *Palorchestes Azael*, which is more than one fourth longer. The tibial covexity of the distal trochlea is less produced than in *Procoptodon Rapha*, and the whole hind surface of the joint is less obliquely disposed than in that species or in *Procoptodon Pusio*.

Thus the resolution of these shorter and stouter metatarsals into three categories, characterized by modifications of shape as well as by size, concurs with the previously adduced evidences of jaws and teeth in showing that the procoptodont modification of *Macropodidæ* was of old manifested by Australian Kangaroos under three specific forms.

* Phil. Trans. 1874, p. 788, plate lxxvii. figs. 2–7.

† Ib. p. 788, plate lxxvii. figs. 8–12, plate lxxviii.

‡ Ib. p. 791, plates lxxix., lxxx.

But these, which my present materials have enabled me to define, may prove not to have been the only links connecting the saltigrade with the gravigrade groups of phytiphagous Marsupials.

Description of the Plates.

PLATE 19.

Fig. 1. Portion of right mandibular ramus and teeth of *Palorchestes Azael*, Ow.
Fig. 2. Working-surface of the same teeth.
Fig. 3. Hind fractured surface of the same fossil.
Fig. 4. Inner side view of last lower molar of *Palorchestes Azael.*
Fig. 5. Upper view of part of left mandibular ramus with teeth and stumps of the same species.
Fig. 6. Outside view of the molar (*m* 1) of left mandibular ramus of the same.
Fig. 7. Inside view of the same molar.
Fig. 8. Back view of the same molar.

PLATE 20.

Left side view of the fore part of the skull and teeth of *Palorchestes Azael*: the entire skull and dentition restored in outline.

PLATE 21.

Fig. 1. Hæmal (under or front) view of the sacrum and first caudal vertebra of *Palorchestes Azael.*
Fig. 2. Right side view of first caudal vertebra of the same.
Fig. 3. Neural (upper or back) view of the same.

PLATE 22.

Fig. 1. Outer side view of part of right "os innominatum" of *Palorchestes Azael.*
Fig. 2. Inner side view of the same.
Fig. 3. Transverse section of ischium at 63, fig. 1.
Fig. 4. Transverse section of pubis at 64, fig. 2.
Fig. 5. Acetabulum of *Procoptodon Goliah* (?).

PLATE 23.

Fig. 1. Back view of proximal portion of right femur of *Palorchestes Azael.*
Fig. 2. Back view of distal portion of the left femur of the same.
Fig. 3. Back view of distal portion of right femur of *Procoptodon Goliah.*
Fig. 4. Upper view of right calcaneum of the same.
Fig. 5. Upper view of left calcaneum of *Palorchestes Azael.*

PLATE 24.

Fig. 1. Fibular (outer) side view of proximal portion of left tibia of *Palorchestes Azael.*
Fig. 2. Rotular (front) view of the same.
Fig. 3. Popliteal (back) view of the same.
Fig. 4. Tibial (inner) side view of proximal end with epiphysis of the same.
Fig. 5. Tibial (inner) proximal articular surface of the same.

PLATE 25.

Fig. 1. Left side view of cranium, with skull restored in outline, of *Macropus Titan.*
Fig. 2. Left side view of fore part of cranium of a young *Sthenurus Atlas.*
Fig. 3. Outside view of left upper third incisor of *Sthenurus Atlas.*
Fig. 4. Outside view of crown of left upper third incisor of *Macropus Titan.*

PLATE 26.

Fig. 1. Under or base view of cranium, with skull restored in outline, of *Macropus Titan.*
Fig. 2. Hind surface of last molar (m_3) of the same.
Fig. 3. Hind surface of last molar of *Macropus major.*
Fig. 4. Under view of fore part of right upper jaw and teeth of a young *Sthenurus Atlas.*

PLATE 27.

Fig. 1. Front view of right femur (omitting 2 inches of shaft) of *Macropus Titan.*
Fig. 2. Back view of right femur (omitting 2 inches of shaft) of the same.
Fig. 3. Inner view of proximal end of right femur of the same.
Fig. 4. Outer view of distal end of right femur of the same.

PLATE 28.

Fig. 1. Outside view of parts of right upper and lower jaws and teeth, with part of the skull restored in outline, of *Sthenurus Brehus.*
Fig. 2. Upper view of premaxillaries and incisors of the same.
Fig. 3. Under view of the same fossil.
Fig. 4. Under view of right mandibular incisor of *Sthenurus Brehus.*
Fig. 5. Upper surface of worn end of right mandibular incisor of an aged *Sthenurus Brehus.*

PLATE 29.

Fig. 1. Front view of metatarsals IV and V and part of III of *Palorchestes Azael.*
Fig. 2. Back view of the same.
Fig. 3. Proximal (upper) articular end of the same.
Fig. 4. Front view of metatarsals IV and V, with part of cuboid, of *Macropus rufus.*
Fig. 5. Back view of distal portion of the same.
Fig. 6. Back view of upper two thirds of fourth metatarsal of *Macropus affinis*, Ow.

PLATE 30.

Phascolagus altus.

Fig. 1. Front view of the right fourth metatarsal.
Fig. 2. Outer side view of the same.
Fig. 3. Inner side view of the same.
Fig. 4. Back view of the same.
Fig. 5. Proximal articular surface of the same.
Fig. 6. Distal articular surface of the same.

Macropus affinis.

Fig. 7. Outer side view of portion of the right fourth metatarsal.
Fig. 8. Back view of part of the same.
Fig. 9. Proximal articular surface of the same.

Undetermined Species.

Fig. 10. Front view of proximal phalanx of fourth toe of an extinct Kangaroo, of the size of *Phascolagus altus.*

PLATE 31.

Fig. 1. Back view of metatarsals IV and V of *Procoptodon Pusio*, Ow.
Fig. 2. Front view of the same.
Fig. 3. Outer side view of the same.
Fig. 4. Proximal (upper) articular end of the same.
Fig. 5. Distal (lower) articular end of metatarsal IV of the same fossil.
Fig. 6. Back view of metatarsals IV and V of *Procoptodon Rapha*, Ow.
Fig. 7. Outer side view of metatarsal V of the same.
Fig. 8. Proximal (upper) articular ends of metatarsals IV and V of the same.
Fig. 9. Distal (lower) articular end of metatarsal IV of the same.
Fig. 10. Front view of metatarsal IV of *Procoptodon Pusio*, fœm.
Fig. 11. Proximal articular end of the same.
Fig. 12. Back view of distal half of the same.

All the figures are of the natural size.

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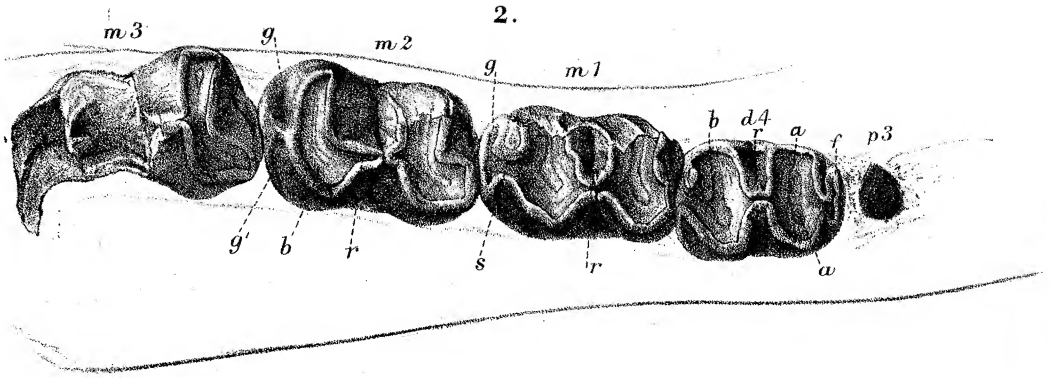

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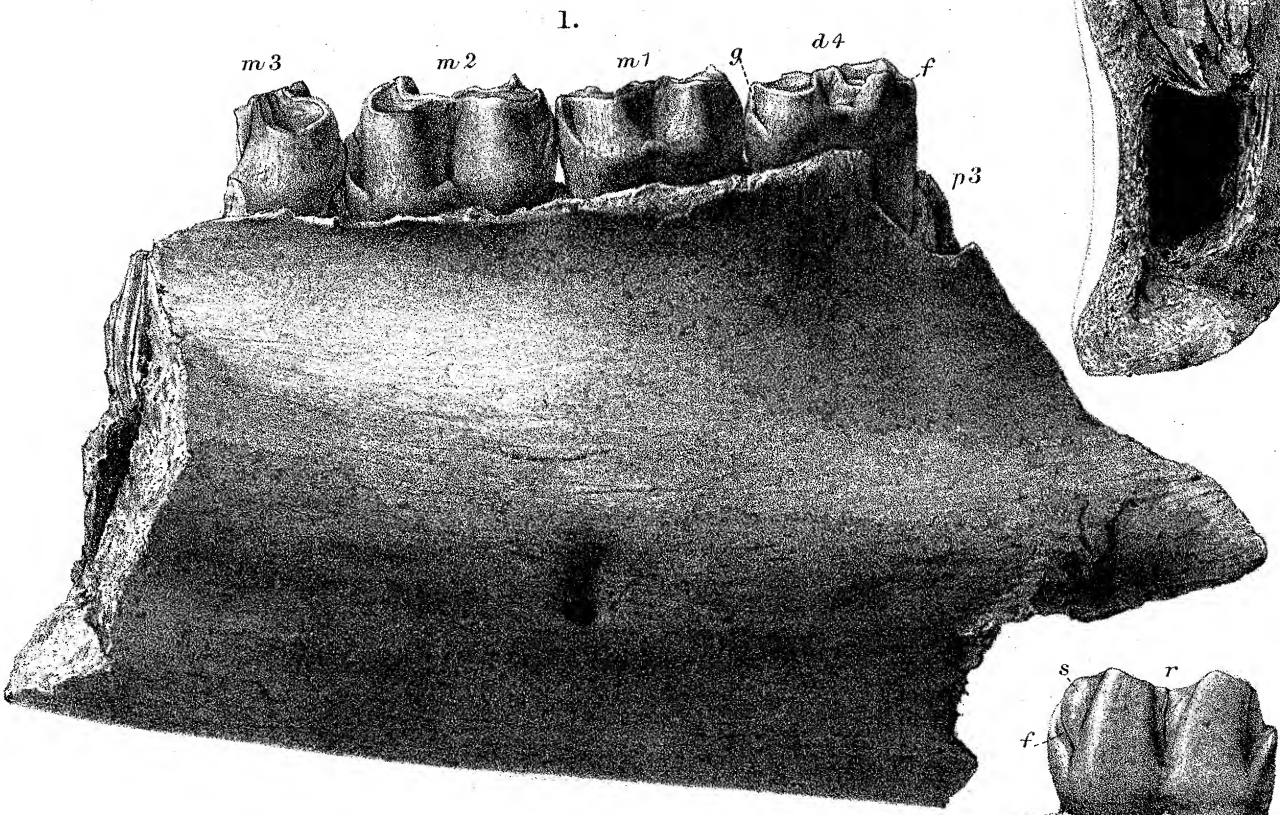

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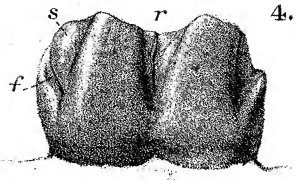

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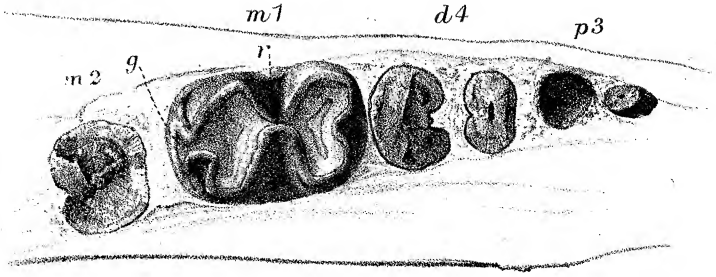

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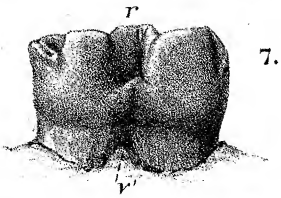

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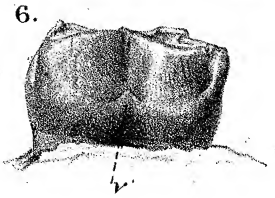

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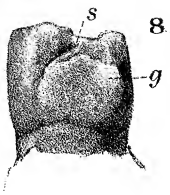

G.H.Ford & C.L.Griesbach.

Mintern Bros. imp.


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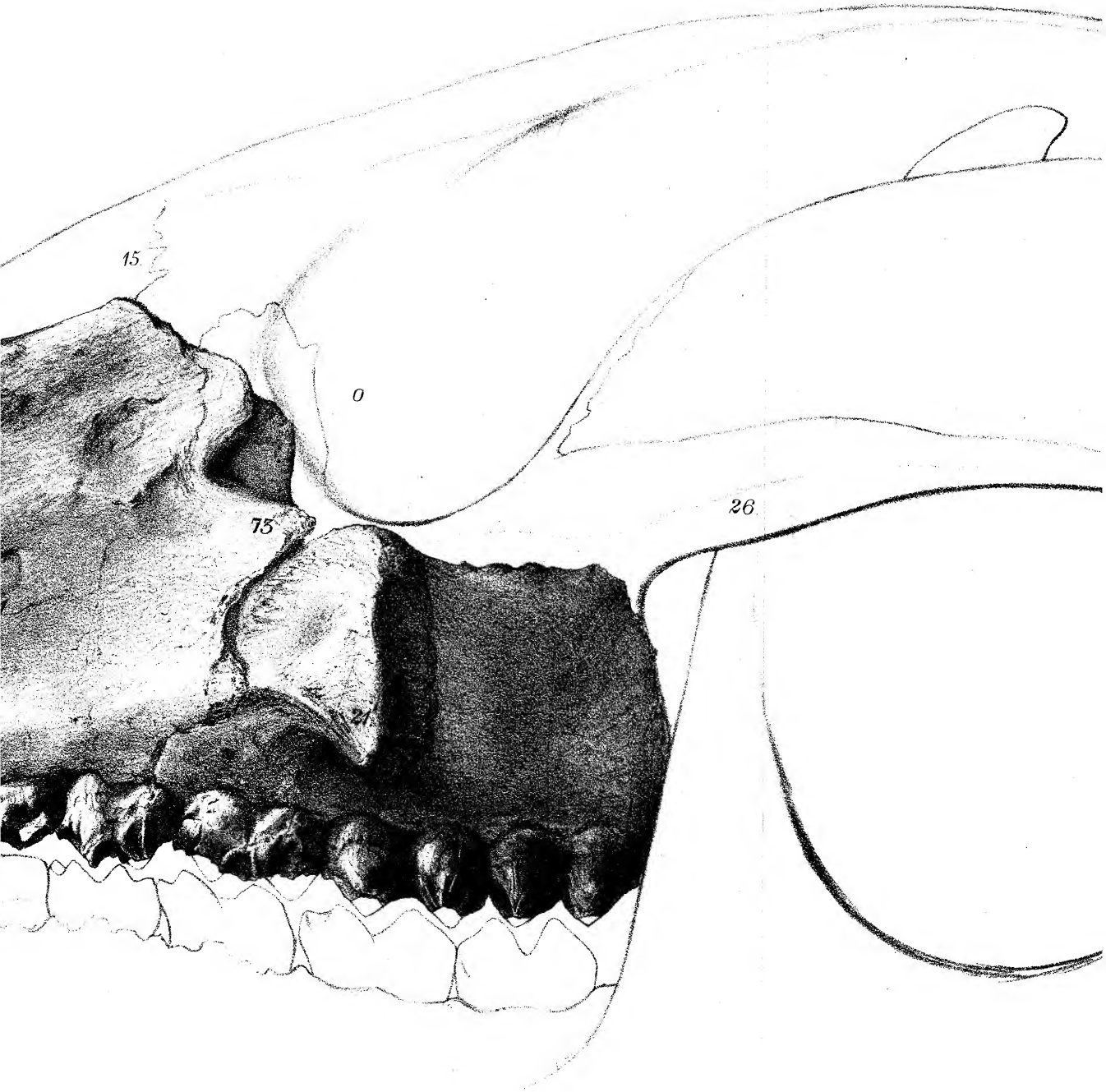
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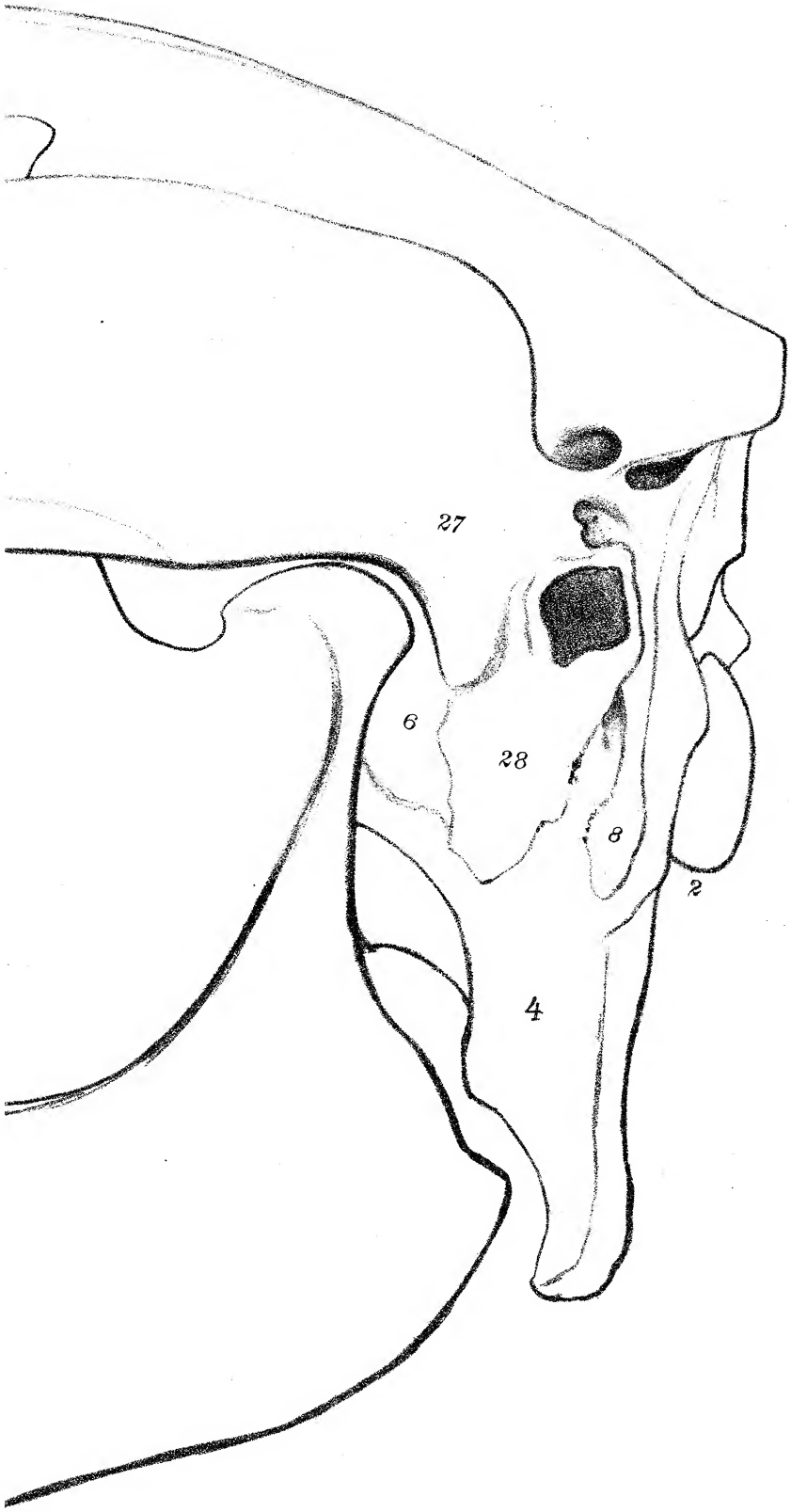
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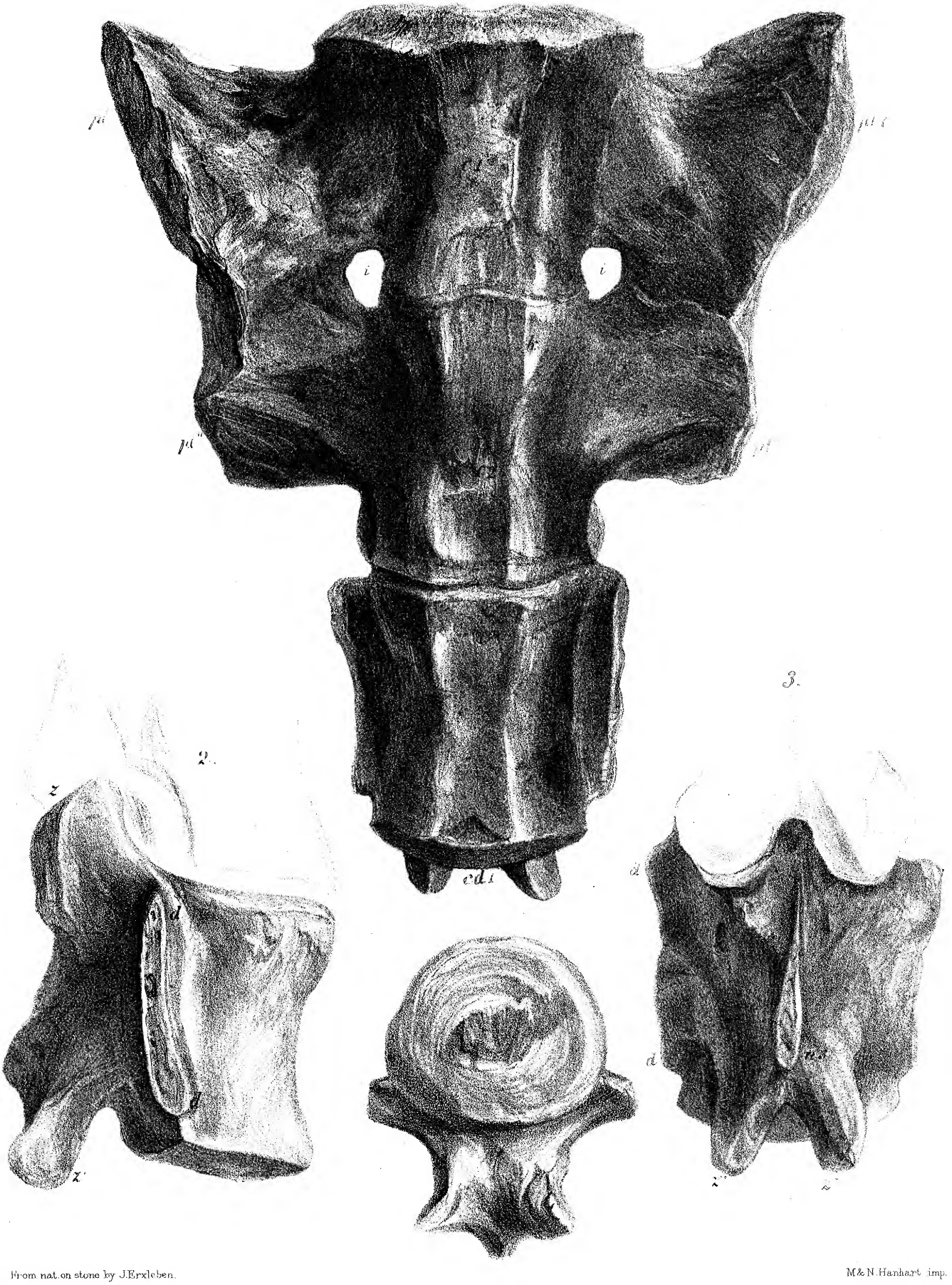
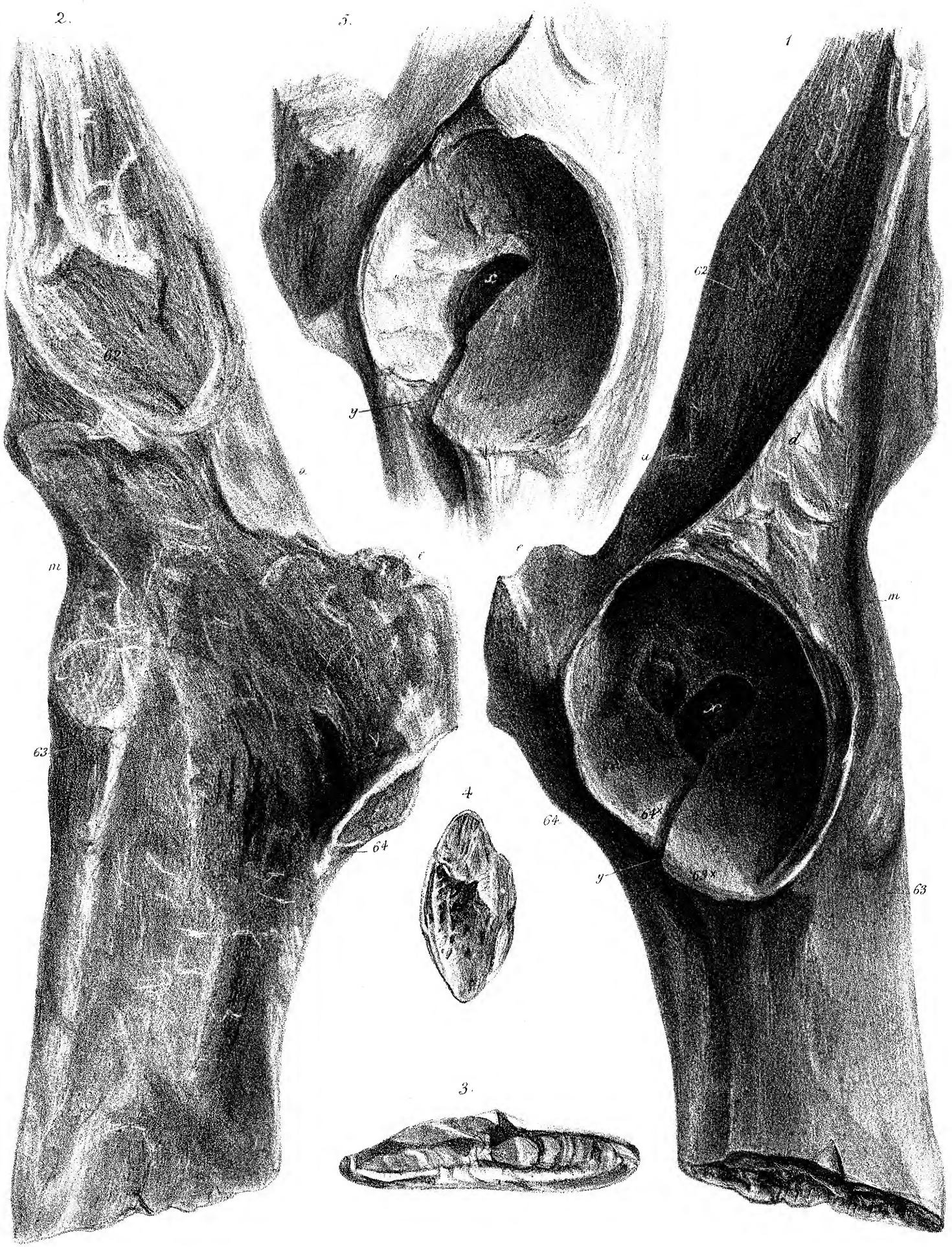
C.L. Griesbach del et lith.

Mintern Bros imp.



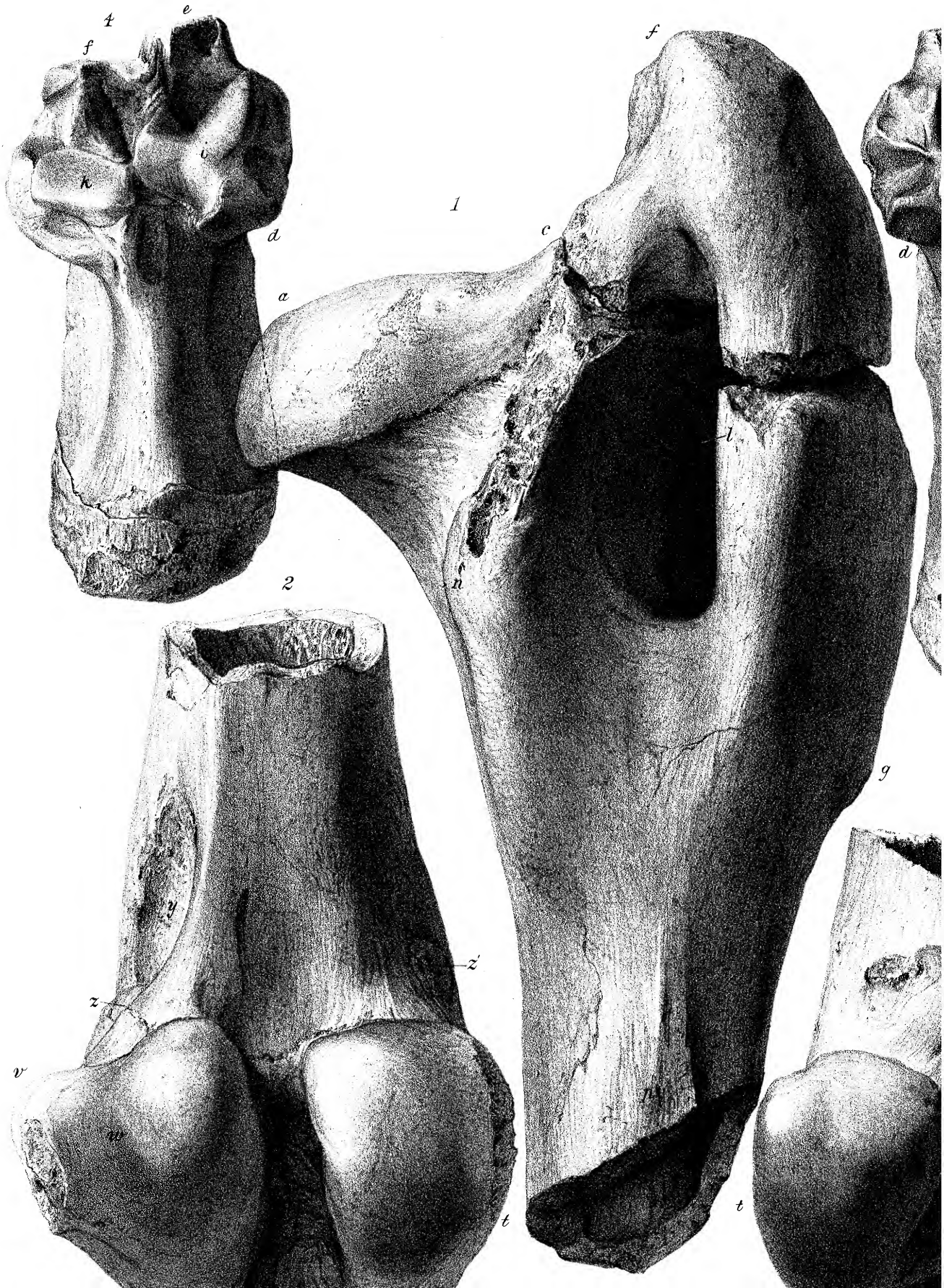
From nat. on stone by J. Erxleben.

M & N. Hanhart imp.



From nat. on stone by J. Erxleben.

M. & N. Hanhart, imp.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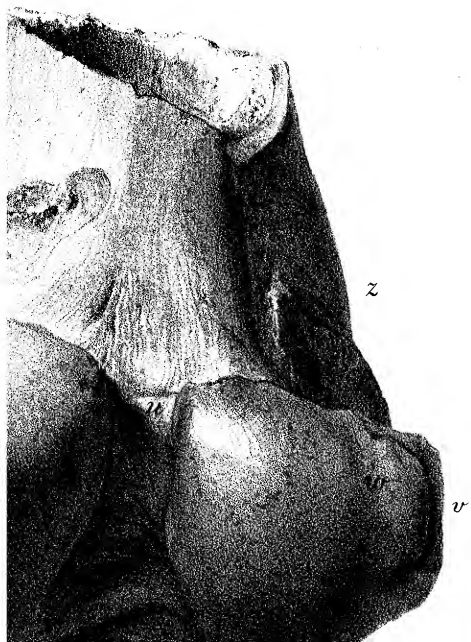
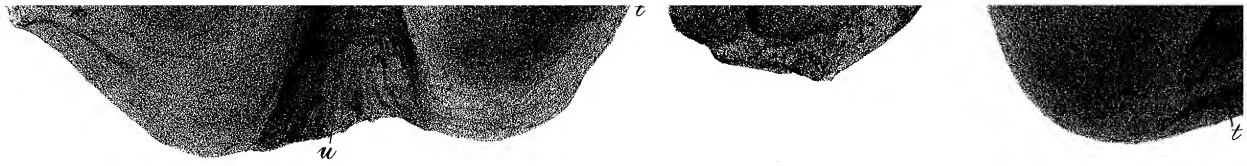
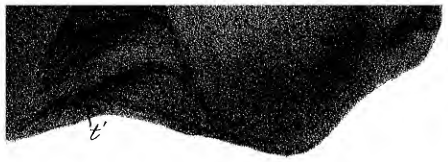
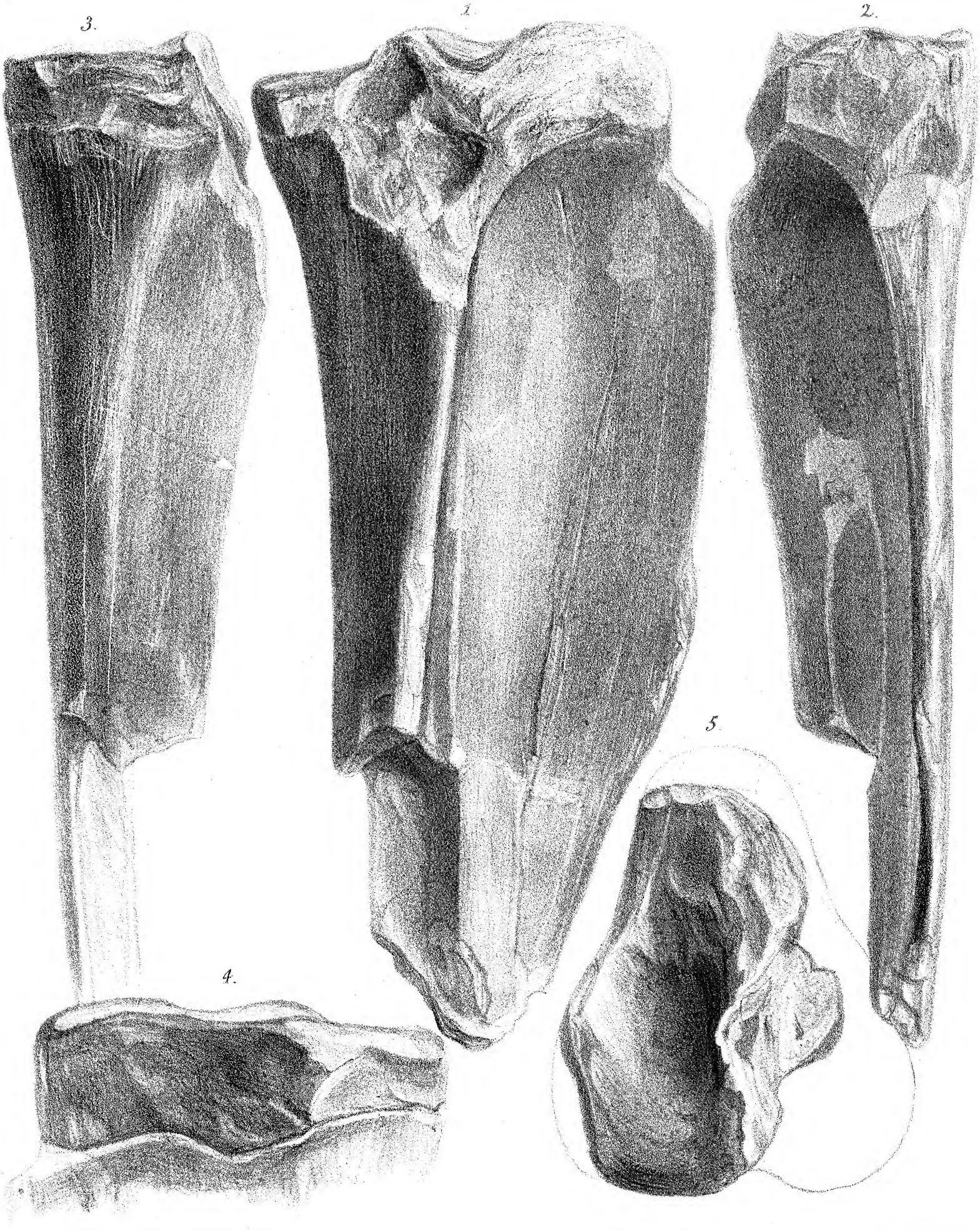




G.L.Griesbach lith.



M&N.Hanhart imp.

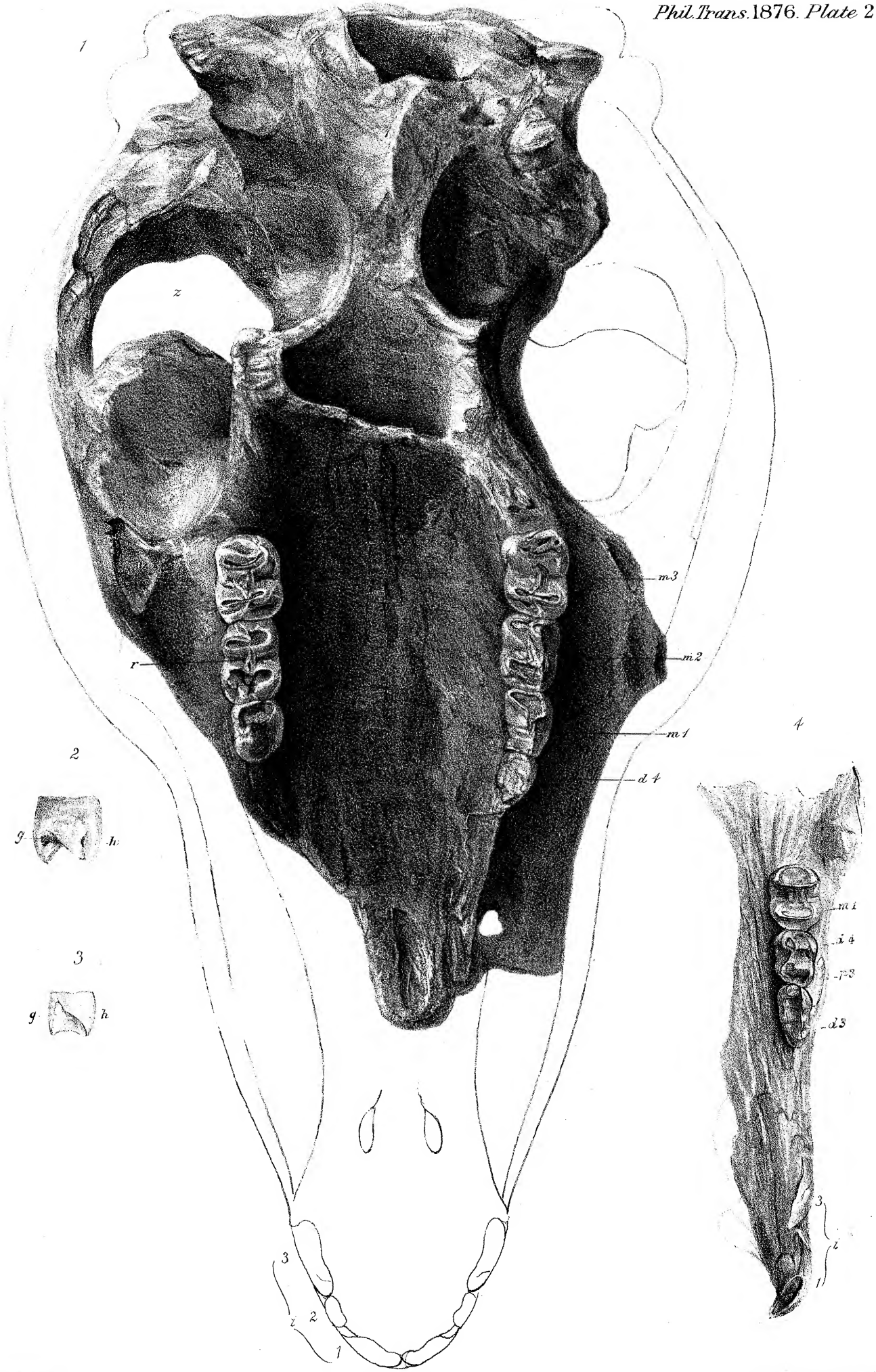


From nat. on stone by J. Erxleben.

M & N. Hanhart imp.

MACROPUS TITAN.

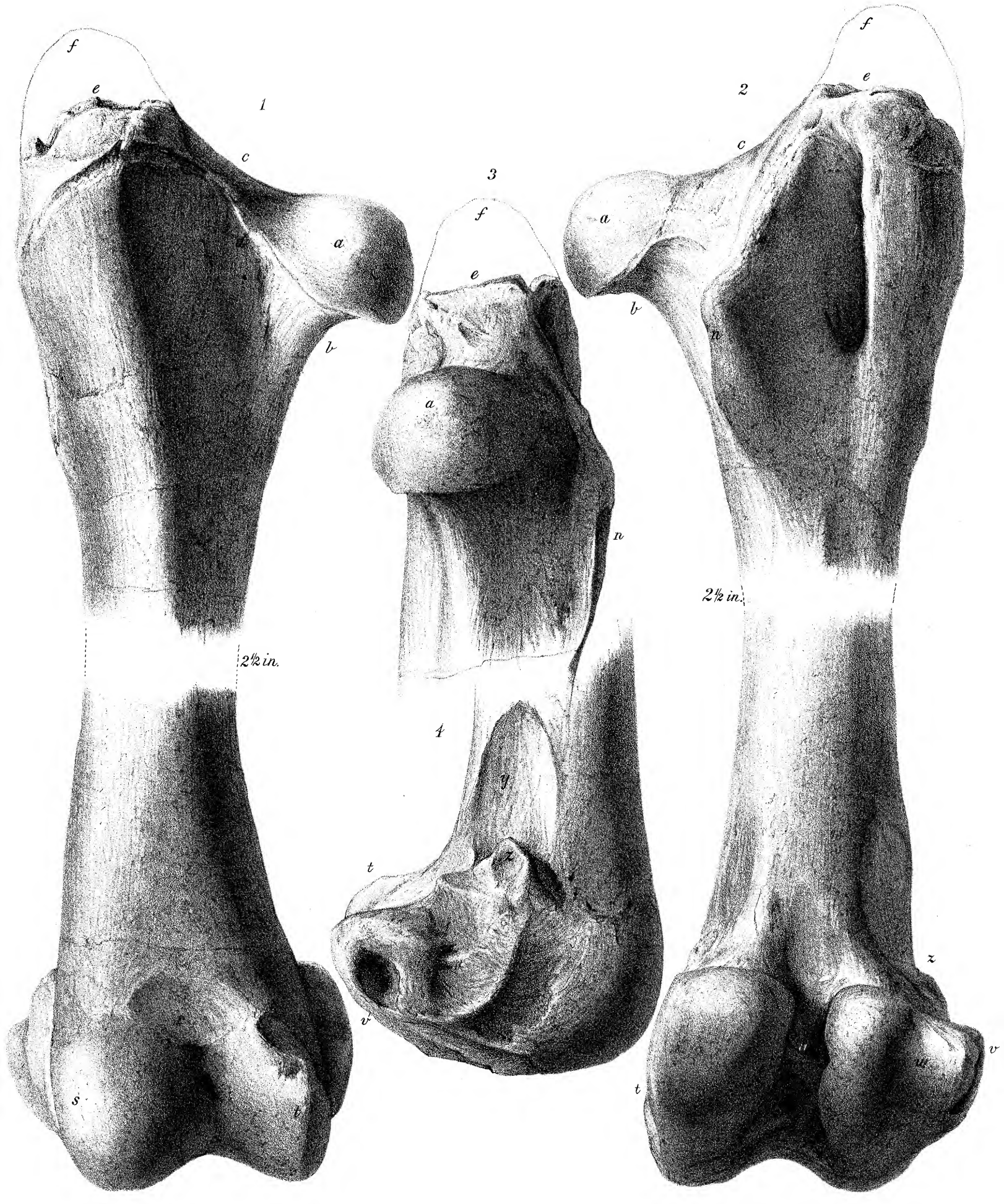
R. Owen, del. on stone by J. Erxleben.



MACROPUS TITAN.

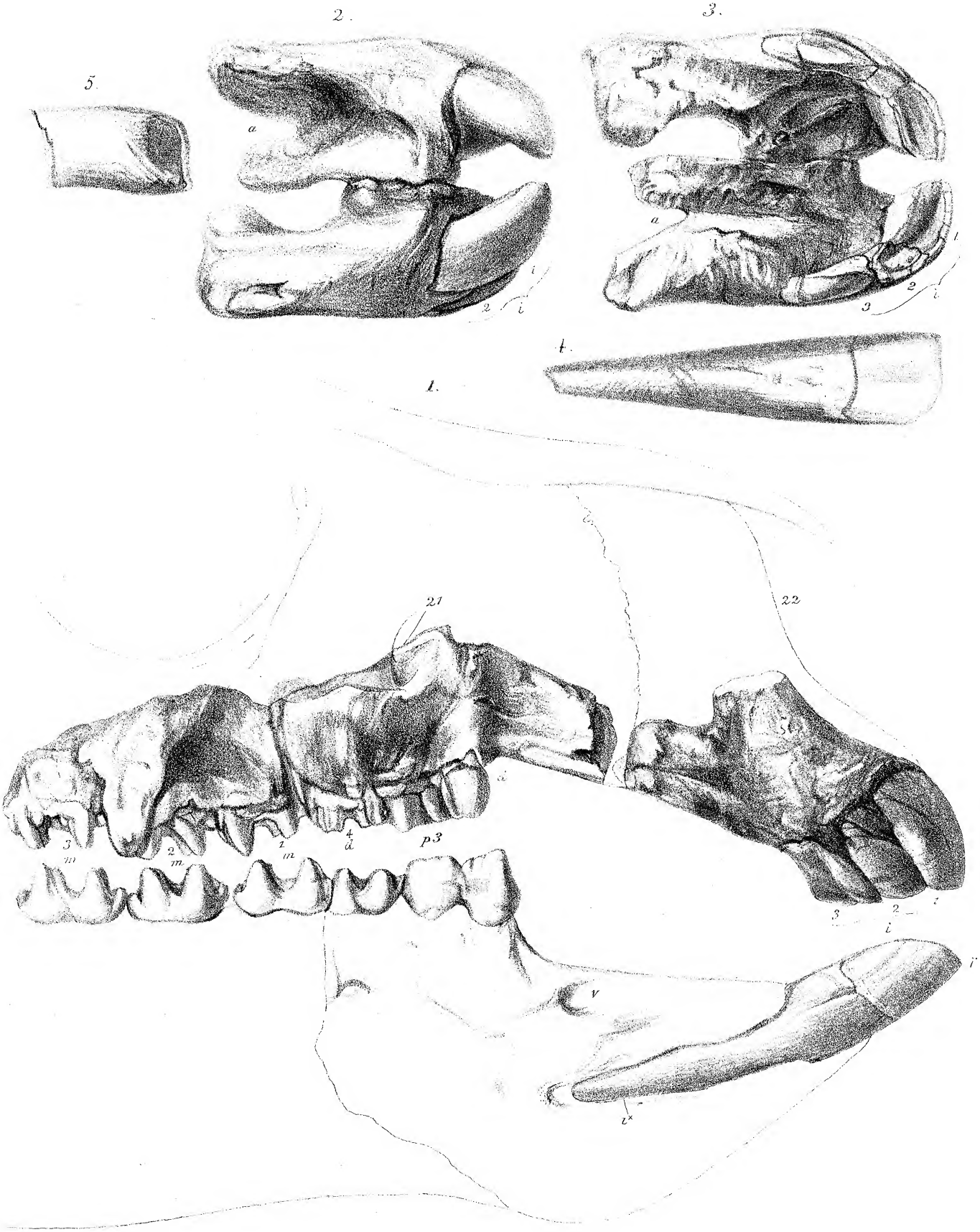
R. Owen, del. on stone by J. Erxleben.

Printed by M & N. Hanhart.



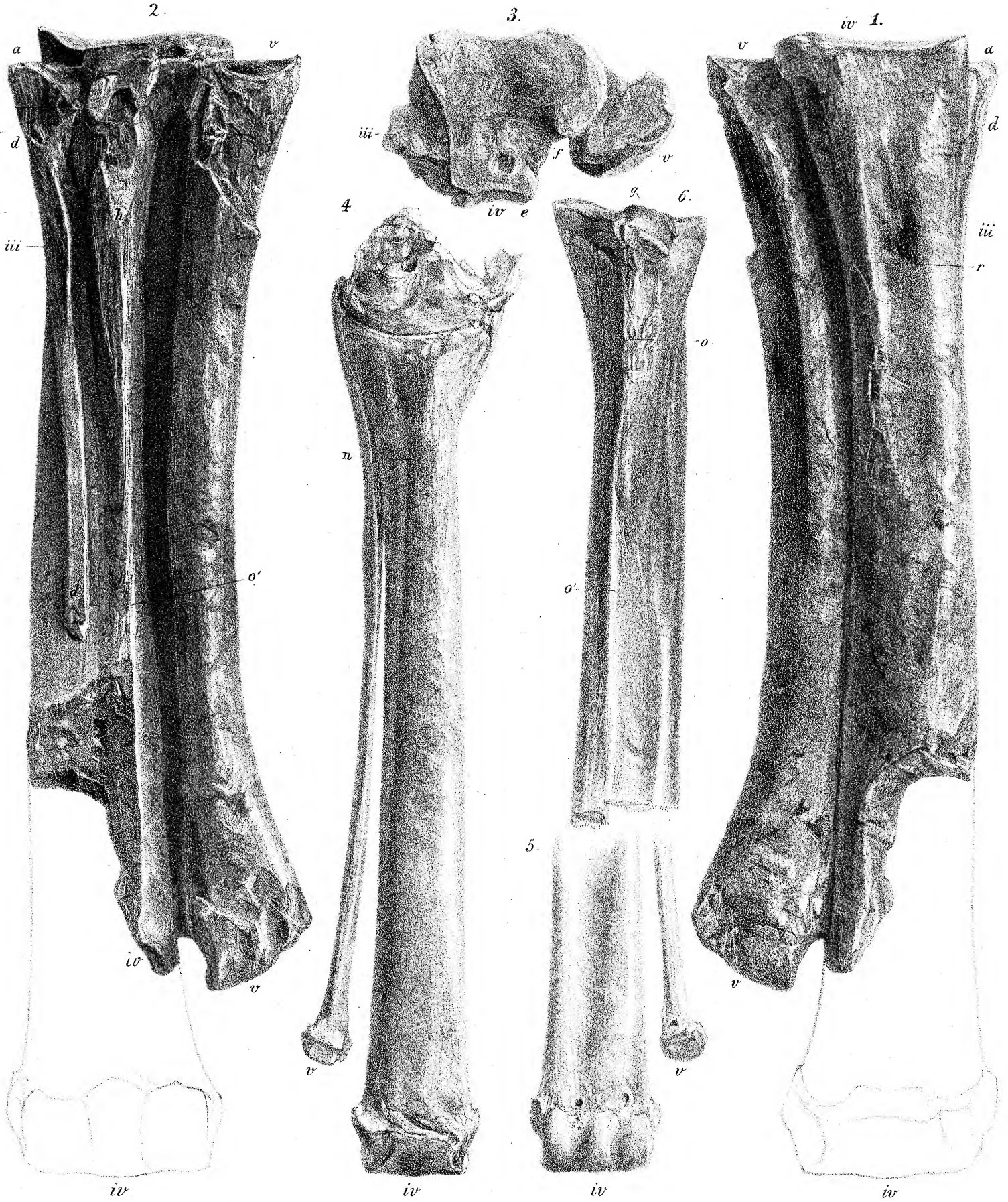
G.L.Griesbach lith.

M&N.Hanhart imp.



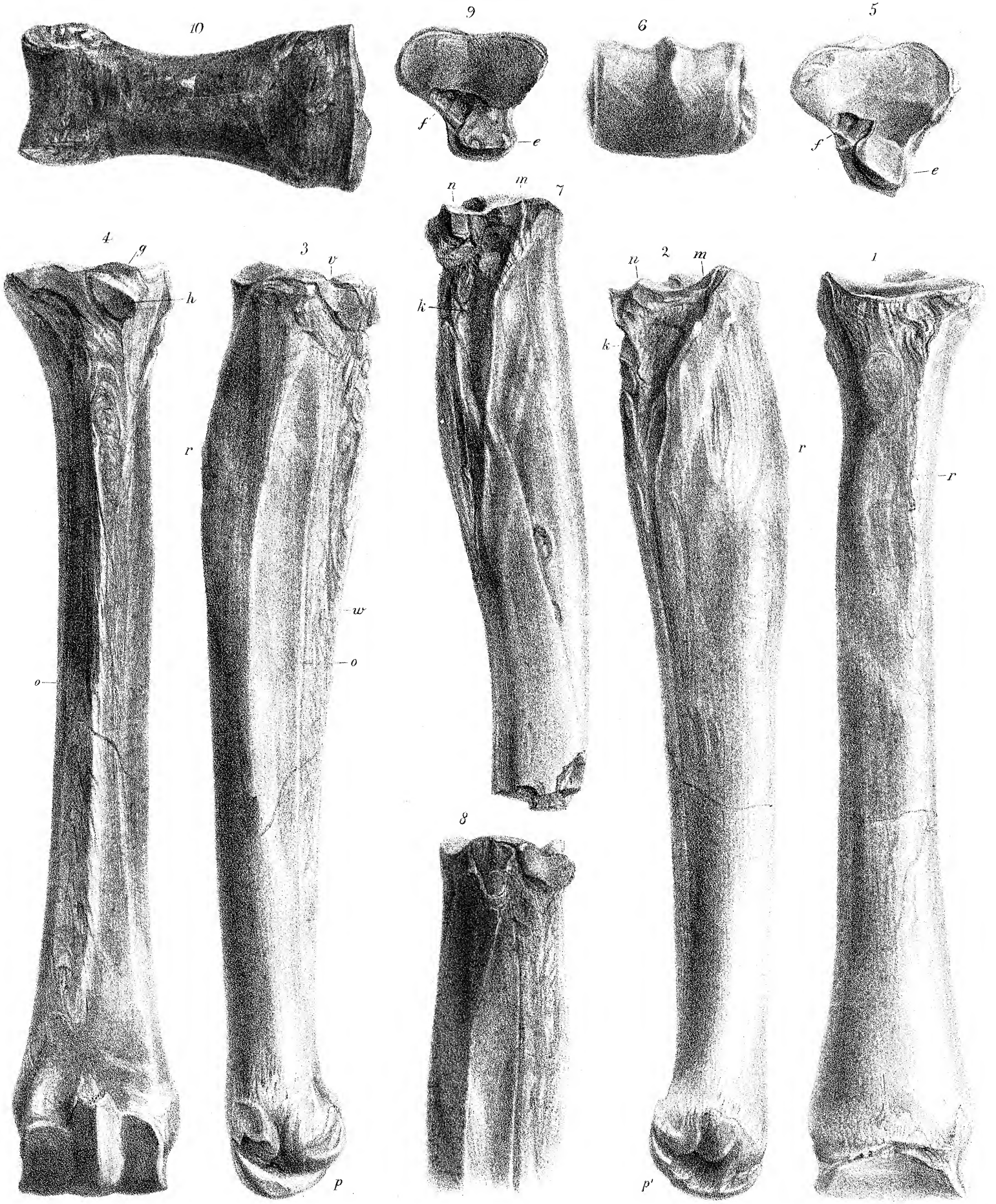
On stone by J. Erxleben.

M. & N. Hanhart imp.



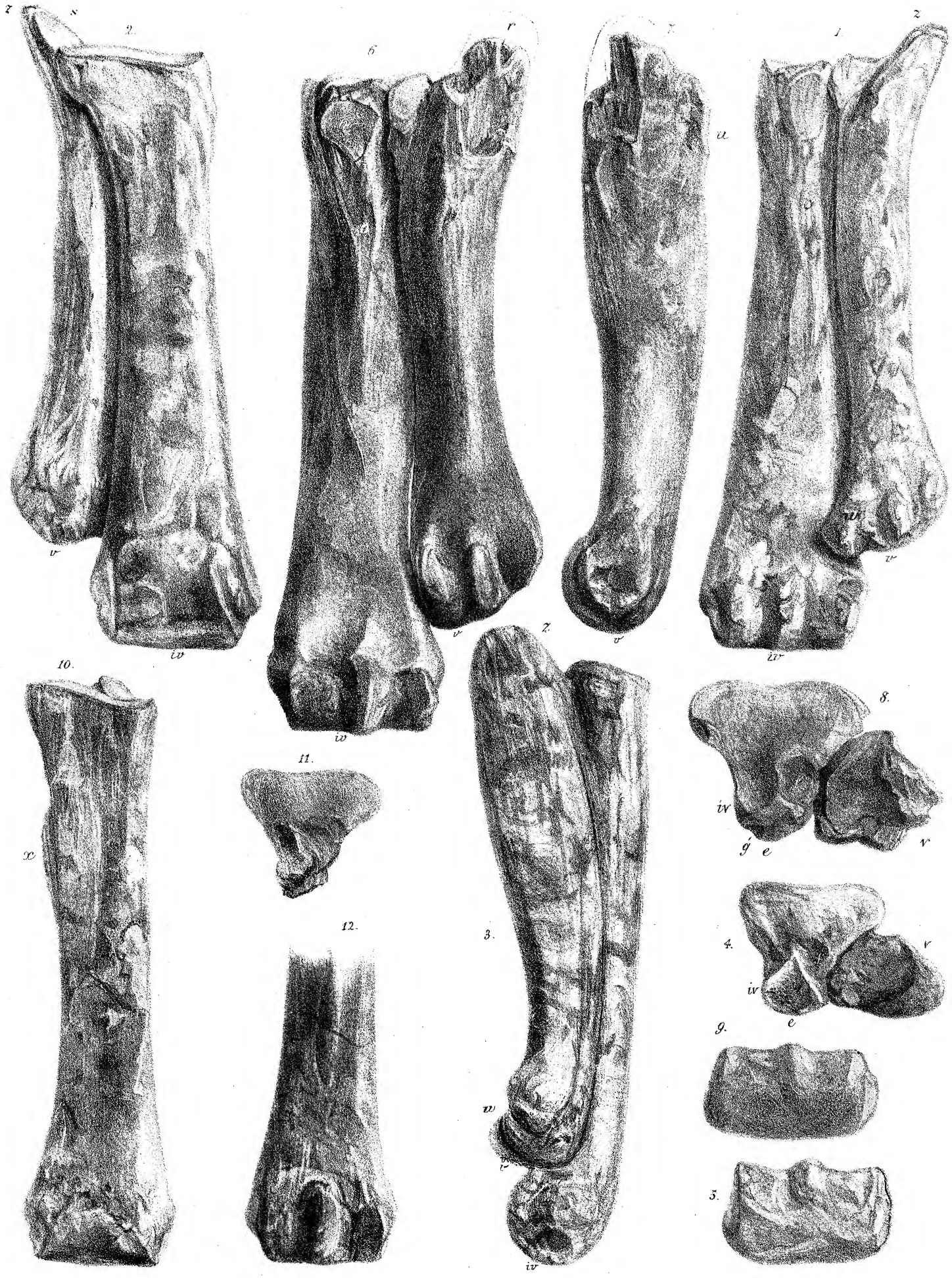
From nat on Stone by J. Erxleben.

M&N. Hanhart imp



From nat. on Stone by J. Erxleben.

M & N Hanhart imp.



From nat. on Stone by J. Erxleben.

M & N Hanhart imp.

C.T. Greenbach del et lith

Hanhart, Brew. sc.

M&N Hanhart imp