Description of the skeleton of an extinct gigantic sloth : Mylodon robutus, Owen, with observations on the osteology, natural affinities, and probable habits of the megatherioid quadrupeds in general / by Richard Owen.

DESCRIPTION

OF

THE SKELETON OF

AN

EXTINCT GIGANTIC SLOTH,

Mylodon robustus, OWEN,

WITH OBSERVATIONS ON

THE OSTEOLOGY, NATURAL AFFINITIES, AND PROBABLE HABITS

OF

THE MEGATHERIOID QUADRUPEDS IN GENERAL.

BY

RICHARD OWEN, F.R.S., &c.

HUNTERIAN PROFESSOR AND CONSERVATOR OF THE MUSEUM OF THE ROYAL COLLEGE OF SURGEONS IN LONDON.

PUBLISHED BY DIRECTION OF THE COUNCIL.

LONDON:

PRINTED BY R. AND J. E. TAYLOR, RED LION COURT, FLEET STREET.

SOLD BY JOHN VAN VOORST, 1, PATERNOSTER ROW.

1842.

DESCRIPTION

OF THE

SKELETON OF THE MYLODON ROBUSTUS.

Introduction.

THE Skeleton which is the subject of the present Memoir was discovered in the year 1841 by M. Pedro de Angelis, seven leagues north of the city of Buenos Ayres, in the fluvatile deposits constituting the extensive plain intersected by the great Rio Plata and its tributaries, and which has been raised during a recent geological epoch above the level of the sea*.

In this formation, and most probably anterior to its elevation, the animal must have been buried entire; and, if the present heat of the climate prevailed, soon after its death: for the parts of the skeleton were found little disturbed, and the very few bones that are wanting are such as would be likely to escape the search of the most diligent collector.

About the same time, and near the same place, a tesselated osseous carapace of some large quadruped, like an Armadillo, was exhumed; and information of this discovery having been communicated to the Royal College of Surgeons by Sir Woodbine Parish, late H.M. Chargé d'Affaires at Buenos Ayres, both this carapace and the above-mentioned skeleton were purchased by the College. They arrived in November 1841, in many pieces, fragile from the loss of the

* See the Geological Introduction by Mr. Darwin to the Description of the Fossil Mammalia discovered in the Voyage of the Beagle, Part 1, 4to, 1838, p. 5.

animal matter; but after having been restored in some measure to their original tenacity, the parts of the carapace were reunited, the skeleton was articulated, and both are now placed in the Museum.

In receiving these rare and instructive evidences of the ancient zoology of South America, the College was expressly assured, by their discoverer, that the carapace and the skeleton belonged to two different animals. Already, indeed, the fossils discovered by Mr. Darwin in Patagonia and La Plata* and those by Dr. Lund, the Danish naturalist, in Brazil†, had indicated that several species of large quadrupeds had become extinct in South America. But independently of these evidences, the complete state of the skeleton about to be described, establishes its essential relations to a family of the order *Bruta* of Linnæus (*Edentata*, Cuv.), distinct from the Armadillos, and throws much valuable light on the organization and affinities of other less known and more gigantic quadrupeds, its congeners and contemporaries in the ancient transatlantic world, and now alike removed from the scene of animated existence.

A few words on these extinct quadrupeds, and on the existing species of the Edentate order to which they are allied, will serve to show the peculiar interest and importance of the present accession to the Osteological Department of the Museum.

Of the three genera of living Edentata, which are peculiar to South America, viz. *Bradypus* (Sloth), *Dasypus* (Armadillo), and *Myrmecophaga* (Ant-eater), the last includes the largest species. The Great Ant-eater (*Myrmecophaga jubata*) equals in length, though not in height, a Newfoundland dog: the gigantic Armadillo‡ may attain to two-thirds of that bulk, but most of the species are of much smaller dimensions: the largest of the Sloths does not exceed two feet from the muzzle to the vent, but the anterior extremities are of disproportionate length.

The fossil quadruped, whose relations to the slow-paced *Bradypi* Cuvier first scientifically determined, thus proving that their peculiar type of organization had once been represented, on a gigantic scale, in the primæval forests of South

* These fossils were presented to the Royal College of Surgeons in 1836, and have been described in the Natural History of the Voyage of the Beagle, 'Fossil Mammalia,' Parts I. to IV., 4to, 1838–40.

† Comptes Rendus des Séances de l'Académie des Sciences, 1839, p. 570.

‡ This existing species was called by Cuvier *Dasypus gigas*, before the remains of the ancient Glyptodons had been determined.

America, was the Megatherium*, which in certain dimensions surpasses all known quadrupeds, existing or extinct.

A summary of the knowledge of the osteology of the Megatherium since acquired by Cuvier from a comparison of the descriptions and figures published by Garriga, Abildgaard, Pander and D'Alton†, is given in the posthumous edition of the 'Ossemens Fossiles'‡, to which the able editor, M. Laurillard, has appended some valuable observations founded on the casts and Mr. Clift's description§ of the remains of the Megatherium presented by Sir Woodbine Parish to the Royal College of Surgeons in 1832.

In that summary the resemblance of the Megatherium to the Sloths in the descending process of the zygomatic arch, and in the angular process of the lower jaw, is pointed out; its supposed difference in both number and mode of implantation of the teeth is dwelt upon‖.

Seven cervical, sixteen dorsal, and three lumbar vertebræ are assigned to the Megatherium by Cuvier, who regrets that the absence of the cartilages or sternal portions of the ribs, and also (with the exception of a single bone) of the sternum itself, prevents the form and capacity of the chest being recognized, or properly shown in the articulated skeleton at Madrid.

The sacrum is described to consist of five anchylosed vertebræ, whose spines form a continuous crest, indicating the existence of a tail of some length; which indication, the fossils brought to England by Sir Woodbine Parish confirmed¶.

* So named and described by Cuvier, in 1795, from impressions of the plates illustrating the work subsequently published by Bru and Garriga, entitled 'Descripcion del Esqueleto de un Quadrupedo muy corpulento y raro, que se conserva en el Real Gabinete de Historia Natural de Madrid, fol. 1796,' and containing the description of the most perfect skeleton of the Megatherium yet obtained. This skeleton was discovered near the city of Buenos Ayres in 1789, and was transmitted to Madrid by the governor of the province, Don Hilario Sosa.

† Das Riesen-Faulthier, *Bradypus giganteus*, abgebildet, beschrieben, und mit verwandten Geschlechtern verglichen, von Dr. Chr. Pander und Dr. E. D'Alton. Bonn, fol. 1821.

‡ 8vo, tom. viii. 1836, pp. 331–370.

§ Geological Transactions, Second Series, vol. iii. p. 437.

‖ The remains of the Megatherium transmitted to England by Sir Woodbine Parish showed that the teeth of the Megatherium are implanted as in the Sloths, and indeed in all other so called *Edentata*, by an undivided root of the same size as the crown; not, as Cuvier supposed, by a bifid fang.

¶ The caudal vertebræ and bony dermal armour ascribed to the Megatherium by Don Damasio de Laranhaja (Bulletin de la Société Philomathique, 1823, p. 83), appertain to another great fossil animal, called by me *Glyptodon clavipes*.—Geol. Trans., Second Series, vol. vi. p. 98.

The difference between the Megatherium and Sloths in the proportions of the fore and hind extremities is pointed out; the existence of the peculiar characteristics of the scapula of the Sloth in the same bone of the Megatherium is dwelt on with emphasis equivalent to the value of such evidence of the real affinities of the fossil; and the marked degree in which the Megatherium differs from all other great quadrupeds with which it might be compared on account of its size, in possessing complete clavicles, is set forth. The humerus, ulna, and radius are described in some detail. The organization of the fore-foot is, however, involved in obscurity, from the faulty manner in which Cuvier believed the bones to have been articulated; and he regrets that MM. Pander and D'Alton have not thrown further light on the subject*. After a comparison of their figures with the bones of the fore-foot in existing Edentata, Cuvier concludes that the fore-feet of the Madrid skeleton are transposed, the right being on the left and the left on the right side; that the index, medius, and annular digits were the only ones provided with claws; that the thumb was clawless, and the little finger rudimental and concealed, in the living Megatherium, under the skin; the hand being thereby specially formed for cleaving the soil and digging, like that of the *Dasypus gigas*.

Names are applied by Cuvier to certain bones of the carpus, none of which had before been determined. M. Laurillard adds, that the bones of the Megatherium received by the Royal College of Surgeons confirm Cuvier's suspicion of the incorrect restoration of the carpus, but not of the transposition of the fore-feet, in the Madrid skeleton; and that they seem to indicate the hand of the Megatherium to have had the greatest analogy to that of the Great Ant-eater (*Myrmecophaga jubata*†).

All the chief characters of the pelvis of the Megatherium are truly pointed out by Cuvier and Laurillard. The femur, tibia, and fibula are fully described. The difference between the Sloth and Megatherium in the vertical position of the astragalus in the latter, and their resemblance in the partial convexity of the scaphoid towards the astragalus are indicated. Besides these bones of the tarsus Cuvier recognizes the cuboid bone; a cuneiform, supporting the largest toe; and another bone representing, apparently, both the remaining two cuneiform

* Recherches sur les Ossemens Fossiles, 8vo, 1836, vol. viii. p. 354.

† *Loc. cit.* p. 356.

bones and the two inner toes; but he quotes Dr. Pander's suspicion that some small bones may be missing from this side of the foot. Only three toes thus appear to be developed, corresponding with the third, fourth, and fifth of other quadrupeds; of these only one supports a claw, which is of immense size, and each of the remaining toes has only two phalanges, and has no claw, in the Madrid skeleton. Cuvier concludes his description by quoting a letter received by M. Auguste Saint-Hilaire from a scientific Brazilian, which announces that the Megatherium had pushed its analogies to the Armadillos so far as to be covered, like them, with a tesselated cuirass*.

After mature deliberation on the skeleton of the Megatherium, Cuvier conceives himself permitted to form the following conjectures as to the nature and habits of the animal to which it belonged:—"Its teeth prove that it lived on vegetables, and its robust fore-feet armed with sharp claws, make us believe that it was principally their roots which it attacked. Its magnitude and its talons must have given it sufficient means of defence. It was not of swift course, nor was this requisite, the animal needing neither to pursue, nor to escape†."

In these conclusions, the editor of the posthumous edition of the 'Ossemens Fossiles' coincides, but appends a warning against too hastily attributing to the Megatherium the fragments of the gigantic bony armour that had been found in the same formations of South America, suggested by his recognition of the remains of the foot of a great Armadillo among the fossils transmitted to England by Sir Woodbine Parish‡.

In a later memoir by Professor Weiss§, on fragments of a gigantic osseous carapace discovered by the Prussian traveller Sellow, in the province of Monte Video, and attributed by the Professor to the Megatherium, this warning seems to have been disregarded.

* *Loc. cit.* p. 367. See note ¶, p. 5 of the present Memoir.

† "L'inspection d'un squelette aussi complet et aussi heureusement conservé nous permet de former des conjectures assez plausibles sur la nature de l'animal auquel il a appartenu. Ses dents prouvent qu'il vivait de végétaux, et ses pieds de devant, robustes et armés d'ongles tranchans, nous font croire que c'étaient principalement leurs racines qu'il attaquait. Sa grandeur et ses griffes devaient lui fournir assez de moyens de défense. Il n'était pas prompt à la course, mais cela ne lui était pas nécessaire, n'ayant besoin ni de poursuivre ni de fuir."—*Loc. cit.* p. 363.

‡ *Loc. cit.* p. 368.

§ Abhandlungen der Kön. Acad. der Wissenschaften zu Berlin, 1827.

In the abstract of a recent essay on the extinct Edentata by Professor De Blainville*, the conclusions of Cuvier as to the close affinity between the Megatherium and the Sloths are rejected; and the association of a bony armour with the internal skeleton of the Megatherium is affirmed to be demonstrated as certainly by *à priori* reasoning, as by the *à posteriori* fact.

In support of this view, M. de Blainville calls attention to the disposition of the spinous processes of the vertebræ, to the angles of the ribs, and to the articulation of the pelvis with the vertebral column; from which modifications of the skeleton, with the addition of the broad rough flattened surface of a part of the crest of the widely expanded ilium, Dr. Buckland† had previously deduced a similar conclusion in favour of the affinities of the Megatherium to the Armadillos‡. Professor De Blainville sums up in favour of the opinion that the Megatherium had the manners and habits of the Armadillos, and consequently fed on flesh, and perhaps also on roots; and that it dug up the earth with its enormous claws, if not for concealment, at least to obtain ants.

Dr. Lund, after a close examination and extensive comparison of the remains of Megatherioid animals discovered by him in the limestone caverns of Brazil,

* Recherches sur l'ancienneté des Edentés terrestres à la surface de la terre; Comptes Rendus de l'Acad. des Sciences, 1839, p. 65. Prof. De Blainville terminates his contrast of the Megatherium with the Sloths by the following statement:—"En effet, ni sa tête, ni son épaule, ni ses membres, ni son système digital, ni son système dentaire, ne se ressemblent presqu'en rien à ce que existe chez les Paresseux:" and, after the comparison of the Megatherium with the Armadillos, he thus concludes:—"Cependant, comme il offre des modifications d'organisation qui lui sont propres, aussi bien dans le système digital que dans le système dentaire, on conçoit très bien qu'il forme une division particulière dans le genre *Dasypus*, puisqu'il n'avait probablement que quatre doigts en avant, et cinq en arrière, et que ses dents, de forme tétragonale, toute différente de ce qu'elles sont dans les Tatous ordinaires, n'étaient qu'au nombre de quatre de chaque côté et à chaque mâchoire. D'après cela, il est plus que probable que ces animaux ne grimpaient pas aux arbres, qu'ils n'avaient pas de trompe, mais qu'ils avaient les mœurs et les habitudes des Tatous, et que par conséquent ils se nourrissaient de chair et peut-être aussi de racines, si ceux-ci en mangent, ce que nie cependant d'Azzara; et que, comme eux, ils fouissaient la terre avec leurs ongles énormes, si non pour s'y cacher, du moins pour déchirer les amas de fourmis."—*Loc. cit.* p. 68.

† Bridgewater Treatise, 1836, vol. i. pp. 160, 161.

‡ I have pointed out the inadequacy of these facts to support the conclusions deduced from them, and their relation to other conditions of structure in the Megatherium, in my description of the *Glyptodon clavipes*, Geological Transactions, Second Series, vol. vi. p. 98.

has been led to the inference that they climbed trees, like the Sloths of the present day, in order to feed upon the leaves*.

* It is due to the laborious and ingenious naturalist above cited to give this somewhat startling conclusion in his own words, with the following translation of which I have been favoured by the Rev. W. Bilton, M.A.:—" Thus in every one of the points of comparison we have instituted between burrowers and climbers, we have seen that the Megalonyx constantly differs from the former, and resembles the latter: but the point to which I last alluded, the inversion of the hind-foot, I consider to be quite decisive. There is one other character in its organization, which is not quite without weight in reference to our present inquiry, I mean its unusually powerful tail. Now, it is certainly true, that many animals which are not climbers have a powerful tail, as for instance, Armadillos, &c., while others that climb will have none, as Sloths, and some Apes; but when we find a remarkably powerful tail attached to an animal, that, according to all probability, was a climber, we are led to infer that this organ must have served for that purpose, in other words, that the Megalonyx was furnished with a prehensile tail.

" How far the Megatherium is to be considered in the same light as the Megalonyx, cannot be decided without an accurate and scientific examination of the skeleton at Madrid. Pander and D'Alton do not mention any distortion of the hind-foot, neither does their figure exhibit any. It is, nevertheless, quite possible that such may exist, but that it is disguised by the faulty manner in which the skeleton is put up. It occurs to me as very unlikely, that two animals which agree so closely in all other striking particulars of their organization, should differ so much in *one* of the most important. The Megatherium has been proved by later discoveries to possess the same powerful tail as the Megalonyx; and as it besides corresponds with the latter entirely in the conformation of its extremities, the same difficulties present themselves against the supposition of its having been a burrower. But if the Megatherium was really a climber, it must have had still more occasion (on account of its greater size) for that peculiar arrangement of the hind-feet, which we have described in the Megalonyx. I am aware that most people, from the immense bulk and clumsy make of these animals, will object to the view I have ventured to give of their habits. I confess the weight of this objection, which no one can feel more than I do. Indeed, it had the effect of long preventing me from coming to what appeared so improbable a conclusion, and impelled me to a detailed and wearisome examination of all the relations and circumstances that could bear upon the subject, to discover, if possible, some other solution of the phenomena which the osteology of the Megalonyx presents. This is not the place to detail all my investigations; but at least I may say this, that the more points of view in which I considered the subject, the more irresistibly was I led to the conclusion I have ventured to express; although no one confesses more readily than I do, how much, at the first glance, it appears to be at variance with nature.

" In truth, what ideas must we form of a scale of creation, where, instead of our squirrels, creatures of the size and bulk of the Rhinoceros and Hippopotamus climbed up trees! It is very certain that the forests in which these huge monsters gambolled, could not be such as now clothe the Brazilian mountains; but it will be remembered, that in the former communication which I had the honour of submitting to the Society, I endeavoured to show, that the trees we now see in this region are but the dwarfish descendants of those loftier and nobler forests which originally covered these Highlands;

Drs. Pander and D'Alton, the only comparative osteologists who have deduced their conclusions as to the nature and habits of the Megatherium from actual inspection of the skeleton at Madrid, clearly recognise its important points of resemblance to that of the existing Sloths. Of these lingering feeble remnants of the race, the Megatheres, in their belief, were not merely predecessors but progenitors, which, by gradual degeneration and transmutation of characters during the lapse of ages, have dwindled down into the present puny scansorial Tardigrades. Far different however were the habits of the *Bradypus giganteus* of the German authors; it was not merely an occasional digger of the soil, as Cuvier concluded, but altogether a creature of subterraneous existence, as it were some earth-whale or colossal mole *.

The collection of fossils brought to England from South America by Mr. Darwin has enabled me to add the following facts to the history of the Megatherium. The teeth of the Megatherium, for example, do not differ in number from those of the Sloths, as both Cuvier and M. de Blainville supposed; there being five, not four molars on each side of the upper jaw†. Microscopic examination having demonstrated a marked difference in the intimate structure of

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and we may surely be permitted to suppose that the vegetation of that primæval age was on a no less gigantic scale than the animal creation."—*Blik paa Brasiliens Dyreverden för sidste Jordom-vældning af Dr. Lund*, 4to, Kjöbenhavn, 1838, p. 21. (View of the Fauna of Brazil, prior to the last Geological Revolution.)

* "Der Einfluss des Klimas und der davon abhängigen Lebensweise, auf die verschiedene Ausbildung des Körpers, ist bei Hausthieren bereits nach wenigen Generationen bemerkt worden. Nach der Lebensweise des Riesen-faulthiers, die wir aus seinem Knochenbau erkannt zu haben glauben, könnte man dieses Thier einen colossalen Maulwurf nennen, der nur mit Anstrengung seiner Kräfte die nöthige Nahrung unter der Erde aufzubringen vermöchte. Nehmen wir nun nach einer solchen Erkenntniss an, dass dieses Thier durch die auf der Erde statt gehabten Revolutionen genöthiget wurde, zu Tage zu leben (indem etwa der unter Wasser gesetzte Boden, den unterirdischen Aufenthalt nicht mehr erlaubte) so wäre bei der verschiedenen Nahrung, die es ohne Aufwand von Kräften im Ueberflusse vorfand, aus Mangel der Thätigkeit, endlich seine Lebensregsamkeit erstorben, und die Glieder, die (wie noch jetzt) anfangs getrennt waren, hätten sich verwachsen und immer mehr verkleinert; so das endlich aus einem Unvermögen, sich den äussern veränderten Verhältnissen gleichzustellen, diese Missgestalten sich gebildet haben, die wie *Buffon* sagte, kaum das Vermögen des Daseyns besitzen. Eben diess Zurücktreten und Vereinigen der Theile die getrennt sind, wie die erwähnten Missverhältnisse, die sich erst in der Folge des Wachsthums erzeugen, deuten auf eine Umbildung der Gestalt."—*Das Riesen-Faulthier*, &c. Fol. 1821, p. 16.

† Zoology of the Beagle, Fossil Mammalia, 4to, 1839, p. 102, pl. 31.

the teeth of the Sloths and Armadillos, I have ascertained by this mode of investigation, that the teeth of the Megatherium have the same texture and composition as those of the Sloth*. And if from identity of dental structure in two different animals we may predicate a similarity in their food, a glance at the bony frame-work of the Megatherium is sufficient to show that it must have resorted to other means of obtaining its leafy provender than that of climbing for it; whereby the necessity of inferring a proportionate magnitude of the trees which nourished the Megatherium is obviated.

This argument will be resumed, in connexion with a survey of the grounds of the conflicting hypotheses of the habits of the Megatherioid quadrupeds above quoted, at the conclusion of the description of the skeleton which is the immediate subject of the present memoir. Such description, however, would have been both less instructive and less interesting without the antecedent sketch of the principal facts ascertained in regard to the Megatherium: and, reciprocally, the scientific knowledge of the Megatherium will, it is hoped, be both increased and established by the details of the osteology of the Mylodon. For it cannot be concealed that doubts have been expressed, and still may be entertained by some comparative anatomists, as to whether the famous skeleton at Madrid be actually composed of bones of the same species, not to say individual†. Proportions of a pelvis and of thigh-bones, surpassing those in the Elephant, have been deemed to be preposterous in combination with a cranium not exceeding in size that of the Rhinoceros, &c. And these doubts have not been materially diminished by the remains of other Megatherioid animals discovered before the arrival of the skeleton of the Mylodon.

The Megalonyx, for example, a large extinct species of the order *Bruta*, allied to, but less than the Megatherium, has hitherto been recognised by portions of the skeleton too fragmentary and unconnected to throw light on the question of the true form and proportions of its gigantic congener.

The parts of the Megalonyx described in the posthumous edition of the 'Ossemens Fossiles‡,' are two portions of teeth; the metacarpal and phalangeal

* Zoology of the Beagle, Fossil Mammalia, 4to, 1839, p. 103, pl. 32, fig. 1.

† Prof. Lichtenstein, in Schmeisser's 'State of Science in France,' tom. ii. p. 95, quoted by Cuvier, *loc. cit.* p. 336.

‡ Tom. viii. pp. 304–330.

bones of three digits, regarded by Cuvier, according to the analogy of the Cabassou (*Dasypus unicinctus*, Gm.), as the index, medius, and annularis, the two latter armed with powerful claws; vestiges of a thumb and little finger; a humerus, radius and ulna; from which bones Cuvier deduces the affinities of the Megalonyx to the Sloth, and its specific distinction from the Megatherium*. All these remains of the Megalonyx were discovered in the continent of North America.

Mr. Darwin's collection of mammalian fossils from South America contained, besides portions of the Megatherium, characteristic remains of at least three other species, indicating distinct subgenera of less gigantic Megatherioid animals. Of these one was unequivocally the Megalonyx; the teeth in the lower jaw having an elliptical or oval crown, depressed in the centre, which is the form characteristic of that genus†.

The existence of the Megalonyx in South America had previously been affirmed by Professor Döellinger, on evidence derived from fossil claw-bones discovered by Drs. Spix and Von Martius in a bone-cave in Brazil. Dr. Lund‡ has subsequently founded, on fossil remains from the same locality, three species of Megalonyx distinct from the original *Megalonyx Jeffersonii*; but other genera of Megatherioid Edentata appear to have been confounded with the true Megalonyx in his enumeration.

A genus or subgenus distinct from both Megatherium and Megalonyx, but of the same natural family, has been very satisfactorily established by a comparison of a large proportion of the skeleton of a Megatherioid animal, discovered by Mr. Darwin in the bay called Bahia Blanca in Patagonia. The bones were imbedded in the cliff so nearly in their proper relative positions, as to lead to the belief that the carcase had been drifted to the spot in an entire state. The characters of this genus, to which I have assigned the name of *Scelidotherium*§, are taken from the modifications of the teeth and of the bones of the extremities,

* "Quant à la comparaison entre le Megatherium et le Megalonyx, elle donne pour résultat des rapports assez marqués, et cependant des caractères de distinction au moins spécifiques."—*Loc. cit.* p. 364.

† Fossil Mammalia of the Voyage of the Beagle, 4to, 1838–40, p. 99, pl. 29.

‡ Lund, *loc. cit.* and Compte Rendu de l'Académie des Sciences, Avril 19, 1839, p. 573.

§ Fossil Mammalia of the Beagle, 4to, 1839, p. 73, plates 20–27.

especially of the astragalus: the species is probably less than the *Megalonyx Jeffersonii*, Desm.

A nearly entire lower jaw, likewise discovered by Mr. Darwin in Bahia Blanca, presented a dentition similar in the number and essential structure of the teeth to that in Megatherium, Megalonyx, and Scelidotherium, but differing in the form of the teeth as much as those genera differ in the same respect from each other. For the genus thus indicated I have proposed the name of *Mylodon*, from the Greek words signifying 'molar teeth,' or teeth adapted solely for grinding*; and I have shown that certain fossil jaws and teeth which had been previously discovered in North America, and assigned to the Megalonyx, belong in fact to this new genus, in which they form a second species. The name of *Mylodon Darwinii* was assigned to the Patagonian species; that of *Mylodon Harlani* to the North American species, in honour of the naturalist by whom it was first described†.

Remains of the *Mylodon Harlani* have been subsequently described and figured by Dr. H. C. Perkins‡: these were discovered in the Oregon territory, near one of the tributaries of the Columbia, twelve feet below the surface. Other remains of the *Mylodon Harlani*, discovered by Mr. Koch in Benton County, Missouri, were perceived by Dr. Harlan to be distinct from Megalonyx, and have been noticed by him as indicative of a new genus and species, for which he has proposed the name of *Orycterotherium Missouriense*§.

In conclusion, I may observe that Dr. Lund has indicated two before unknown extinct genera of large Sloth-like quadrupeds, whose remains he has discovered in the Brazilian caverns. One of these, called by him *Cœlodon*, is stated to have

* Μύλη *mola*, ὀδοὺς *dens*. See Fossil Mammalia of the Beagle, 4to, p. 63. It is to be observed that canine and incisor teeth are absent in the other genera of Megatherioid animals; but an objection that such name, signifying the presence of molar teeth only, does not imply a peculiarity of the genus, might equally be made to the term *Megalonyx* (*μέγας, great, ὄνυξ, a claw*), of which genus the known species have not relatively longer or larger claws than the Mylodon and other Megatherioids; all of which, likewise, as well as the Scelidotherium (*σκελὶς, hind-leg, θηρίον, beast*), are remarkable for the size of their hinder extremities; nor can any of the known Megatherioids be termed other than great animals, although the Megatherium proper (*μέγας, great, θηρίον, beast*) best merits that term. On this principle of the nomenclature of the Megatherioid genera all the characteristic peculiarities of the family are readily fixed in the memory.

† Harlan, Medical and Physical Researches, 1835, 8vo, p. 334.

‡ Silliman's Journal, vol. xliii. No. 1, January 1842.

§ Proceedings of the American Philosophical Society for November 1841.

only four molars in the upper jaw and three in the lower jaw, and to be represented by a species of the size of the Tapir; the other, called *Sphenodon*, is not larger than a Hog*.

These indications of an extensive family of most singular quadrupeds, once spread over the American continents from the latitude of New York to Patagonia, cannot, it is presumed, be pondered on without exciting the strongest interest and desire to obtain further and more definite insight into their habits, their natural affinities, and the business assigned to them in the organic economy of a former world.

The skeleton of the Megatherium of Madrid, hitherto the most complete exponent of the type of this extinct race, exists under conditions which have raised doubts even as to its representing one and the same animal: and if the additional evidence obtained by Sir Woodbine Parish has proved that its anomalous proportions were actually such as once characterized a living being, yet comparative anatomists, who, with Cuvier, have admitted the authenticity of the Madrid skeleton in this respect, still lament its inadequacy to give the much-desired information as to the exact structure of the locomotive extremities: and we have already seen that it has failed to afford a true knowledge of the number and form of the teeth which rightly characterize the genus.

In the absence, therefore, of a second skeleton of a Megatherium, more complete, and more authentic in regard to its discovery and mode of articulation than the existing one, further light on this subject can only be obtained, as it were, by reflexion from such a skeleton of some nearly allied species. The subject of the present memoir happily fulfils all the required conditions; and the desire to derive every possible advantage in the solution of this interesting problem in Comparative Anatomy from the singularly perfect skeleton of the *Mylodon robustus*, must plead as the excuse for any apparently undue detail in the following descriptions and comparisons.

Generic and Specific Characters of the Mylodon robustus.

On the reception of the bones composing the present skeleton, the lower jaw was immediately examined, and was found to present a dentition conformable

* *Loc. cit.* and Compte Rendu de l'Académie des Sciences, Paris, Avril 1839, p. 574.

with that characterizing the genus *Mylodon*: certain modifications in the shape of the teeth indicated the specific distinction of the fossil of the Plata from both the Patagonian *Mylodon Darwinii* and the North American *Mylodon Harlani*, but showed it to be more closely allied to the latter species.

The differential characters of the *Mylodon robustus*, as it is proposed to call the present species, are further and very satisfactorily illustrated, in regard to the *Mylodon Darwinii*, by the different proportions of the lower jaw itself, as will be seen by comparing Plate VI. of the present memoir with Plate XVIII. of the description of the Fossil Mammalia collected in the Voyage of the Beagle. The distinction of the *Mylodon robustus* from the *Mylodon Harlani* was demonstrated by a comparison of the bones of the latter species in the collection of Missouri fossils* exhibited in the present year (1842) by Mr. Koch, in London, with the corresponding bones of the *Mylodon robustus*.

The more obvious modifications by which the dental and osteological characters of the genus *Mylodon* differ from those of the genera *Megatherium*, *Megalonyx* and *Scelidotherium*, are pointed out in the detailed comparisons succeeding the descriptions of the several parts of the present skeleton, and are succinctly defined in the concluding synopsis of the families, genera and species at present known to constitute the Phyllophagous division of the Edentate order.

General Description of the Skeleton of the Mylodon robustus.

The singularly massive proportions of the skeleton of the *Mylodon robustus*† arrest the attention of every observer, and are not less calculated to excite the surprise of the professed comparative anatomist.

A trunk, shorter than that of the Hippopotamus, is terminated behind by a pelvis, equalling in breadth and exceeding in depth that of the Elephant. This capacious bony basin rests on two massive but short hind extremities, terminated by feet as long as the femora, set at right angles to the leg, as in the plantigrade animals, but with the sole slightly turned inwards.

A tail equalling the hind limbs in length, and proportionally as thick and

* These are the bones noticed by Dr. Harlan in the Proceedings of the American Philosophical Society above cited.

† Plate I.

strong, assists in supporting, rather than depends from the broad sacral termination of the pelvis.

The sacrum is lengthened at the expense of the lumbar vertebræ by a continuation of the general anchylosis through that region.

A long and capacious thorax is defended by sixteen pairs of ribs, most of which equal in breadth those of the Elephant, and all the true ribs are clamped by massive and completely ossified cartilages to a strong and complicated sternum.

The scapulæ, distinguished by their unusual breadth, and by the osseous arch connecting the acromial and coracoid processes, are attached to the large manubrium sterni by strong and complete clavicles.

The humeri, short and thick, like the femora, have their muscular processes, ridges and condyles still more strongly developed; but the rotatory and lateral movements are unobstructed by any inordinate production of the proximal tuberosities.

The fore-arm is longer than its corresponding segment in the hind limb, has both bones distinct, and equally remarkable for their great breadth and the angular form occasioned by the prominence of the intermuscular ridges; yet the mechanism for free pronation and supination is complete.

The fore-foot is pentadactyle, but so unusually massive are the proportions of the radius and ulna, that, though actually broad and thick, it appears relatively small; and notwithstanding certain fingers are terminated by claw-bones of great size and length, yet owing to the form of their proximal phalanges and metacarpal bones, it is short in proportion to its breadth.

The hind-foot is tetradactyle, with the two inner toes elongated and armed with unequal but large claws.

Both the fore- and hind-feet are remarkable for the shortness, breadth, and ungulate character of the two outer digits, which, when the Mylodon stood or trod upon the ground, must have principally sustained the superincumbent weight.

A skull, smaller than that of the Ox, but long, narrow and terminated by a truncated muzzle, is supported by a short neck composed of seven cervical vertebræ.

These vertebræ are freely articulated together, and are succeeded by sixteen dorsal or costal vertebræ, remarkable for their broad and high spinous processes, which are nearly equal, and have an uniform inclination backwards.

The capacious trunk, thus slightly elevated upon its short and strong supporters, presents the form of a cone, gradually tapering forwards from the enormous pelvis which forms its base, to the short neck and slender head.

For such proportions and combinations we may search in vain amongst the skeletons of existing Mammalia; but the palæontologist will recognise them in the Megatherium. The precise nature and amount of the affinities of the Mylodon to this and other extinct Edentata, and to the existing species of that order, will be deduced from the following more detailed description.

Description of the Skull.

The small relative size of the skull of the *Mylodon robustus*, and its short, broad, and abruptly truncated muzzle, have been already alluded to. Progressive ossification has obliterated most of the sutures, and has reduced the originally complex assemblage of bones forming the cranium and upper jaw to an almost continuous whole: this will be first described as seen from the lateral, the superior, and inferior aspects: the shape and connections of the constituent bones will next be given, so far as they can be satisfactorily traced.

*Side-view**.—The skull of the *Mylodon robustus* presents, from this aspect, the form of an elongated parallelogram, chiefly characterized by the singular form and development of the malar bone, and by the shortness and depth of the muzzle.

The occipital plane, bounded behind and below by the large condyles, inclines forwards as it rises to join the upper surface of the cranium. This surface extends horizontally in a nearly straight line to the muzzle, being slightly depressed at the root of the nose, and gently convex in the rest of its extent.

The maxillary part of the cranium terminates suddenly by a vertical concave line, and, independently of the lower jaw, is deeper than the opposite or occipital termination: the cranium, in fact, contrary to its usual proportions, gradually increases in depth as it extends forwards; and, as the lower jaw diminishes in depth in the same direction and degree, the base of this bone taken as that of the entire skull, runs parallel, when the mouth is closed, with the coronal line of the skull.

The side of the cranium is bounded, posteriorly, by a prominent but flattened

* Plate II.

tract of bone, arching down between the occipital and temporal regions to behind the base of the zygoma, and terminating below in the rugged apophysis supporting the stylo-hyal articulation. This arched tract bounds by its posterior ridge the occipital region, and by its anterior one, the temporal fossa; but its lower half is separated from the occipital region by a broad and deep vertical excavation, which has lodged the origin of the digastric muscle.

The anterior ridge arches forwards superiorly, and is continued above the long temporal fossa to the external angular boundary of the orbit: below, the same ridge is continued upon the upper and outer angle of the zygoma. The temporal depression is twice as long as it is deep; its length more than equals half that of the entire cranium: it is not separated from the orbit, but the respective limits of these cavities are indicated by the slight angular process above noticed. The surface of the temporal depression is roughened by small reticularly decussating ridges of bone, which fall towards the lower outlet into a sloping direction, corresponding with that of the fasciculi of the temporal muscles as they converged to their insertion into the broad coronoid process of the lower jaw, which here enters the temporal fossa. A slight horizontal depression along the middle of the posterior part of the temporal fossa indicates the upper margin of the squamous bone.

The zygomatic process of the temporal bone is a strong, nearly straight, trihedral process, extending forwards and outwards, and with the extremity inclined upwards. Its external surface is nearly flat, and is continued from the anterior part of the tympanic cavity: the angle separating the external from the internal and upper surface is continued, as before stated, from the posterior ridge bounding the temporal fossa: it is at first slightly convex, then slightly concave. The upper surface of the zygoma is continued from the squamous plate of the temporal, and extends three inches and a half anterior to the origin of the upper angle of the zygoma, increasing in breadth as it advances, having a smooth and concave surface, and terminating anteriorly by a rather sharp concave margin. The under surface of the zygoma presents at its posterior part a broad and flat articular surface for the lower jaw. From this surface the zygoma contracts to its extremity, which is obliquely bevelled off from below upwards and forwards to an obtuse termination above, which is wedged somewhat loosely into the upper angular cleft of the large malar bone.

This bone forms the most striking feature in the lateral view of the skull, from which it projects like a diminutive elk-antler. It is articulated at its anterior extremity by a broad sutural surface, which was unobliterated, and allowed a slight yielding movement between the malar and the superior maxillary bones. The malar commences by a subcylindrical, smooth, short and thick stem; rather flattened and concave above, where it forms the floor of the orbit: it then suddenly expands into a broad vertical plate, divided posteriorly into three flattened processes which diverge from each other in nearly the same vertical plane.

The uppermost of these processes is the longest and thickest, being not less than three inches and a half in length; it is flat externally, convex on the inner surface, and terminated by a rounded extremity which projects backwards and upwards above the temporal zygoma, the obtuse end of which underprops the base of the process. The second process of the malar bone is the shortest of the three, and is broader but thinner than the preceding: its upper surface is adapted, but not very exactly, to the sloping terminal surface of the zygomatic process, which rests upon it. It thins off at its lower surface, which is continued by a semicircular emargination to the third, lowest, and at the same time, broadest and deepest, of the three divisions of the malar bone. The terminal margin of this descending process is cut by two shallow notches: its anterior border is convex. A narrow rising of bone is continued from the root of this process along its external surface to the projection between the notches. A second ridge runs almost parallel with, but an inch above the preceding to the upper and posterior angle of the process. These two ridges define, or separate, three depressions, extending in the same direction, downwards and backwards. The lowest depression, which is parallel with the lower margin of the os malæ, is the narrowest; the next above is larger, and much broader; the third is one inch and a half in breadth, and of the same length. The surface of each of these shallow depressions is marked by ridges running irregularly and decussating each other: they are most numerous in the highest and shortest depression, where they intercept areolar spaces about one-third of an inch in extent.

Similar, but finer, reticulate markings characterize the outer convex surface of the second process; but, with the exception of a few minute impressions upon the highest or digital process, the rest of the outer surface of the expanded and trifurcate malar bone is smooth. The sculptured surface indicates the extent of attachment and the powerful character of the malar portion of the masseteric muscle; and when it is considered by how slender a stem its forces are transferred from the malar to the fixed maxillary bone, the advantage of the persistent malo-maxillary suture, and of the yielding motion it allows to the malar bone, will be obvious.

The contour of the orbit describes a full vertical ellipse, but is open or incomplete posteriorly for one-fourth of its extent; its upper third is developed into a slight obtuse supraciliary ridge; the rest is smoothly rounded off.

The limits of the lachrymal bone are not defined, but a small lachrymal foramen, protected anteriorly by a small angular process, is situated at the upper and anterior part of the orbit, three lines from the margin: the lachrymal depression extends an inch below the foramen.

A smooth protuberance projects from the lower and anterior margin of the orbit, formed by the junction of the malar with the maxillary bones; the suture defining this articulation runs along the lower and anterior part of the orbit. The malar process of the maxillary is perforated by the large suborbital canal, the outer opening of which is concealed, in a side-view of the skull, by the above protuberance.

The facial or rostral part of the skull, anterior to the orbit, is singularly short and large; both its vertical and transverse diameters much exceed its length. It is bounded above by the broad, slightly convex and almost confluent nasal bones, and the rest of its extent is formed by the superior maxillaries.

The extremity of the nasal bone is slightly deflected: it expands both in breadth and depth, and terminates by a thick rugged margin which projects beyond the corresponding margin of the maxillary, and supports a central transversely elliptical depression.

The lateral or outer plate of the superior maxillary bone is of a nearly quadrate figure, slightly concave anterior to the orbit, and convex where it forms the alveolus of the first molar tooth. Its anterior margin is smoothly rounded off, and descends almost vertically to terminate in a blunt-pointed angle about an inch in advance of the first molar tooth.

An intermaxillary bone may probably have completed the length of the upper jaw, which, in its present state, is exceeded for about an inch by the lower jaw. Such bone, if present, must have been very small, and loosely connected with the anterior margin of the maxillary; for there is as little trace of an intermaxillary suture as of the bone itself.

Another of the peculiar features of the side-view of the Mylodon's skull is the inferior line of the bony palate, which is seen extending half an inch lower than the grinding surfaces of the upper molars, in consequence of the shortness of their exposed crowns, and the convexity of the palate. The anterior border of the palatal process of the superior maxillary extends nearly an inch in advance of the external and inferior angular process of the same bone.

In the side-view of the skull, the broad ascending ramus of the lower jaw is seen applied, by the transverse condyle, to the flat glenoid articulation at the base of the zygoma, sending its broad coronoid process upwards into the temporal cavity, and its angular process backwards as far as the vertical line dropped from the posterior root of the zygoma. The ridges and depressions on the angle indicate the place of insertion of those protractor fasciculi of the strong masseter which took their origin from the depending plate of the malar bone. The horizontal ramus gradually diminishes in depth towards the symphysis, which slopes forwards from below towards the anterior margin, which is very little in advance of the vertical line dropped from the extremity of the nasal bone.

Three of the inferior teeth are visible when the mouth is closed; the fourth being concealed by the malar bone.

*Upper view**.—The upper, like the lateral surface of this singularly-shaped skull, presents the form of a parallelogram, which is slightly contracted at the middle third included by the zygomatic arches, and a little expanded at the two extremities; the anterior expansion being scarcely of less breadth than the posterior one. This is formed by the thick occipital or deltoidal ridge; behind which the sloping posterior region of the cranium, and the widely separated occipital condyles, come into view.

The upper surface of the skull is uniformly smooth; gently convex, both transversely and longitudinally; almost flat in the parietal region; a little raised above the orbits, and as much depressed at the root of the nose. It is bounded laterally by two longitudinal ridges, slightly overhanging the sloping sides of the skull, and describing three successive curves, with their concavities directed out-

* Plate III.

wards: of these, the anterior, which is the shortest and deepest, forms the upper boundary of the orbit; the middle curve, somewhat longer and shallower, bounds the anterior third of the temporal region; the rest of which is defined by the posterior, longest and shallowest curve, from which the ridge is continued down to the posterior origin of the zygomatic process. The angle between the first and second curvatures represents the posterior or external orbital process.

The median third of the short and broad facial portion of the skull is formed by the nasal bones, which are anchylosed together along their narrower posterior halves, and likewise to the frontal bones: the internasal suture is not obliterated along the expanded anterior halves of the bones; each of which presents a small notch at its broad, thick, truncated and deflected anterior margin. The naso-maxillary sutures remain on each side. From these, the maxillary bones arch downwards, slightly expanding forwards, and terminate by a thick rounded edge about half an inch behind the nasal bones.

The strong and singularly complicated zygomatic arches circumscribe a longitudinal elliptical space on each side of the middle third of the long and narrow skull: the posterior origin of each arch presents a horizontally slightly hollowed surface, giving origin to, and supporting the posterior fasciculi of, the temporal muscle: the anterior termination of the zygomatic arch presents, in like manner, a horizontal concavity for the support of the eye-ball; the plane of the intermediate part of the arch is changed from the horizontal to the vertical position, and the edge of the compressed ascending process rises above the middle of the zygoma, and meets the eye looking down upon the upper surface of the skull.

The most extraordinary features which this surface presents are accidental to the individual example under consideration, and arise out of two extensive fractures of the skull which the animal has received some time before its death. One of these fractures is four inches in length, and extends in the axis of the skull, across the fronto-maxillary suture, near the right orbit. The blow has depressed the outer table of the skull, but the fracture is entirely healed, and is indicated by the furrows along which the bone sinks below its natural level into the large frontal sinuses. The surface of the supra-orbital plate, which has participated in the primary injury, and been affected by the inflammation consequent thereon, is roughened, and, as it were, eaten into by numerous small vascular grooves and fissures. The second fracture is more extensive, and affects the middle of the posterior part of the parietal region of the skull, extending a little way into the occipital region. The outer table of the skull has been smashed in for an extent of five inches in the long diameter, and three inches transversely: several of the bony fragments have exfoliated, and left wide irregular apertures leading into the large air-sinuses which are continued from the frontal to the occipital region. The margins of the broken bone, both of the outer table and the exposed edges of the vertical sinuous walls, extending between the outer and inner tables, are rounded off by the absorbent action, and are thickened irregularly by new ossific depositions which shoot out in the form of jagged exostoses from the posterior and narrower end of the fractured surface. The inner table of the skull has not been injured by the blow which caused such destruction to the outer plate; and the integrity of the cranial cavity, and the safety of the contained cerebral organ, may be ascribed to the singular extension and development of the air-cells, which raise the outer considerably above the vitreous table, along the whole upper plane of the skull.

The questions which naturally arise as to the cause of these remarkable injuries, and the circumstances under which they were received, will be subsequently discussed; at present it need only to be observed that they must have occurred some time before the death of the animal. Sufficient time has elapsed to allow of the complete healing of one of the injuries, which may have been received at a different and antecedent period to the second; and notwithstanding the greater extent and more dangerous position of the latter fracture, directly over the brain, the animal, though probably stunned and temporarily disabled by its reception, has recovered itself, and lived sufficiently long to allow of considerable progress in the usual reparative processes.

*Base-view**.—The under surface of the skull agrees in its general form with the upper, presenting a median constriction at the interspace of the zygomatic arches and expanding at both extremities: behind the posterior expansion, formed by the lower terminations of the occipital ridge, the base of the skull contracts to form the condyles, which project backwards and a little downwards. The convex surface of each condyle is inclined a little outwards; it describes more than half a circle in the vertical direction, and the quarter of a long ellipse in the trans-

* Plate IV.

verse direction. It is bounded by a well-defined almost sharp ridge, which encroaches for about the third of an inch upon the outer extremity of the smooth articular surface, forming there a rough angular rising. The inner surface of each condyle is, as it were, cut down vertically to the sides of the occipital foramen, and is also slightly hollowed, so that the inner margin of the articular surface somewhat overhangs it.

The posterior margin of the broad basi-occipital plate, forming the lower boundary of the foramen magnum, presents an obtuse angular excavation. The under surface of the plate is flat: it is pierced by a small vascular foramen (*a*) immediately anterior to the condyle; and the large anterior condyloid foramina (*b*), each half an inch in diameter, open obliquely upon the sides of the basi-occipital, about half an inch from the condyles: the bone is continued, external to these, into a short but strong rough tuberosity, forming the posterior boundary of the articular depression (*c*) for the stylo-hyal bone, and the external boundary of the jugular foramen (*d*), which is immediately anterior and external to the anterior condyloid foramen. The sides of the basi-sphenoid begin to descend below the level of the intervening plate, rendering it concave transversely, and terminating each in a rough subelliptical tuberosity (*f*), placed with its long axis almost transversely, its extremities being pointed, and the inner ones over-arching, in the reversed position of the skull, the narrow, smooth, intervening surface of the sphenoid. In the antero-posterior direction, the sphenoid, as it extends forwards into the posterior wide opening of the nasal cavity, is slightly convex. The sides of the basi-sphenoid, immediately anterior to the jugular foramen, are excavated and give lodgement to the obtuse inferior apex of the loosely articulated petrous bone which divides the jugular from the very small carotid foramen. The transverse protuberances above described, are the seat of large air-cells, which do not communicate with the tympanic cavity; they are laid open on the right side in the plate. The bony canal for the Eustachian tube is narrow at its commencement, but rapidly expands near its communication with the posterior nasal aperture; it divides the sphenoid protuberance from the pterygoid bones. These are anchylosed, as processes, to the sphenoid, and consist on each side of a moderately thick, long, vertical plate of bone, about three inches in depth at their posterior part, which is the thickest, and is roughened by vertical ridges and furrows. The anterior extremities of the pterygoid converge with a gentle curve, convex outwards, to the posterior margin of the osseous palate, and thus form the lateral and anterior boundaries of the long and wide posterior nasal aperture. The inner side of the pterygoid is moderately convex; the outer side concave; the inferior obtuse margin being slightly everted. The foramen ovale perforates the middle of the outer side of the pterygoid, nearly two inches from its posterior margin: a ridge is continued from the middle of the posterior edge of the bony palate along two-thirds of the inner side of the pterygoid, about an inch above its inferior margin. The canal for the second division of the trigeminal nerve is continued from the foramen rotundum, along the inner side of the root of the pterygoid, which separates it by an extremely thin plate of bone from the nasal cavity; the outlet of the canal is situated about three inches in advance of that which gives exit to the third division of the same nerve. The body of the sphenoid, as it extends forwards into the nasal cavity, contracts to a median ridge, which supports the vomer: on each side of this median ridge, a smooth and concave plate of bone arches down to form the inner side of the pterygoid, and is broken only by a narrow, deep and straight vascular canal, continued from a foramen about an inch anterior to the expanded terminations of the Eustachian depressions. The sides of the base of the cranium are chiefly formed by the petrous or petro-temporal bones, here wedged in between the sphenoid, exoccipital and squamo-temporal bones. The innermost portion of the petrous bone is a subcompressed, conical protuberance, the blunt apex of which projects downwards into the lateral emargination of the basi-sphenoid and forms the outer and posterior boundary of the canalis caroticus. On the outside of the conical process the petro-temporal sends down a rugged cubical process, one side of which is towards the cavity lodging the conical process, a second bounds the jugular foramen anteriorly, a third forms the inner side of the rough stylo-hyal cavity, and the fourth, or anterior side, bounds the posterior part of the tympanic cavity.

The inferior, rugged mastoid protuberance is excavated for the ligamentous articulation of the stylo-hyal bone*. The articular cavity is shallow, of a subcircular form, about an inch in diameter, with a well-defined, rugged margin; its

* This bone is figured *in situ* in Plate I.

plane is nearly horizontal. From the middle of its outer margin the ridge is continued vertically upwards, which bounds anteriorly the depression described in the side-view of the skull.

The tympanic cavity is not very deep nor very large: it is bounded posteriorly by the mastoid and rugged cubical process of the petro-temporal; internally by the smoother conical process of the petro-temporal and by the rough protuberance of the sphenoid; anteriorly it is continued forwards and downwards by the Eustachian depression upon the posterior base of the pterygoid; externally it opens upon the smooth depression between the stylo-hyal and the glenoid articulations of the temporal: an elliptical depression, admitting the end of the little finger, leads from the roof of the tympanic cavity into the cellular structure of the base of the zygoma. The tympanic bone is wanting: it has not been broken off, as a mere process of the temporal; but must have been an independent detached ossicle, and probably similar in shape to that of the Glossotherium and Orycteropus.

The concave outer side of the base of the pterygoid, above the large foramen for the third division of the fifth, is continued into the flat, horizontal articular surface for the lower jaw at the base of the zygoma. This surface is obscurely bounded by a slight convex prominence of the bone behind; it passes externally into the narrower, flattened surface, which is continued along the under part of the zygoma, to its termination at the articular surface for the malar bone.

The base of the skull is naturally divided into three regions,—the posterior one behind the pterygoids; the middle one including the pterygoids, and formed chiefly by the wide posterior depression and aperture of the nasal cavity; and the anterior one formed by the dental alveoli and bony palate. The anterior region is of a triangular form, with the base turned forwards and bounding the floor of the skull anteriorly by a convex curve, indented by a median angular notch; the sides of the triangle are slightly concave, and converge to the posterior boundary of the palate, the apex of the triangle being here cut off by an entering notch, the sides of which receive the pterygoids; five alveoli are situated on each side of the palate, and the intermediate plate of bone is slightly convex and sculptured by vascular grooves and foramina.

The posterior alveolus is situated one inch and a half from the apex of the posterior median notch of the palate; the extent of the alveolar series is five inches eight lines, and the first socket is about half an inch from the outer and anterior angle of the base of the skull. The sockets are small and simple, but deep, corresponding with the teeth; the plane of their outlets slopes from without downwards and inwards: in the present skull the teeth are worn in a corresponding direction, but so that whilst they project a little beyond the thin external walls of their sockets, they do not attain the level of the rough, convex, internal alveolar boundaries, which we may suppose, therefore, to have been defended by a callous gum, aiding perhaps, by the attrition of the tongue against the palate, in the triturating process. This description applies to the four posterior sockets, which are separated by very narrow intervals. The first or anterior socket is half an inch in advance of the second, and its external wall forms a distinct convex prominence near the anterior part of the muzzle; it is also more curved than the rest; all which distinctions indicate the first tooth to be the representative of a canine. The gradual convergence of the two rows of sockets as they extend backwards, and the shape and relative size of their outlets, are shown in Plate IV.

The posterior contracted part of the palate presents several small foramina. It is moderately smooth and slightly concave on each side the median line, which concavities contract to longitudinal grooves opposite the penultimate and antepenultimate grinders, the middle line of the palate being developed into a ridge between these grooves; the broad and slightly convex part of the palate is sculptured by numerous irregular vascular perforations and canals; the median suture, and those defining the limits of the palatine and maxillary bones, are obliterated. The anterior palatine foramen is represented by an angular notch: one of the principal vascular foramina and grooves is situated on each side of this notch. It is probable that some rudiment of an intermaxillary bone may have converted this notch into a foramen.

Forms and Connections of the Cranial Bones.—The obliteration of most of the sutures in the present skull, which is probably that of an aged animal, leaves little to be said of the connections of the cranial bones, or of the proportions in which they respectively entered into the formation of the different cavities.

The occipital bone is obviously large, with the condyloid or ex-occipital elements widely separated by a broad and flat basilar plate. The supra-occipital element forms nearly the whole posterior region of the skull* ; and guided by the remains of the suture joining it with the squamo-temporal, and by the analogy of the young Scelidothere †, it probably encroached upon the coronal surface of the skull and joined the parietals by a transverse lambdoidal suture. This broad supra-occipital plate is, upon the whole, slightly convex, and inclined from below upwards and forwards; developing superiorly the occipital crest, the strongest in the whole cranium of the Mylodon, and a little below this, on each side, a narrower and sharper ridge (*e*) receding from the upper crest as it curves downwards towards the condyle, and leaving a deep concavity in the interspace. Immediately above each condyle there is a small foramen. A groove runs down from this foramen to the inner side of the condyle, widening as it descends: the middle of the upper part of the foramen magnum presents a wide but not deep emargination.

The extent of the parietal bones was doubtless great, but cannot be precisely defined in the present cranium: their outer plate is almost flat and smooth above, and is bent down at nearly a right angle upon the side of the temporal fossa; the extent of this descending plate, and the straight course of the squamous suture is indicated by the depression containing its nearly obliterated remains ‡.

The squamo-temporal plate and its zygomatic process have been already described, and the detached condition of the tympanic bone has been alluded to; the petrous and mastoid elements are confluent, but the sutures dividing the latter from the squamous and from the supra- and ex-occipitals are distinct. Nearly the whole of the stylo-hyal (*b*) and digastric (*c*) cavities are formed by the mastoid bone.

The anterior extent of the frontals is shown by the persistent fronto-maxillary suture on the left side §; elsewhere these bones are confluent with each other, with the parietal, with the sphenoid, and even with the broad nasal bones. The nasals have likewise coalesced, except near their expanded anterior extremities, where a trace of the median harmonia remains.

The fronto-maxillary suture, which is unobliterated on the right side, and the malo-maxillary suture, define the proportions in which the frontal, maxillary and malar bones respectively enter into the formation of the frame of the orbit.

The cranial division of the skull seems, on an outward inspection, to be of

* Plate V. fig. 1.

† Zoology of the Beagle, Fossil Mammalia, p. 77. pl. 22.

‡ This depression is well shown in Plate II.

§ Plate III.

great proportional size, especially in longitudinal extent, but the proper cranial cavity is small: it does not extend forwards beyond the posterior third part of the skull, and is separated from the upper, lateral, and even from the posterior and under surfaces of the skull by large air-cells. To use a botanical comparison, one might say that the cerebral pith or kernel, besides having its immediate hard shell in the vitreous table, is also defended by a thick cellular husk and a tough outer capsule.

The prodigious extent of the air-cells continued from the frontal and ethmoidal sinuses, form, indeed, one of the most striking characters in the cranial organization of the Mylodon: they are continued backwards into the parietal, temporal, sphenoid and occipital bones, separating the two tables of the skull for an extent of sometimes two inches; irregularly sinuous bony plates form the medium of support and connection of these tables, divide the air-chambers, and multiply the surface of the vascular lining membrane.

The cerebellar division of the cranial cavity may be traced by a slight projection of the inner wall at its circumference: but this is not developed into a bony tentorium. It is of large proportional size, and shows that the cerebellum was wholly posterior to the cerebrum. The small proportion of the carotid to the basilar artery, manifested by their respective bony canals, also indicates the low development of the higher or cerebral division of the encephalon. The sella turcica is wide and very shallow, undefended by clinoid processes. The cribriform plate is of great extent, and divided by a crista galli: the anterior compartment of the cranial cavity in which this plate is lodged, indicates the large size of the olfactory lobes.

The two fractures before described are limited to the outer table of the skull, and have laid open only the air-sinuses. Of the inflammation and disturbance thence ensuing, abundant evidence is afforded by the vertical section of the skull through the anterior healed fracture, represented in Plate V. fig. 2. *f*. The outer table and contiguous septa of the air-sinuses have been thickened; the sinuses have been distended with collections of pus, their walls have yielded, modified by the absorbent and restorative processes, and the vomer (*d*) has been bent considerably to the left side. It resumes its ordinary median vertical position anterior to this seat of injury, and extends to near the anterior extremity of the skull, forming there a stout supporting wall to the large nasal bones.

Remains of superior and inferior turbinated bones are recognisable in the wide nasal cavern: the superior ones commence anteriorly as strong plates curving inwards from the outer margins of the nasal bones (fig. 3. *b*.); the lower ones arise from the inner side of the maxillary bones near the lower angles of the cavity, leaving a large middle meatus (*c*).

Maxilla inferior *.—The lower jaw consists of two rather short, deep and strong rami, extending nearly parallel with each other to a broad, transverse, sloping symphysis, where they are anchylosed together. The posterior part of each ramus expands into a deep but thin vertical plate of bone, forming the ramus ascendens, which divides into the coronoid, condyloid and angular processes. The alveolar series, including the four molar teeth, occupies nearly the middle third part of the horizontal ramus.

The condyle (*a*) is broad and convex from side to side, narrow from before backwards, and nearly flat in this direction at its outer half, which chiefly played upon the glenoid surface: the flattened part is smooth; the inner convex part is rough. The articular surface is not quite transverse, the outer end inclines a little forward; the inner and thicker part of the condyle overhangs the supporting plate of bone to the extent of nearly an inch; the outer end is less prominent, and more gradually subsides by an oblique ridge extended forwards and downwards for the extent of an inch upon the outside of the ramus.

A slight concavity, about the thickness of one's finger, intervenes between the articular surface of the condyle and the coronoid process (*b*), the base of which extends forwards to the posterior parallel of the last molar tooth; this process is a thin, triangular, vertical plate; the anterior margin is convex, the posterior one is concave, and the upper angle inclines backwards; the inner surface is slightly concave and smooth; the outer one convex in a similar degree, but roughened by small intermuscular ridges reticularly disposed, and by a larger ridge extending down the middle, and curving backwards so as to define the boundary of the insertion of the temporal muscle.

The angular process (*c*) is similar in size and form to the coronoid one, but projects backwards instead of upwards, the angle only being slightly inclined in the latter direction. The lower margin is convex, the upper one concave, but in a

* Plate VI.

less degree; the outer surface is more convex than that of the coronoid process, and is traversed by three nearly parallel longitudinal ridges, and by a fourth shorter ridge which curves upwards. These indicate the strong insertion of that part of the masseter which arises from the descending process of the zygoma, and which protracts the jaw. The inner side of the angular process presents a general and moderately deep concavity, bounded below by the inflected inferior border of the process, and in front by a ridge extending from that border obliquely upwards and forwards to near the alveolus of the last molar. Above the termination of this ridge, and behind the last alveolus, a short vertical ridge of bone projects inwards and backwards, and bounds anteriorly the concavity on the inner side of the ascending ramus. The surface of this concavity is smooth except at its posterior part near the concave border of the angular process, where it is broken by some irregular ridges and impressions.

The anterior part of the base of the coronoid process is continued by a convex, smooth, osseous prominence or buttress, along the outside of the alveolar process, for about two inches, gradually subsiding to the level of the outer plane of the horizontal ramus. The alveolar tract of each ramus includes four sockets, the two posterior of which are slightly inclined inwards; the right and left series of sockets diverge as they advance forwards: the sockets correspond of course with the shape and size of the teeth, and are consequently of great depth. The last two molars in the present specimen are worn down to the level of the alveoli, the others project more as they advance forwards. The margin of the alveolar outlet is rough; in the last one it is rather broad, slightly excavated, and rises at a little distance from the tooth as an irregular ridge, indicating that the molar was surrounded by a thick and probably callous gum. The interval between the first and second sockets is three lines, or nearly twice that of the interval between the second and third, or the third and last sockets. A convex rising of bone bounds the outside of the alveolar series, but is interrupted between the first and second sockets. These, though they be slight indications of the distinctive character of the first socket, are interesting, since the anterior molar of the upper jaw, by its greater separation from the four posterior ones, more decidedly represents a canine tooth; and if the last large molar of the lower jaw be regarded, from its peculiar form, as equivalent to the two separate posterior molars in the upper jaw, then the first molar would correspond with the canine-like anterior tooth of the upper jaw, and not with the second of that series. On the outside of the jaw, below the alveolar process, there is a shallow longitudinal channel, and below this depression the horizontal ramus presents a slight but general convexity to its thick inferior border: the longitudinal course of this border from the angle to the symphysis of the jaw is slightly sinuous, convex in its posterior third, then gently concave, then very slightly convex below the middle alveoli, and again very slightly concave where it begins to sweep inwards to form the symphysis. This anterior termination is the most remarkable feature of the lower jaw, and resembles the blade of a spade: it is inclined from below upwards and forwards at an angle of 130° with the basal line, as a broad nearly square plate of bone, diminishing in thickness to its upper margin, which is nearly straight. The trenchant anterior edge is a little roughened or broken for the attachment doubtless of a callous gum: it offers no trace of incisive sockets: it forms a right angle with the lateral margins of the symphysis, which are slightly concave; each angle is rounded off. The inner surface of the symphysis is smooth and concave at its anterior half, convex vertically at its lower half; but here also smooth and without any ridge or process indicating attachments of genio-hyoid or genio-glossal muscles. Its size, form and position strongly indicate that it supported and facilitated the movements of a large and probably long and prehensile muscular tongue.

The outer surface of the symphysis is rough and irregular, slightly concave, and with an oblique eminence on each side of the middle line. These eminences* indicate the place of origin of the retractors of the lower lip. The lower margin of the symphysis is almost trenchant and concave; it is only one inch in advance of the anterior socket. The lower margin of the horizontal ramus † expands to form a thick convex support of the dental sockets, and again contracts to an almost trenchant edge beneath the broad ascending ramus.

The large elliptical entry to the dental canal is situated near the middle of the inner concave surface of the ascending ramus; a shallow depression leads forwards to it from below the inner overhanging part of the condyle. A narrower and deeper groove is continued obliquely downwards and forwards from the preceding bed of the trunk of the dental nerve, and cuts through the middle of the ridge bounding the general concavity of the ascending ramus.

* Plate V. fig. 4. *e, e.*

† Plate VI. fig. 3.

In another specimen the descending branch of the nerve forming the preceding groove, undermines the ridge, which was continued uninterruptedly across the foramen by which the groove terminates below.

The great dental canal is continued forwards for about an inch, and then divides: the smaller branch perforates obliquely the anterior part of the base of the coronoid process, and terminates by an elliptical foramen* on the outer side of the jaw, about an inch below the anterior root of that process. The larger division, forming the continuation of the canal, descends obliquely to the under and inner side of the alveolar series, where it bifurcates into a wider and a narrower groove, the latter being at the outer part of the canal. The canal ascends near the anterior part of the alveolar series, and divides into three branch canals, which open upon the outer side of the jaw, where the ramus bends inwards to form the symphysis: the largest of the foramina is the highest and hindmost, and is situated just anterior to the first socket, and about half an inch below the upper margin of the ramus: on one side there were two, on the other three small foramina.

The size and number of these foramina, which transmitted the vessels and nerves to the lower lip, indicate its great development; and the corresponding evidences of the strength of the muscles inserted into it combine to prove its importance in the economy of the Mylodon. The power of the retractors must have had an equivalent in that of the elongators, consisting of the fibres of the orbicularis oris; and the lower lip, thus organized, doubtless aided the tongue in stripping off the foliage and smaller branches of the trees which the general organization of the skeleton of the Mylodon will be shown to be so well calculated to enable it to uproot and prostrate.

Comparison of the Skull.

A brief inspection of the skulls of existing quadrupeds suffices to determine those to which the Mylodon makes the closest approach in its cranial organization.

In no other genus, save *Bradypus*, is the cheek-bone so nearly developed to

* Plate VI. fig. 2. *g*.

the mylodontal proportions; in no other does it ascend above the zygoma into the temporal region, or descend below the alveolar tract. And the similarities of cranial organization do not end here: the complicated malar bone is associated, in the Sloths, with a terminal position of the great anterior and posterior orifices of the cranium; with terminal occipital condyles; with a sloping occipital region; with a smooth and crestless parietal tract; and with a muzzle almost as short, thick, and abruptly truncated as in the *Mylodon robustus*.

The cranial division of the skull is relatively as great in the Sloths as in the Mylodon; and the actual capacity of the cerebral cavity is masked by a similar expansion of the air-cells which almost everywhere surround that cavity, and raise the outer plate of its bony parietes above the vitreous table.

The occipital bone presents the same expanded proportions, the same broad and flat basilar plate; and the anterior condyloid foramina are of conspicuous size. The tympanic bone nearly completes a circular frame for the ear-drum, to which function it is limited, and long remains separate. The detached and lost tympanic bones of the Mylodon have been evidently restricted to the same office. The temporal fossa is long and large, and is continued freely into the orbit: the squamous plate of the temporal scarcely rises half-way towards the upper boundary of the fossa, and terminates by an almost horizontal margin. The supraorbital boundary, continued from an obtuse postorbital process, is almost lateral. The single lachrymal foramen is perforated exclusively in the lachrymal bone. The large quadrilateral nasals become sometimes confluent in the Sloths. The intermaxillary bones are edentulous, and without ascending process; they are almost of rudimental proportions in the Unau, and in the Ai are represented by a single small triangular plate, bounding by its base a triangular cleft at the anterior part of the maxillaries, and thus defining the incisive foramen. We may thence infer that the anterior palatine cleft was similarly inclosed in the Mylodon. The correspondence here pursued is not less closely marked in the lower jaw; the rami of which, in the Sloths, enlarge and branch out posteriorly into a coronoid, a condyloid, and a long and deep angular process, and are anchylosed anteriorly at a broad sloping symphysis. Only in the genus *Bradypus*, amongst existing quadrupeds, do the alveoli of both jaws correspond in number, simpiicity, relative depth, and position with those of the genus *Mylodon*. The still more important agreement between these existing and extinct *Bruta* in the structure of the teeth yields the crowning proof that it is to the diminutive arboreal Sloths that the Mylodon and its more or less bulky congeners have the closest natural affinity.

The chief differences observable in the cranial anatomy of the Sloths, as compared with that of the Mylodon, are the greater relative depth and breadth, and the more convex outline of the coronal aspect of the skull. The zygomatic process of the temporal bone is relatively shorter, and does not attain the malar bone; this, therefore, has not the middle process for supporting the zygoma, and is bifurcate, instead of being, as in the Mylodon, trifurcate. In the greater breadth and exterior sculpturing of the descending process of the malar, and in the greater relative length and minor convexity of the upper part of the skull, the resemblance of the Unau to the Mylodon is greater, but in the large size of the anterior tooth in both jaws it is less than that of the Ai.

The Mylodon, in the more elongated form and straighter contour of its skull, and in the complete zygomatic arch, is more like the Orycterope and Armadillos than the Sloths; but the unimportant character of these approximations is apparent on a closer comparison. The length of the head in the fossorial Edentata is chiefly due to the prolongation of the jaws, the orbits being situated in the posterior half of the skull. The zygoma is a simple arch without ascending or descending processes; at best a rudiment only of the latter appears in the Chlamyphore—the smallest of the existing Armadillo tribe*. The angular process of the lower jaw is short or obsolete. The exaggerated length of the slender edentulous jaws of the Ant-eaters and Pangolins, and their defective zygomatic arches, remove them to a greater distance from the Mylodon. With other existing Mammals, not of the Edentate order, it would be lost time to pursue the present comparison, with a view to the elucidation of the natural affinities of the Mylodon. It needs only to place the skull of the species under consideration by the side of that of the Horse, Ox, Elk, Tapir, Rhinoceros, Dugong, or other vegetable feeder of corresponding size, to be struck with the peculiarities of the fossil, and to infer that the habits and mode of feeding of the Mylodon must have been such as are no longer manifested by the large Herbivora of the present day.

* It would seem that the large extinct Glyptodon had the origin of the masseter extended by an inferior prolongation of the malar, similar to that in the Megatherium and Sloth tribes.

It remains, then, to inquire whether, among the extinct forms of the Mammalian class to which was assigned the office of restraining the too luxuriant vegetation of a former world, there be any that, from their cranial or dental characters, may be concluded to have resembled the Mylodon in the mode of performing that task?

The skull of the Megatherium, while it presents all the essential resemblances to that of the Mylodon which have been pointed out in the skull of the Sloth, as the long cranium, the short muzzle, the terminal position of the condyles, and of the occipital and nasal apertures, and the large and complicated malar bone, approximates still more closely in the junction of the malar with the zygomatic process of the temporal, and in the relative depression and flatness of the elongated cranium.

In thus receding from the Sloths the Megatherium does not approach any other existing genus, but only another member of its own peculiar extinct family; and in receding from the Mylodon in the cranial characters next to be noticed, the interval is not diminished which separates the Megatherium from existing large vegetable feeders, but its own peculiar modifications alone are manifested.

The most marked differences in the skulls of the Megatherium and Mylodon depend on the greater length of the teeth, and consequent depth of their sockets, in the larger species; which require a greater vertical extent of the maxillary bone in the molar region, and of the corresponding part of the lower jaw, the lower border of which describes a deep convex curve at the middle third of the horizontal ramus. This modification necessitates a greater proportional length of the descending process of the malar bone, which is at the same time more vertical in position and relatively narrower than in the Mylodon. In these differences the Mylodon shows its closer resemblance to the Sloths.

The basi-occipital is relatively narrower, and the condyles nearer together, in the Megatherium than in the Mylodon; the occipital plane is less inclined; the zygomatic process is proportionally stronger. The greater depth of the lower jaw and the heavier grinding machinery call for a more extensive origin of the temporal muscles; and accordingly the superior boundaries of their fossæ meet and form a median crest upon the upper surface of the cranium of the Megatherium. This structure, which is represented by MM. Pander and

D'Alton*, is also very clearly indicated by the anterior portion of the skull of the Megatherium in the Museum of the Royal College of Surgeons, in which the anterior portions of the temporal ridges, where they diverge to the upper parts of the orbits, are shown. The orbit in the Megatherium is better defined than in the Mylodon, by the presence of a postorbital process ascending from the upper margin of the malar bone, which bone is thus divided into four processes, and is by so much the more complicated than in the Mylodon. The interorbital part of the skull is relatively broader, the maxillary part relatively narrower, than in the Mylodon. There are three suborbital foramina in the Megatherium, instead of one, as in the Mylodon†. The intermaxillary bones, which are preserved in the above-mentioned skull of the Megatherium, are unquestionably of a different form and of larger relative size than they could have been in the Mylodon. This is proved by a comparison of the anterior margin of the maxillary bones, to which they are articulated, with the corresponding part of the skull in the Mylodon. In the latter these margins are narrow, rounded, smooth, and offer no trace of a sutural surface; in the Megatherium they present a broad rough depression, into which the base of the intermaxillary bone is wedged. The intermaxillary is an elongated, four-sided, subcompressed bone, expanded at both extremities, united with its fellow, bounding the anterior palatine aperture, which is absolutely narrower than in the Mylodon, and prolonging the upper jaw; to which the intermaxillaries thus give a conical form, with a slightly expanded apex. This, perhaps, is the most essential difference between the Megatherium and Mylodon, and one which again removes the Megatherium further from the true Sloths. Another well-marked difference in the Megatherium is the absolutely narrower palate: the intermolar part, for example, is widest between the anterior molars in both fossils, but while its breadth at this part is five inches in the Mylodon, it is only two inches in the Megatherium. The edentulous anterior part of the lower jaw corresponds in length and narrowness with the upper jaw in the Megatherium, and consequently offers another striking deviation from the cranial characters of the Mylodon.

* Das Riesen-Faulthier, pl. 3. fig. 3.

† These holes indicate the nerves of the upper lip of the Megathere to have been of the same proportional size as in the Tapir.

A comparison of the skull of the Mylodon with that of the Megalonyx would doubtless be replete with interest, since many intermediate approximations to the Megatherium might be anticipated: but the requisite materials are still wanting. The only part of the skull of the Megalonyx hitherto determined upon sufficient grounds for such a comparison, is the mutilated lower jaw, described and figured in the 'Fossil Mammalia of the Beagle*.' As compared with the Mylodon, the rami of this lower jaw, instead of being straight and parallel, recede from each other in the molar region by a slight outward curvature, and besides the generic differences in the form of the teeth, the two series slightly converge anteriorly in the Megalonyx, instead of diverging, as in the Mylodon; the rami of the jaw also meet anteriorly with a more contracted curve.

The extinct Megatherioid animal, of which, after the Mylodon and Megatherium, the most complete cranium has hitherto been obtained, is the *Scelidotherium* †. This presents the before-mentioned essential characters of the Sloth's skull, but with the mylodontal modifications which are manifested in the complete zygoma and trifurcate malar bone. The occipital plane differs from that of the Mylodon and Sloths in being vertical; and the palate is narrower, the rami of the lower jaw more convergent as well as relatively shallower anteriorly, than in the Mylodon. But the Scelidothere, in the general form and proportions of the skull, in the depth of the molar portion of the jaws, in the contour of the lower margin, and in the extent and shape of the angle of the lower jaw, resembles the Mylodon, not the Megatherium. Its chief approximations to the Megatherium are made by the absence of the diastema between the first and second molars in the upper jaw, and by the contraction of the palate, which, however, is less marked in the Scelidothere. A valuable fact is yielded by the skull of the Scelidothere, from which these observations were taken, in the persistence of the stylo-hyal bone, cemented by the matrix to its natural place of articulation, viz. the cavity in the mastoid bone already described. By this I have been enabled to recognise the corresponding bone in the collection of remains of both the Megatherium and Mylodon in the Museum of the College.

* Part IV. 4to, p. 99, pl. 29.

† Fossil Mammalia of the Beagle, p. 73, pl. 21, 22, and 23.

The relations of the Megathere and Scelidothere to the Mylodon in the form of the lower jaw will be better appreciated when the modifications of this bone in the different species of Mylodon have been pointed out. In the *Mylodon Darwinii* the rami of the lower jaw are relatively longer than in the *Mylodon robustus*, especially anterior to the molar series, where they become more contracted vertically, and converge to a narrower and longer symphysis. The posterior angular process is relatively shorter and more bent upwards. The molar teeth project further from their sockets in the specimen compared with that of the *Mylodon robustus*. The anterior outlet of the dental canal is single, and it is more in advance of the first alveolus. The symphysis is not only longer, but is inclined forwards at a more open angle with the horizontal ramus: the two tuberosities on the outside of the symphysis for the attachment of the retractors of the lower lip are much more strongly developed in the *Mylodon Darwinii*, than in the *Mylodon robustus*.

The lower jaw of the Megatherium is relatively narrower than in the Mylodon, but deeper, except at its anterior or symphysial prolongation, which is much more, and more suddenly contracted in all its dimensions. The angle of the jaw is less produced backwards, so that the *Mylodon Darwinii* is somewhat intermediate in this respect between the *Mylodon robustus* and the Megatherium: it wants, however, like its congener, the deep convexity of the submolar part of the jaw, which has already been alluded to as characteristic of the *Megatherium*, in which it gives greater depth to the sockets of the teeth. The symphysis slopes forwards almost horizontally in the Megatherium: its upper margin is expanded and convex on each side. The muscles of the lower lip which took their origin from the symphysial tuberosities in the Mylodon, probably arose from the submolar convexities of the lower jaw in the Megatherium.

The Scelidotherium resembles the Mylodon in the general form of the lower jaw: the angular process is most like that in *Mylodon robustus*, but is more obtuse. The horizontal ramus becomes narrower vertically as it approaches the symphysis, and thus more resembles that of the *Mylodon Darwinii*. In all the essential characters of the lower jaw, as in the number, structure, and kind of teeth which it contained, the extinct Megatherioid quadrupeds more closely resemble each other and the existing Sloths, than any other known existing or extinct species.

Description of the Teeth.

The teeth of the Mylodon are eighteen in number, arranged according to the following formula, $\frac{5-5}{4-4} = 18$: they are simple, long, fangless, and of the same thickness from the implanted to the exposed end; the former is excavated by a deep conical pulp-cavity *, the latter worn into a shallow depression, with a raised obtuse margin. The forms of the grinding surfaces are so accurately given in Plates IV. and VI.,—those of the upper jaw being represented of the natural size,—that verbal description may be dispensed with. The exserted parts or crowns are unusually worn down, and rather obliquely, so as not to reach the level of the inner wall of the socket in the upper jaw, nor that of the outer wall in the lower jaw †.

The first tooth of the upper jaw, which, as the figures express, is separated by a marked interval from the rest, is also more curved, the convexity being turned forwards; the posterior teeth are nearly straight: their length is about three inches, the first is a few lines longer than the rest.

In the lower jaw, the first tooth opposes the second upper molar when the jaws are naturally closed; but the nature of the joint would allow considerable extent of motion forwards and backwards, and the bony attachments for the masseter show its peculiar adaptation for working the jaw extensively in the horizontal direction. The grinding surface of the first lower molar is worn down obliquely, the anterior edge being the highest; its curvature is outwards and forwards. The last tooth of the lower jaw, which is the largest and most complex of the series, is slightly bent with the convexity turned inwards.

Each tooth has a central body of vascular dentine ‡, in which the medullary canals run parallel with each other obliquely to the axis of the tooth, and form loops at the periphery of the central constituent: this is inclosed by a cylinder of hard unvascular dentine §, about one line and a half in thickness: the outer covering consists of cement ‖, about one-third of a line in thickness. The unvascular dentine, as the densest constituent, forms the prominent ridge inclosing the central depression of the grinding surface.

* This is indicated by the dotted line in the teeth figured in Plate V. figs. 5 and 6.

† In Plate II. the teeth are figured a little more protruded than in the skull itself.

‡ Plate XXIV. fig. 3. *a*. § Ibid. *b*. ‖ Ibid. *c*.

Comparison of the Teeth.

The structure of tooth above described is peculiar, among existing Mammalia, to the Sloths; and is doubtless especially adapted for the comminution of the foliage which constitutes their food*. The number of the teeth, their length and absence of fangs, their excavated base, and the unlimited growth resulting from the persistent pulp, together with their composition of cement, unvascular and vascular dentine, are characters common to the Megatherioids and Sloths. The form of the teeth, which determines that of their grinding surface, differs in, and is characteristic of, the different genera. It would seem that the Megalonyx, in the simple elliptical or subcylindrical shape of such of its teeth as are known, more closely resembled the existing Sloths than do the other Megatherioids. If the tooth of the Megalonyx possessed, as has been affirmed†, true enamel, it would materially differ not only from those of the Mylodon and Sloths, but from every other Edentate animal. I have, however, ascertained by examination of a tooth in the lower jaw above mentioned, that the hard part which Cuvier thought to be enamel, is the unvascular dentine or ivory; and that, in the large proportion of the vascular dentine in the centre and of the cement at the circumference, the teeth of the Megalonyx correspond with those of the Sloths, not with those of the Armadillos‡.

The Unau resembles the Mylodon in the separation of the first from the other upper molars, but the detached tooth assumes, in the existing Sloth, the form and proportions, as well as the position, of a canine; and the corresponding tooth of the lower jaw is similarly developed and separated from the other three teeth by a nearly equal interval. In the adult Ai the first molar of both jaws presents

* See the magnified section of a molar of the *Bradypus tridactylus*, Plate XXIV. fig. 1.

Cecropia peltata and *Achra sapota* have been particularized as affording nutriment to the Sloths, but few of the trees forming the denser forests of tropical America are exempt from their attacks.

† Cuvier, describing the tooth of the Megalonyx, says, "Je l'avois crue d'abord nécessairement de Paresseux; mais aujourd'hui que je connais mieux l'ostéologie des divers Tatous, je trouve qu'elle ressemble au moins autant à une dent de l'un des grands Tatous. Dans ces deux genres, les dents sont de simples cylindres de substance osseuse enveloppés d'un étui de substance émailleuse."—*Ossemens Fossiles, ed. cit.* tom. viii. p. 329.

‡ Zoology of the Beagle, 'Fossil Mammalia,' 4to, p. 69.

the proportions of those in the Mylodon, but is not separated from the rest by so wide a diastema. In neither of the existing Sloths has the last molar of the lower jaw so complicated a form or so large a relative size as in the Mylodon, but the three-toed species makes the nearest approach to this character in the outer and inner longitudinal grooves of the last molar.

The superior number, and still more the distinct microscopic structure of the teeth of the Orycterope and Armadillos, remove them from the pale of comparison with the Mylodon and its extinct congeners.

The comparison of the dentition of the species under consideration with that of the *Mylodontes Darwinii* and *Harlani* is necessarily limited to the teeth of the lower jaw.

With respect to the *Mylodon Harlani*, the difference is chiefly manifested in the last molar tooth. In the *Mylodon robustus* the outer side of this tooth is impressed with a single wide and shallow longitudinal depression; but in the *Mylodon Harlani* it presents two similar depressions, the anterior one being the deepest. The deep and broad posterior longitudinal depression on the inner side of this tooth is round in *Mylodon robustus*, but angular in *Mylodon Harlani*.

In *Mylodon Darwinii* the posterior molar of the lower jaw is less complicated and relatively smaller than in either of the other species; being impressed by only a single longitudinal channel on both the outer and inner sides: the inner channel is as oblique as the outer one, but it penetrates the tooth in the opposite direction.

The penultimate molar in the *Mylodon Darwinii* has both the outer and inner side longitudinally indented, but not the anterior side, as in the *Mylodon robustus*. The antero-posterior diameter of the crown exceeds the transverse diameter, whilst the corresponding tooth of the *Mylodon robustus* has these proportions reversed. The second or antepenultimate molar is less deeply indented along the inner side. The first molar has a simple elliptical transverse section, as in the other species of Mylodon.

The dentition of the genus Megalonyx is at present known only (with the exception of the lower jaw, brought home by Mr. Darwin,) by the detached teeth figured by Cuvier in *Megalonyx Jeffersonii*, and by Dr. Harlan in his *Megalonyx laqueatus*. Either of these detached teeth sufficiently indicate by their compressed figure, giving in transverse section a long, irregular ellipse, with a prominence from one side, their specific distinction, at least, from the above-cited species of Mylodon. The Darwinian specimen of Megalonyx more satisfactorily establishes the distinction by showing that both the second and third lower molars present the elliptical section characteristic of the teeth of Megalonyx, and have no trace of the longitudinal channels which distinguish the corresponding teeth in the genus Mylodon; and the Brazilian species of Scelidotherium, described under the name of *Megalonyx Cuvieri* by Dr. Lund*.

In the *Scelidotherium leptocephalum*† the dentition of both the upper and lower jaws can be compared with that of the Mylodon. The first molar is not divided by a disproportionate interspace from the rest: its transverse section gives a narrow inequilateral triangle, with rounded angles, and the base turned inwards and obliquely forwards. The second molar also, instead of an elliptical transverse section, presents also a triangular one with the angles rounded off, and two of the sides slightly indented: it resembles the antepenultimate molar in the *Mylodon robustus*. The third and fourth molars of the Scelidothere are more compressed than in the Mylodon; the long axis of their transverse section is from before backwards, instead of transversely. The fifth molar has a trihedral form, with the broadest side turned outwards and slightly indented. In the lower jaw of the Scelidothere the differences in the form of the teeth are equally manifest, especially in the prismatic form of the first molar: the last molar resembles that of the *Mylodon Darwinii*, the grinding surface of this tooth being divided into two lobes by two oblique channels, which traverse longitudinally, one the outer, the other the inner side of the tooth; but these are shallower than in the *Mylodon Darwinii*, and the lobes are more equal and more flattened. The two middle teeth differ more markedly from the corresponding ones in any of the species of Mylodon: the transverse section of both these teeth presents, in the Scelidothere, a compressed oval form, with the large end turned obliquely forwards toward the outer side of the jaw, and slightly indented, whilst the inner and narrower end of the section is convex. The first lower molar in the Scelidothere corresponds in form with the first upper molar, and is consequently easily distinguishable from the corresponding tooth in the genus Mylodon‡.

* *Loc. cit.*, tab. 3 to 9.

† Fossil Mammalia of the Beagle, p. 81. pl. 23.

‡ The form of the first and last molars of the lower jaw, and the two concave surfaces upon the an-

The Megatherium agrees, as has already been shown, with the Mylodon, Scelidotherium and Bradypus in the number, structure, and fangless condition of the teeth. Its claims to generic distinction in regard to dental characters, rest, therefore, on modifications of the same kind as those which have led to the formation of the genera Megalonyx, Mylodon, and Scelidotherium, and which have influenced naturalists in the formation of many acknowledged genera of existing Mammalia. The differences which will be subsequently pointed out in the locomotive organs of the Megatherium, Megalonyx, Mylodon, and Scelidotherium, fully justify the confidence which may be placed in the dental characters on which these genera were originally established. Those by which the Megatherium is distinguished from the subsequently discovered extinct members of the same natural family, are derived from the shape, and the greater proportion of the cement or external constituent of the teeth.

All the teeth of the Megatherium are larger in proportion to their thickness than in the Mylodon, Megalonyx or Scelidothere. They are also more closely approximated, and, as has been shown in the comparison of the skulls, the interval separating the right from the left molar series is narrower. The first tooth in the upper jaw is close to the second, as in the Scelidothere and the three-toed Sloth: but it presents a nearly semicircular transverse section, with the convexity turned forwards and the angles rounded off: the three succeeding molars are four-sided, with the transverse somewhat exceeding the antero-posterior diameter, and with the outer and narrowest side slightly depressed: the last or fifth molar is likewise four-sided, but is only half the size of the preceding, and has a relatively greater transverse diameter. The first and fifth molars are gently curved, with their concavities turned towards each other: the second and third teeth are nearly straight; the fourth is quite straight. To judge from the figures by Bru and Pander of the Madrid Megatherium, the first, second and third molar teeth of the lower jaw correspond with those above; but the shape of the fourth molar is not indicated in either their figures or descriptions. It is obviously most desirable to learn whether it presents the large proportional size and complex form which are its characteristics in the Mylodon and Scelido-

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terior part of the astragalus, determine the *Megalonyces Cuvieri* and *Bucklandi* of Dr. Lund to be species of the genus *Scelidotherium*.

therium; and whether it thus equals the two opposing molars above, or whether these be opposed by two corresponding molars of unequal size below.

The grinding surface of the close-set molars of the Megatherium differ, on account of the greater thickness of cement on their anterior and posterior surfaces, from those of all the smaller Megatherioids in presenting two transverse ridges; one of the sloping sides of each ridge being formed by the cement in question, the other by the vascular dentine, whilst the hard unvascular dentine forms the summit of the ridge. These modifications, with the narrow palate, the close-set series of teeth, their great length, and the concomitant depth of the jaws, are features of resemblance to the maxillary and dental characters of the Elephant; but the fundamental structure and nature of the teeth, not only of the Megatherium, but of all the allied extinct species, are manifested in the present day exclusively by the restricted and diminutive family of the Sloths. These mammals present to the zoologist, conversant only with living species, a singular exception in their dental characters to the rest of their class; but there has been a time when this peculiar dentition was manifested under as various modifications as may now be traced in some of the more common dental types in existing orders of Mammalia.

Description of the Os Hyoides.

A symmetrical bony arch, measuring eight inches along its convex side, with two articular tubercles defining the limits of the body and crura, the expanded extremities of which support a small flat articular surface, evidently represents the body and posterior cornua (*cornua majora* in Anthropotomy) of the os hyoides. The part of the body included between the articular tubercles for the anterior cornua is short, subcylindrical, and of less vertical diameter than the anchylosed posterior cornua. A rather thick and rough convex ridge projects downward from the anterior extremities of these processes, doubtless for the attachment of strong thyreo-hyoidei: two slight tuberosities on the front of the body, below the articular tubercles, indicate the insertions of the sterno-hyoidei. The under part of the body is not flattened nor expanded. No parts corresponding with the stylo-hyal or cerato-hyal elements, which together form the long anterior cornua (*cornua minora* in Anthropotomy) in the Sloths, could be detected among the collection of bones of the Mylodon; but as the most characteristic of these parts, viz. the stylo-hyal bone, is preserved in the collection of the bones of the Megatherium, and also *in situ naturali* in the petrified skeleton of the Scelidotherium, and are in both these genera modified in adaptation to the articular cavity in the mastoid bone, the presence of the same cavity in the skull of the Mylodon shows that it must have possessed a corresponding stylo-hyal bone.

In the Megatherium the stylo-hyal has the form of a hammer with a long, slender, slightly-bent handle, terminated by an obliquely truncated rough surface for syndesmosis with the cerato-hyal. At the opposite end it is subcompressed and expands suddenly in the vertical direction, and terminates posteriorly by a straight but rugged margin; the upper end of the expansion is thickened, and forms a smooth convexity or head, adapted to the cavity at the under part of the mastoid, and therewith united by a much more secure articulation than that of the lower jaw. The lower end of the expansion is more produced, more rugged, but has an obtuse and rather smooth termination. The inner surface of the hammer-head is impressed by a deep and wide groove. The outer surface has a wide depression at the middle, rough, with several short and well-marked ridges. The length of the specimen described is eight inches, the breadth or depth of the expanded end three inches and a half. In the Scelidotherium the stylo-hyal has the same general form and proportions, but the expanded end terminates by a concave line, and has a more bifid character, the upper or articular end being more slender and more produced.

In the Sloths the hyoid system presents two different conditions. In the three-toed species the body and posterior cornua become anchylosed lengthwise with the cerato-hyal or first piece of the anterior cornua, thus forming a single bony arch, to the extremities of which the long stylo-hyal pieces are articulated by their anterior ends, and the apparatus is thus divided into three parts. In the two-toed Sloth the original separation of the body and cerato-hyals persists, and the body is characterized by two articular eminences above the angles at which the posterior cornua are sent backwards.

The preservation of the corresponding part of the hyoid apparatus with the rest of the skeleton of the Mylodon, not only shows its general agreement with the hyoid type in the Sloths, but illustrates the closer affinity of the Mylodon to that species, viz. the Unau, which we have already seen to have deviated least from the Megatherian type in the form of its skull, and shall subsequently find to present a closer resemblance in other important parts of the skeleton.

The stylo-hyal bone is hammer-shaped in the Sloths as in the Megatherioids, but the handle is relatively shorter, which agrees with the shorter cranium; that of the *Cholæpus* comes nearest the Megatherioid type of the bone in the form of its expanded extremity, which in the *Bradypus* proper, or three-toed Sloth, sends up a longer and more slender articular part at an acute angle with the shaft of the bone.

In the Armadillos, at least in *Dasypus sexcinctus*, the stylo-hyal is relatively much shorter and more simple than in the Sloths or Megatherioids, and the cerato-hyal is joined with the body of the hyoid by a separate small ossicle. The posterior cornua are however anchylosed to the body, but this is characterized by a pair of processes at its under part. In the Orycteropus the body of the hyoid is relatively broader than in the Megatherioids or Sloths, and both the anterior and posterior cornua are moveably articulated with it: the stylo-hyoid is as short and simple as in the Armadillos. The hyoid apparatus in the true Ant-eaters (*Myrmecophaga*) and Pangolins (*Manis*) deviates still further, as their anomalously-proportioned tongue may well render probable, from the type of that part in the Sloths and Megatherioids; and further comparisons with the hyoidean apparatus in quadrupeds not of the Edentate order would throw no additional light on the immediate subject of the present memoir, viz. the osteology and affinities of the Mylodon.

Description of the Vertebral Column.

The central axis of the skeleton of the Mylodon presents a character of great strength in relation to the size of the animal; but derives its most striking feature from the anchylosis which prevails throughout the pelvic and lumbar regions.

The true vertebræ are divisible into seven cervical, sixteen dorsal, and three lumbar, yet not more than two-and-twenty are moveable upon each other, the last dorsal and all the lumbar vertebræ contributing to form an anterior prolongation of a peculiarly extensive sacrum. The cervical vertebræ are short, not excepting even the second, and are not otherwise remarkable, than for the great breadth of the atlas, which surpasses that of the skull, and for the large and strong spine of the dentata. The dorsal region is characterized by the almost uniform length and direction of its spines, but is more remarkable for the great capacity of the spinal canal and the concomitant expansion of the neural arches, the vertebræ surpassing in these characters those of the Elephant. The lumbar region is still more peculiar: instead of the row of long and broad transverse processes which usually characterize it in the larger Mammalia, a continuous, thin and nearly horizontal plate extends from each side of this short region of the vertebral column, in which plate only the two anterior vertebral interspaces are indicated by emarginations.

Cervical vertebræ.—The atlas* is a transversely oblong, subdepressed, shuttle-shaped bone, perforated by a large, subquadrate aperture for the spinal chord, which is bounded above and below by simple and slightly arched plates of bone, neither of which bear tubercle or spine: the lower plate, representing the body of the vertebra, has a shorter transverse, and a still shorter antero-posterior extent, than the upper or neural plate. The sides of the central aperture are formed by the articular and transverse processes; the latter are broad and large, and decrease in thickness to their outer convex margins, the posterior rounded angles of which are produced backwards.

The laminar body of the vertebra† is smooth and convex at its under surface; the thick anterior margin is straight, and separated by a notch, on each side, from the deep anterior articular cavities: the posterior margin is a little produced in the middle and concave on each side: the upper part of the plate is impressed by the large transversely elliptical surface‡, on which the odontoid process plays. The anterior part of the spinal aperture is suddenly widened by two deep lateral excavations§, forming the anterior articular cavities for the occipital condyles. The surface of these cavities is not, as usual, uniformly smooth; a rough tract, which evidently has not been covered by synovial membrane, encroaches on the surface from its inner side. The posterior articular surfaces‖ are circular, very slightly concave, with their plane looking obliquely inwards and backwards. Between these and the odontoid surface, on the inner

* Pl. VII. figs. 1, 2, 3, 4. † Figs. 2, 3 and 4, *a*. ‡ Figs. 1 and 3. *f*.
§ Fig. 2. *d*, *d*. ‖ Fig. 3. *e*, *e*.

side of the bony arch, there are two very rough surfaces for the implantation of the transverse ligament which bound down the odontoid process. The superior margins of the posterior articular processes were separated, in the atlas figured, from the upper arch by a deep groove, for the exit of the nerve. In another mutilated atlas, transmitted with the bones described, but apparently not of the same species of Mylodon, a small vertical bar of bone united the process with the superior arch, and converted the groove into a canal. At the outer end of this neural groove or canal, the posterior aperture of the vertebrarterial canal* is situated: it soon divides into two smaller canals, one below and rather external to the other. The upper canal perforates immediately the upper surface of the transverse process, and appears at fig. 1. *k*; the lower canal first issues at the lower surface at fig. 2. *i*, then perforates the upper surface, at fig. 1. *h*, where it likewise seems to divide, into a canal which runs inwards to the spinal aperture, and into a groove which is continued forwards and outwards. This complicated condition of the arterial canal would indicate that the current of blood was influenced both by sudden bends of the artery, and by its bifurcation and probable reunion at *h*, *k*. The broad upper or neural arch has a thick, rugged, obliquely flattened anterior margin, and a thin, almost trenchant, posterior edge.

The axis, or vertebra dentata†, has a long, subdepressed body, terminated posteriorly by a vertical, elliptical and nearly flat articular surface, and prolonged anteriorly into the thick odontoid process, which is obliquely truncated below to form the articular surface resting on the body of the atlas. The neural arch springs from about half the extent of this long basis, near its posterior end: it immediately sends off from its anterior and outer part a thick and short round articular process, with a very slightly convex terminal surface, *d*; and behind this a short and slender transverse process, *c*, perforated at its base by the vertebral canal, *h*. Above these the sides of the arch contract and converge to the base of the large spinous process: this is prolonged on each side into the posterior articular process, *e*, which is almost horizontal and looks downwards. The thick spinal plate expands antero-posteriorly as it ascends, overhanging the atlas by its rounded anterior angle, and covering the spine of the third cervical vertebra with its more produced and sharper posterior angle.

* Fig. 3. *g*.

† Pl. VII. fig. 5.

Of the five succeeding cervical vertebræ only the bodies and the spinous processes and the roots of the perforated transverse processes have been preserved. The bodies are short, and subdepressed; of a transversely elliptical form; their under surface is slightly concave on each side, but without the intervening part being produced into a spine or tubercle: it forms a broad ridge in the third vertebra, but gradually subsides in the rest. The body of the seventh vertebra is longer than the rest, and is impressed on each side by part of the articulation for the first rib. The spinous processes are of moderate size and length, triangular, with obtuse summits; increasing in the sixth, and still more so in the seventh, which begins to incline backwards.

*Dorsal vertebræ**.—The body of the first dorsal is a little longer than that of the preceding vertebræ; the bodies of the rest preserve an equal length, but slightly increase in depth, and decrease in thickness. In the fourth dorsal the sides converge to a median inferior ridge; and from this vertebra to the tenth dorsal inclusive the bodies are wedge-shaped. In the eleventh dorsal the lower edge becomes blunted or convex; in the twelfth the lower surface grows broader; in the thirteenth it is rendered concave by the development of two parallel longitudinal ridges which divide the inferior from the lateral surfaces; in the sixteenth dorsal the lower surface again contracts in breadth; and in the first lumbar vertebra it reassumes the form of an obtuse ridge, and the body is again wedge-shaped. The sides of the bodies of the dorsal vertebræ are slightly concave: they are perforated on each side, near the lower margin, by a large vascular foramen; which foramina, beyond the twelfth vertebra, are situated upon the concave under surface. The bodies of the dorsal vertebræ, especially of the middle and posterior ones, expand at each extremity, which presents in the middle vertebræ a triangular, in the posterior ones a nearly circular, articular surface: this is almost flat, depressed in the centre, elsewhere slightly convex, and least so on the back part of the vertebra. The anterior costal articular surface† is double the size of the posterior one, is more concave, of an elliptical form, and ascends upon the neural arch: the posterior surface‡ is supported on a very short triangular process, forming the upper angle of the corresponding end of the vertebral body, and is nearly flat. The vertebral arch expands as it

* Pl. VIII. figs. 1, 2, 3, 4, eighth dorsal. † Fig. 2. *a*. ‡ Fig. 2. *b*.

rises from the body, and incloses a spinal canal almost as large as the body itself: its superior anterior margin overhangs the body*, and supports the posterior expansion of the arch of the preceding vertebra, to which it is articulated by two large elliptical and nearly horizontal articular surfaces†. This imbricated overlapping of the arches of the dorsal vertebræ prevails throughout the greater part of that region. The anterior part of the base of the spinous process commences between the anterior articular surfaces and extends to the posterior part of the arch, increasing in thickness. The spines are slightly inclined backwards throughout the dorsal region, and maintain the same antero-posterior extent to their thick truncated and rugged summits. They present very little difference in length, but gradually gain in antero-posterior diameter and thickness from the first to the eighth vertebræ. A somewhat short but very thick and strong transverse process extends outwards and a little upwards from the upper and posterior part of the neural arch‡, and terminates in a nearly circular and flat surface§, looking obliquely downwards and outwards, for the tubercle of the rib. On the upper part of the transverse process there is a stout tubercle, and between this and the base of the spine, a thick longitudinal ridge, both of which are shown in fig. 3. These eminences are most developed on the middle and posterior dorsal vertebræ, and indicate the great power of the spinal muscles. In the last dorsal vertebra the small rib was anchylosed by both its head and tubercle, resembling a long transverse process, perforated at its base‖. The neural arch of this vertebra was anchylosed to that of the first lumbar vertebra; but the centrum remained free, and was characterized by a very flat posterior surface.

The three vertebræ in the lumbar region being confluent with each other and the sacrum, of which they thus form part, as in the class of Birds, will be described with the rest of the anchylosed region of the spine.

Ribs.—There are sixteen pairs of ribs, of which nine were articulated with the sternum, by means of completely ossified cartilages. The ribs increase in length to the seventh, maintain the same length to the thirteenth, and then rapidly diminish, the last being the shortest and straightest. They are relatively broader than in the ungulate quadrupeds of the same size as the Mylodon, equalling, in

* Pl. VIII. fig. 4. † Figs. 2 and 3. *d*. ‡ Fig. 1. § Fig. 2. *c*. ‖ Pl. X. fig. 1. *a*.

this respect, as has been already observed, the ribs of the Elephant itself. All the ribs are articulated to the vertebræ by a head and tubercle, separated by a neck, which is longest in the middle pairs of ribs: the head abuts against and crosses the vertebral interspace, where it is articulated by two distinct surfaces; one terminal, adapted to the surface *b* in Pl. VIII. fig. 2, of the antecedent vertebra; the other superior, and received into the cavity *a*, of the same vertebra, to the transverse process of which the third articular surface on the tubercle of the rib is joined.

The first rib is more curved than in the large Pachyderms and Ruminants. Its small head stands inwards at right angles to the shaft: this is compressed antero-posteriorly; the upper half of the anterior surface is traversed by a longitudinal ridge, bounding the outer side of a deep and wide channel, in which the surface of the bone is reticulated. The rib increases in breadth as it approaches the sternum: rough prominences on its outer surface indicate where the ossified cartilage originally began: this, which in its present ossified and anchylosed state forms the sternal end of the rib, was of a quadrate figure, broader than long. It is articulated, by a synovial surface of a narrow oval form, to the manubrium sterni, at the part marked *a*, fig. 1, Pl. IX. The inner surface of the first rib is smooth and slightly convex, except near its posterior margin, where the shallow groove for the intercostal nerve and vessels may be traced.

The second rib is longer and more slender than the first, but is similarly indented by a broad longitudinal groove on its anterior and upper surface, which gradually contracts and disappears as it descends. The superior length of this rib is chiefly due to its ossified and anchylosed cartilage: this contracts and assumes a trihedral form near the sternum, to which it is articulated by two surfaces in the interspace of the manubrium and second bone*.

In the third and succeeding ribs, the groove, described as impressing the outer surface of the first and second ribs, runs along the thickened anterior margin, and attains rather the inner side of that margin, in the long posterior ribs. These decrease in thickness to their posterior margin, which is sharp and bends inwards, so as slightly to define the ordinary shallow canal for the intercostal

* The surface on the manubrium for the second rib is shown at fig. 2. *c*, Pl. IX.

nerve and vessels. The vertebral ribs are convex upon both outer and inner surfaces, and maintain a nearly uniform breadth. The sternal ribs, or ossified cartilages, have a very irregular form: they are expanded and compressed, with the margins directed forwards and backwards, where they join the vertebral ribs; they then contract as they approach the sternum, become compressed in an opposite direction, having their thick and flattened margins looking outwards and inwards, with the intervening sides deeply concave, and divided by strong ridges from the margins. The extremity which joins the sternum is dilated and convex: it presents two distinct articular surfaces, one on the inner or back part of the rib*, adapted to the flattened posterior plate of the sternum†; the other surface is terminal‡, and is applied to the anterior cubical processes of the sternum§: each surface is divided into two compartments corresponding to the adjoining surfaces of the contiguous sternal bones, to the interspace of which the sternal rib is articulated. The eighth broad sternal rib presents a short thick elliptical process on its anterior margin, midway between its two extremities; this process supports a flat articular surface for the contiguous sternal rib.

Sternum‖.—The form and construction of the assemblage of bones, called collectively the sternum, are satisfactorily shown by a considerable proportion in perfect preservation, including the manubrium and five consecutive pieces, and a more posterior piece, probably the eighth of the sternal series. The manubrium is the broadest as well as the longest piece; the second bone is the narrowest: beyond this they gradually expand to the sixth, which again contracts; the eighth is narrower than this, but broader than the second. It is probable that three-fourths of the sternum are here present.

The manubrium¶ is an elongated, hexagonal, subdepressed bone; the outer or under side is convex transversely, and also longitudinally at its anterior half, then concave to near its posterior part, which is crossed by a strong transverse ridge, contracting backwards to a thick square process, standing boldly out from the broader body of the bone, and with its posterior angles truncated to form two articular surfaces for the second pair of sternal ribs**. The inner or upper surface of the manubrium is convex transversely at its anterior third part, which is

* Pl. IX. fig. 5. *b*, *b*′. † Fig. 4. *b*, *b*′. ‡ Fig. 5. *a*, *a*′.
§ Fig. 4. *a*, *a*′. ‖ Pl. IX. ¶ Fig. 1. I. and fig. 2. ** Fig. 2. *c*.

rough, with the indication of a ridge along the middle: below this there is a smooth and moderately deep concavity. The anterior border presents a thick rough convexity, forming an obtuse ridge at the middle of its posterior part. The two anterior lateral margins are thinner and slightly concave; the clavicular ligaments were doubtless attached to these and to the contiguous concavities. The two posterior lateral margins, *a*, *b*, present a narrow, elongated, slightly sinuous articular surface for the first sternal rib, and below this a concavity, forming the contracted posterior part of the manubrium.

Anterior to these emarginations the bone is pinched in, as it were, below the strong transverse ridge, which is continued across the outer surface of the bone, between the posterior ends of the first costal articulations, giving great strength to that part of the sternum. The posterior boundary of the manubrium forms a subquadrate surface, supporting five articular surfaces; two on each side for the bifid, thickened, articular ends of the second sternal ribs: and the intermediate part, by which it is joined to the second bone, or the first of the series forming the body of the sternum. The anterior part of the outer surface of the manubrium is roughened with small irregular ridges, depressions, and vascular perforations; the ridges upon the concave part of the manubrium are more regular in their arrangement, and indicate the interspaces of the attached strong fasciculi of the great pectoral muscle.

The bones forming the body of the sternum may be divided into two parts, a broad and flat posterior plate of a quadrate form, and an anterior rhomb or cube projecting from the middle of the plate; and they each present not fewer than ten articular surfaces, two for the contiguous sternal bones, and the remaining eight for portions of two pairs of sternal ribs.

The second sternal bone* is short as compared with the first, subconcave on each side, and with its posterior plate traversed on the inner or upper surface by a thick, obtuse longitudinal ridge. The external or anterior process is less abruptly continued from the posterior plate than in the succeeding bones: it is shorter than the supporting plate, to admit of the interposition of the anterior extremities of the second sternal ribs, which meet between it and the manubrium, and likewise of the extremities of the third pair of ribs between it and the third

* Pl. IX. fig. 1. *n*.

sternal bone. Each of the four angles of the external process is obliquely truncated to form the shallow concave articular surfaces for portions of the terminal articulations of the second and third sternal ribs. The angles of the posterior expanded plate are similarly truncated, forming smaller articular surfaces, to which the corresponding subterminal surfaces at the posterior part of the second and third sternal ribs are adapted. The anterior and posterior articulations, with the manubrium and third sternal bone, are of the kind called synchondrosis; but the eight glenoid articulations for the sternal ribs were evidently provided with smooth cartilage and synovial membranes.

The third sternal bone* is more distinctly divided than the preceding into its posterior plate and anterior or external cuboid process. The surface of the plate is nearly smooth and flat towards the chest, and presents an oblong quadrilateral figure, broadest below, and slightly concave at the lateral margins: on the anterior part of each angle is the articular surface for the corresponding half of the subterminal articulations of the sternal ribs†. The anterior subcompressed portion of this sternal bone presents the same number of articular surfaces as at *a*, *a′*, fig. 4. for the convex terminal joints of the sternal ribs, and it has nearly the same form as that of the preceding bone.

The fourth sternal bone differs from the preceding in the greater breadth and flatness of its posterior expanded portion; this gives to the anterior division the character rather of a subordinate epiphysis; but the number and form of the articular surfaces are the same.

In the fifth sternal bone the expanse of the flat posterior plate has reached its maximum, and it is broader than it is long: the anterior portion or process having diminished in antero-posterior extent, without having increased in breadth, gives to this singular bone a resemblance to a common form of paper-weight, the handle of which is represented by the anterior process, here reduced by the approximation of the four articular surfaces to the form of a cube‡.

In the sternal bone, which appears to be the eighth of the series, the propor-

* Plate IX. fig. 1. III. † Fig. 4. *b*, *b′*.

‡ The anterior or external surface of the fifth sternal bone is shown at fig. 3. V.; the heads of the fifth and sixth sternal ribs being introduced in the right side to show their mode of application to the median external process. The flat inner or upper surface of the same sternal bone is shown at fig. 1. V. A side view of the fourth sternal bone is given at fig. 4. IV.

tions of the posterior plate and anterior cube are less unequal. The articulations on the upper angles of the cube are still distinct from those on the corresponding angles of the plate; but the lower ones of the plate and cube are confluent on each side, forming an oblong surface, slightly contracted in the middle, and separated by deep and narrow depressions from the triangular median surface for the articulation of the ninth sternal bone.

Comparison of the true Vertebræ.

The vertebræ of the skeleton of the Mylodon here described would appear to have been discovered in their natural relative position, for they were numbered consecutively from the atlas to the twenty-third vertebra, the body of which was separated from the above-described anchylosed neural arch. The exact adjustment of the articulations of the vertebræ, arranged according to these numbers, left no doubt as to their accuracy: and, whilst the indications of the transverse processes showed that five cervical vertebræ succeeded the atlas and dentata, the number of the ribs equally established the correctness of assigning the remaining sixteen vertebræ to the dorsal region.

Few as are the striking or important modifications of the cervical vertebræ in the Mammalia, and closely as those of the Mylodon adhere to the common condition of this part of the spine, certain features of resemblance to the corresponding part of the vertebral column in the Sloths may nevertheless be discerned, as, for example, the great relative breadth of the atlas compared with the skull, and the shortness of the dentata. The most remarkable peculiarity of the cervical region is presented, as is well known, by the three-toed species of Sloth, which has the exceptional number of nine vertebræ anterior to that which supports the first true rib. The Mylodon, in conforming, like the Megatherium, to the ordinary mammalian number of seven cervical vertebræ, agrees with the two-toed Sloth. And not only in the number, but in the forms and proportions of the spinous processes, the Unau resembles the Mylodon more than does the more anomalous three-toed Sloth.

The atlas of both species of Sloth has a distinct tubercular rudiment of a spine on the neural arch; but the Unau's atlas further differs from the Mylodon's in having the transverse process compressed obliquely, whilst in the Ai it is more horizontal, as in the Mylodon. I find in the Ai only two vascular perforations on each side the atlas, both of which are above the root of the transverse process.

The spinous process of the dentata corresponds in the Unau, both in size and shape, with that of the Mylodon ; it is relatively smaller and inclined forwards in the Ai. The slender spine of the third vertebra is overlapped by the large spine of the second in the Unau, as in the Mylodon ; while it is equidistant from the adjoining spines, and equal with those which succeed it in the Ai.

Other Edentata besides the Unau resemble the Mylodon in the number of cervical vertebræ, but not more so than other Mammalia ; a brief glance at the peculiarities of these vertebræ in Armadillos and Ant-eaters will suffice to show that they differ in this part of their skeleton more than the Unau from the Mylodon. The Chlamyphore and other Armadillos are at once distinguished by the anchylosis of a certain number of the cervical vertebræ. In the Ant-eaters the spine of the dentata is low, and is extended more forwards than backwards, and those of the other cervicals are still less elevated. In the long-tailed Manis very similar proportions of the cervical spines prevail ; but in the short-tailed species, and in the Orycteropus the cervical spines approach nearer to the forms and proportions of those in Mylodon, yet not so close, on account of their greater antero-posterior extent, as in the Unau.

It is, however, in the extinct Mammalia, and precisely in those whose dentition and cranial organization prove them to belong to the same natural family as the Mylodon, that the closest correspondence prevails in the form and structure of the cervical vertebræ.

In the large proportion of the skeleton of the Scelidothere, discovered by Mr. Darwin in the limestone of Bahia Blanca, the whole cervical and the anterior part of the dorsal series of vertebræ were imbedded in natural juxtaposition ; and the seven cervical vertebræ closely correspond in the form and proportions of their spinous processes with those of the Mylodon*. The transverse processes of the atlas are as remarkable as in the Mylodon for their great length, breadth and thickness, and equally indicate the muscular forces passing from

* Zoology of the Beagle, 'Fossil Mammalia,' p. 84. pl. 24.

them to the occipital region of the long and narrow head to have been very considerable.

In the quest of the affinities of these gigantic Sloth-like animals to their diminutive existing congeners, a certitude as to the number of the cervical vertebræ was especially desirable; and the conditions under which those of the Scelidothere have been discovered,—worked out of their stony matrix for the most part by my own hands,—from the atlas to the first dorsal vertebra with its broad rib, coupled with the evidence of the Mylodon, fully establishes our confidence in the number of the cervical vertebræ exhibited in the skeleton at Madrid. Nor is it less interesting to find, that although both the Mylodon and Megatherium differ from the anomalous Ai in the number of their cervical vertebræ, they both present precisely the same numbers of the remaining true vertebræ as in the Ai, viz. 16 dorsal and 3 lumbar. The spine of the dentata in the Megatherium is relatively lower and thicker than in the Mylodon, and is bifurcated behind. It, however, partly overlaps the small pointed spine of the third cervical, and those of the fifth, sixth and seventh progressively increase in length. The atlas of the Megatherium is chiefly distinguished, in addition to its size, by the tuberous rudiment of a spine on the upper arch, as in the Sloths, by the more angular production of the broad or upper transverse process, and by the strong tuberous rudiment of a lower transverse process at the posterior part of the base of the preceding. The spinal canal is more contracted laterally: the anterior articular cavities have a greater proportional vertical diameter, and are more approximated. The grooves for the nerves at the posterior part of the vertebra are converted into canals by the extension of a bony bridge from the neural arch to the upper margin of the posterior oblique processes. There are two vascular foramina above and one below the root of the transverse process in the Megatherium, as in the Mylodon.

If the two-toed species of Sloth shows its nearer affinity to the extinct Megatherioids in the normal number of cervical vertebræ, it deviates, on the other hand, as much in the unusual extent of its dorsal or costal region, which includes twenty-three, sometimes twenty-four vertebræ; a greater number, as Cuvier remarks, than exists in any other known mammalian quadruped. The Ai has sixteen dorsal vertebræ, like the Mylodon and Megatherium; but according to the view taken by Professor Bell of the nature of the two supernumerary cervicals, it would differ from its gigantic extinct congener, and approximate to the Unau, in possessing eighteen dorsal vertebræ; and under any interpretation of its vertebral peculiarities, it has two more true vertebræ than the Mylodon and Megatherium.

The spinous processes of the dorsal vertebræ are relatively shorter in the existing Sloths. A few of the anterior dorsal spines in the Unau are more developed, but those of the posterior dorsal vertebræ are almost obsolete in both species. The spinal canal is relatively smaller, but the neural arches are broad and flattened, and overlap each other, though not so completely nor so extensively as in the Megatherioids.

The number of the dorsal vertebræ in the Ant-eaters, viz. sixteen in the *Myrmecophaga jubata* and short-tailed Manis, seventeen in the Tamandua and long-tailed Manis *, fifteen in the little Ant-eater—very closely corresponds with that in the Mylodon and Megatherium. Their spinous processes, though shorter in proportion to their antero-posterior breadth, present the same uniform backward inclination. The Orycterope, which has only thirteen dorsal vertebræ, has the last spine vertical, indicating a centre of motion in the trunk; and both those behind and those before have a converging inclination towards this centre. The Armadillos present an uniform backward inclination, and a nearly equal development of their dorsal and lumbar spines; but they deviate more than the Orycterope from the Megatherioids in the smaller number of their dorsal vertebræ, which does not exceed eleven in some species, nor twelve in any. The posterior dorsal vertebræ of the mailed Edentates likewise differ in a much more important character, which immediately relates to the support of their peculiar osseous covering, and is so conspicuous and obvious in its relations, as to have merited, though it has not hitherto received, the attention of those anatomists who have confidently attributed a similar bony covering to the Megatherium.

The anterior oblique processes begin, at the middle of the dorsal region, in the Armadillos, to send a process upwards, outwards and forwards, which, progressively increasing in the posterior vertebræ, attains in the lumbar region a length

* Cuvier ascribes only thirteen dorsal vertebræ to the Phatagin (*Manis longicaudata*), but the skeleton of this species in the Hunterian Museum shows seventeen.

equal to that of the spinous process; these peculiar oblique processes have the same relation to the spinous processes in the support of the osseous carapace, which the tie-bearers have to the king-post in the architecture of a roof.

As the only analogous trace of such developments from the neural arch is presented by the low ridge or tubercle from the upper surface of the transverse processes in the posterior dorsal vertebræ of the Mylodon and Megatherium, the conclusion may be legitimately drawn from this single anatomical difference, that the Megatherioids, like the Sloths and Ant-eaters, were not invested with a bony carapace.

The dorsal vertebræ of the Megatherium very closely resemble those of the Mylodon; but the anterior spines are relatively longer in order to give adequate attachment to the supporters of the relatively larger and heavier head. The dorsal vertebræ are equally remarkable with those of the Mylodon for the capacity of the spinal canal, the expanded arches of which similarly overlap each other, and are articulated by broad, flat, and nearly horizontal surfaces: but the following difference is deserving of notice in the dorsal vertebræ of the Megatherium, viz. that through a great proportion of the posterior part of the dorsal region there is a third articular surface on both the front and back parts of the imbricated neural arches; the anterior surface is situated on the anterior part of the base of the spine, between the two normal articular processes; the posterior median surface is supported on an osseous platform, depending from the posterior and under part of the root of the spine: there is a corresponding rough process in the Mylodon indicating a ligamentous union of the imbricated arches, where the additional synovial joint existed in the Megatherium.

Notwithstanding the excess of either cervical or dorsal vertebræ which characterizes the existing Sloths, it is interesting to find that they agree with both the Mylodon and Megatherium in the number of the lumbar vertebræ. But the neural arches of these vertebræ are depressed, the transverse processes short, the spines almost obsolete; and all are unfettered by bony union in the Sloths. The anchylosis of the lumbar vertebræ with each other and the sacrum is as peculiar to the Mylodon amongst Mammalia, as is the number of cervical vertebræ in the Ai. Strange that two such remarkable features in the osteology of Birds as supernumerary cervical vertebræ with floating ribs, and confluence of lumbar vertebræ with the pelvis, should be repeated separately, the one by an existing, the other by an extinct species of the same natural tribe, and by no other known mammalian animals. The figures of the skeleton of the Megatherium by both Garriga and Pander show the three lumbar vertebræ as separate bones; and the first sacral vertebra in the pelvis in the College Museum presents a free surface for ligamentous articulation on the anterior part of its body; and the left oblique process with its articular surface. In the Scelidotherium, likewise, the three lumbar vertebræ are unanchylosed. Two of the species of Myrmecophaga have three lumbar vertebræ; the largest species (*Myr. jubata*) has only two*. Not any of the other genera of Edentata have fewer than five lumbar vertebræ.

In the breadth of the ribs the Megatherioid animals resemble the Sloths and the Edentata generally. This character is however exaggerated in the true Ant-eaters, in which the vertebral ribs overlap each other. It is common to the Ant-eaters, Pangolins, and Armadillos, with the Sloths, to have the cartilages of the ribs ossified; but only in the Myrmecophagæ are the sternal ribs articulated by double joints with the sternum.

In the Sloths the sternal portion soon becomes anchylosed to the vertebral portion, especially in the anterior ribs; and the same thing happens in both the Mylodon and Megatherium.

Amongst extinct animals, the ribs of the Megatherium offer the nearest resemblance to those of the Mylodon, but with sufficiently recognizable distinctions. The first rib is relatively shorter; its sternal part † is more expanded, and the sternal articulation broader; the anterior surface has not the longitudinal excavation which the first rib of the Mylodon presents.

The proximal or vertebral ends of the succeeding ribs present in the Megatherium, as in the Mylodon, three distinct articular surfaces; one terminal, subcircular, and flat, for the body of the vertebra next in front; the second on the upper part of the head, horizontal, convex, oval, for the surface on the base of

* In the skeleton of an aged individual of this species in the Museum of George Langstaff, Esq., the last lumbar vertebra is anchylosed to the sacrum.

† This rib offers no surface on its outer part for the attachment of the clavicle, as represented in the figures of the Madrid skeleton, in which the anterior production of the manubrium is turned backward.

the neural arch of the same vertebra; the third on the tubercle for articulating with the transverse process. If to these be added the two surfaces at the end of the ossified sternal portion, most of the ribs of the Mylodon, Scelidothere, and Megatherium, present no less than five distinct joints. I am not aware that this structure exists in any other Mammal, or that it has been before noticed in the Megatherium; as it likewise obtains in the Scelidothere, it is probably characteristic of the Megatherioid quadrupeds generally.

There next remains to be considered, in connexion with the true vertebræ and their appendages, how far the affinities of the extinct Mylodon and its congeners may be elucidated by a comparison of the structure of the sternum.

The sternum of the Sloths consists of a number of small, simple, subcubical, or oblong bones, having their angles truncated for the terminal articulations of the ossified cartilages, and thus representing the anterior processes merely of the sternum of the Mylodon. In regard to the manubrium sterni, the two-toed Sloth offers the closest resemblance to the Mylodon in having that process prolonged in front of the expanded part, giving articulation to the first rib. This prolongation, which is not present in the Ai, relates to the complete development of the clavicles in the Unau, and serves for their ligamentous attachment. The manubrium sterni has a broader and shorter figure, and is generally emarginate anteriorly in other Edentata; but it is in a genus of this family, viz. *Myrmecophaga* *, to which, after the Sloths, the Megatherioids offer the closest affinity, that we find in the remaining sternal bones the same remarkable structure which has been described in the Mylodon. The sternal bones in the true Ant-eaters, coincidently with a bifurcation of the sternal end of the ribs, consist of two parts, each having articular surfaces for the sternal forks which are wedged into their interspaces: but the broad depressed portion of the sternal bone is anterior or external, the stumpy or cylindrical part internal, or towards the thoracic cavity.

The comparison of the sternum of the Mylodon with that of other extinct Edentata, is necessarily much limited, as in no other species has so large a proportion of this series of bones been found; and the few that have been recognized appertain exclusively to the Megatherium. Some of these are, however,

* Cuvier, Ossemens Fossiles, 8vo, 1836, tom. viii. p. 210.

of the greatest interest, since they show that the giant of the present extinct family had the same complicated interlocking of the sternal ribs with the sternum as in its less bulky congener. The manubrium sterni of the Megatherium is relatively broader than in the Mylodon, except where it joins the sternum, and there it is narrower. The lateral borders above the costal articulations are convex; these articular surfaces are triangular, and relatively broader and shorter than in the Mylodon; their posterior interspace is less concave and is rough: the articular surface for the succeeding sternal bone is oval, convex, and slopes obliquely from behind forwards and downwards; there are no surfaces for the second pair of sternal ribs.

The bone of the body of the sternum, described in Mr. Clift's Memoir on the Megatherium * as having ten articular surfaces, appears to have come from near the posterior end of the series. It consists, as in the Mylodon, of two parts, an anterior and a posterior, but these are of similar shape and nearly equal dimensions. The posterior division has the four angles truncated for the costal articulations, and has two larger semicircular articular surfaces, one at the anterior and another at the posterior ends, for the adjoining sternal bones. The anterior division has merely the four surfaces for the anterior or terminal articulations of the bifurcated sternal ribs; which surfaces are elliptical, and are larger and deeper than those on the posterior division of the bone. This bone clearly indicates the same essentially complex junction of the costal arches with their sternal keystones, which characterizes the Mylodon, the minor modifications being adapted to the specific peculiarities of the more bulky species. It is probable also that the internal division may be broader in the more anterior sternal bones of the Megatherium.

In one of the sternal bones of the Megatherium, described by Mr. Clift, only the anterior surface presents the articular surface for the adjoining sternal bone, the posterior surface being deeply excavated by a large elliptical costal surface on each side. It thus appears, as Mr. Clift remarks, to be the last bone of the sternum; but some of the sternal bones are similarly disjoined in the Sloths, and are articulated only to the simple extremities of the sternal ribs. The modification of the supposed eighth sternal bone in the Mylodon, and the close

* Geol. Trans., Second Series, vol. iii. p. 445.

analogy of the remainder to those of the Megatherium, render it probable that the sternum may have terminated in both animals by more simple bones, completely detached from each other by the interposition of the extremities of the posterior sternal ribs which were not bifurcated.

Description of the Pelvis *.

Sacrum.—The sacrum of the Mylodon, defined by its connections with the ossa innominata, consists of seven vertebræ; but according to the character of anchylosis it includes eleven; the last dorsal and the three lumbar vertebræ being united with the ordinary sacrum by confluence of the neural arches and spines, and, with the exception of the dorsal vertebra, also by continuous anchylosis of their bodies.

The length of this enormous sacrum is two feet four inches; it gradually increases in breadth to the sacro-iliac symphysis, and, after a slight contraction, again expands to join the ischia. The sychondrosal articulations of the sacrum with both these parts of the ossa innominata are obliterated by continuous ossification.

The body of the first lumbar or sacral vertebra is subcompressed, and its sides converge to the inferior surface; those of the second and third gradually expand; and in the third and following sacral vertebræ the inferior surface is broad, slightly concave, and meets the lateral surfaces at a right angle, from which it is separated by a rough ridge on either side; the breadth of the under surface of the second true sacral vertebra, which is nearly flat, is three inches and a half: this surface then slightly diminishes in breadth to the last sacral vertebra. The longitudinal contour of the under surface of the sacrum describes a slight double curvature, which is convex downwards, opposite the junction with the ilia, and concave at the other parts. The bodies of the lumbar and sacral vertebræ are each perforated by two vascular canals extending from the middle of the surface which supported the spinal marrow to the under surface. These perforations assist in the completely confluent state of the bodies of the vertebræ in determining their true number.

* Plate X.

The canal for the spinal chord is of remarkable width throughout the sacrum. Its transverse diameter in the first lumbar vertebra is two inches and a half, and its vertical diameter two inches. It progressively dilates to the middle of the sacrum, after which it contracts. The lumbar nerves issued by lateral perforations in the continuous neurapophysial plate, which are a little in advance of the intervertebral spaces. The fourth pair of nervous foramina, which is between the last lumbar and first sacral vertebræ, has a more oblique direction, looking downwards and outwards, and is situated nearer the body of the vertebra. Each of these foramina is formed by the confluence of two distinct canals. The fifth, sixth, seventh, eighth, and ninth pairs of foramina for the sacral nerves look nearly vertically downwards, open on the under or inner surface of the vertebræ, and progressively increase in size. A wide oblique canal is continued from the fifth outwards and downwards. A corresponding canal extends from the sixth directly outwards to the upper border of the great ischiadic foramen. The canal from the seventh leads obliquely downwards to the border of the same foramen. A small canal is continued from both these to the upper or outer surface of the sacrum. The eighth and ninth wide foramina pierce the sacrum vertically.

The neural arch of the first anchylosed sacral or last dorsal vertebra (fig. 1. II.) sends off from its anterior part three articular or oblique processes. The uppermost is the largest, is compressed, and slightly thickened at its free extremity; its direction is nearly vertical and a little inclined outwards. The second articular process is nearly horizontal, depressed, and terminated by an obtuse convex margin. The third, or lowest, projects directly forwards, in the form of a short mammilloid process. The anchylosed rib or costal process (*a*) is strong, moderately long, flattened and rough above, convex and smooth beneath, proceeding outwards and a little backwards, with a slight downward curve, from the side of the neural arch, from which it arises by two distinct roots; the lower one being continued from the anterior and outer part of the neural arch, between the nervous foramen and the base of the two lower articular processes, whilst the upper root extends from the posterior articular process to the uppermost of the anterior articular processes. These two roots intercept at their junction a foramen or canal ten lines by eight in diameter, which thus traverses the base of the process in a line almost parallel with the axis of the trunk*. This very re-

* A style is represented as passing through this canal on the left side in Pl. X. fig. 1. *d.* 16.

markable repetition, in a dorsal vertebra, of a structure characteristic of the cervical vertebræ, appears to be peculiar to the Mylodon amongst Mammalia. It is present in the posterior dorsal vertebræ of birds, one or more of which are occasionally, with their costal appendages, anchylosed to increase the anterior extent of the sacrum in that class. The complicated articular processes in front of the last dorsal vertebra indicate that it was interlocked with a double articular process on each side of the posterior part of the preceding dorsal vertebra. The superior pair of these posterior articular processes of the fifteenth dorsal, which are broken off in the specimen, were received into longitudinal concavities (*r*), between the upper anterior articular processes and the commencement of the spinous process; the lower and outer posterior processes of the fifteenth dorsal were received into the concavities between the upper and middle anterior articular processes of the anchylosed dorsal; the third and lowest articular process of this vertebra was adapted to a cavity at the posterior part of the neural arch of the fifteenth dorsal. Part of the interspace between the upper and middle articular process appears to have been occupied by the vessel or nerve which traversed the base of the transverse process. The interspace between the middle and lower articular process forms part of the conjugational hole for the transmission of the fifteenth dorsal nerve.

A plate of bone is continued backwards from the base of the transverse process of the last dorsal to that of the first lumbar vertebra. In this vertebra the transverse process assumes the form of a broad plate (*c*) with a convex external margin, directed obliquely upwards and outwards. Nearly the whole of the posterior margin of this transverse plate is continuous with the corresponding plate of the second lumbar vertebra (*d*), the outer extremity of which is joined by continuous ossification to the corresponding process of the third lumbar, and with it to the upper and posterior part of the iliac labium; the corresponding processes of the first and second sacral vertebræ are joined by a similar continuity of ossification with the ilium, and progressively increase in thickness. The transverse processes of the third, fourth, and fifth sacral vertebræ form the inner and upper boundaries of the sacro-ischiadic foramina (*e*), and terminate in a ridge (*i*) which is bent upwards and outwards. The transverse processes of the sixth and seventh vertebræ extend outwards and downwards, slightly expand as they become confluent with the tuberosities of the ischia (*f*), and thus complete the osseous boundary of the sacro-ischiadic foramina.

The spinous processes of all the anchylosed vertebræ form one continuous vertical bony crest (*g*, *g*), which rises, in the first lumbar, to nearly three inches in height, and so continues with very little diminution to the end of the sacrum. This remarkable crest is about four lines in thickness, and slightly expands at the upper margin: it describes a single and moderate convex curve. The vertical diameter of the middle of the sacrum, including this ridge, is nine inches, which gives the height of the sixth sacral vertebra, counting from the beginning of the anchylosis.

The breadth of the last lumbar vertebra, where its transverse processes join the ilia, is one foot. The breadth of the sacrum between the ischiadic foramina, is seven inches and a half: the breadth of the posterior end of the sacrum where the two foramina indicate its junction with the ischia, is eleven inches.

Os innominatum.—The ilium, ischium and pubis, the analogues respectively of the scapula, coracoid and clavicle, are so completely and extensively united with the sacrum, that the great whole which they constitute, and which in the Megatherium is the largest single bone in any land animal, will be more conveniently and intelligibly described in the same section.

The greatest breadth of the pelvis of the Mylodon, taken across the iliac plates, is three feet five inches: the antero-posterior diameter of the ilium is one foot six inches. The labium of the ilium is continued in a curved line, describing about a third of a circle from the transverse processes of the last lumbar vertebra to the anterior superior spinous process. From this point, the margin of the bone is bent inwards with a sinuous outline to the neck of the acetabulum.

The anterior or inner surface of the iliac plate is concave above and slightly convex below; it is traversed by a narrow longitudinal or vertical ridge extending towards the acetabulum, and doubtless indicating the boundary between the psoas magnus and iliacus internus.

A ridge* is continued from the posterior and upper margin of each ilium, backwards and inwards upon the side of the sacrum, to the articular processes, which are separate and distinct in the three last sacral vertebræ. These ridges divide the channels between the spinal crest and articular processes, from the wider and deeper channels situated between the articular processes of the pos-

* Pl. X. fig. 2. *h*.

terior sacral vertebræ and the terminations of the transverse processes, which form the strongly developed ridges (*i*, *i*) extending from the posterior superior angles of the ilia to the tuberosities of the ischia. Five of the posterior sacral foramina (*k*, *k*) open into these depressions, which foramina increase in size as they recede backwards; the last foramen is of an elliptical form, and measures two inches by one in diameter.

The expanded plates of the ilia are slightly convex posteriorly*, and the labium is bent forwards so as to appear of unusual breadth, but really forming the upper or anterior boundary of a deep cavity on the internal and anterior part of the plate†. The large fasciculi of the glutæi muscles are strongly indicated by the ridges of bone on the back part of the ilium, which have shot up in their interspaces, and by which their general course may be traced in the fossil. The whole of this surface for muscular attachment is bounded anteriorly by a nearly regular semicircular ridge of bone, dividing it from the broad and deflected labial surface. This surface‡ becomes gradually narrower to the anterior superior spinous process or angle. The acetabula (*m*, *m*) are deep cavities of an ovate form, with the long axis directed forwards and outwards: the plane of the cavity looks obliquely outwards, downwards, and a little backwards. The Harderian depression extends from the part of the acetabulum which is next the obturator foramen, to the middle of the articular cavity, decreasing in breadth and increasing in depth as it descends. The inlet of the small pelvis is of an elliptical form, with a vertical diameter of twenty inches and a transverse one of twelve inches. There is no ilio-pectineal ridge or process on the part corresponding with the brim of the pelvis.

The pubic bone§ rapidly contracts after leaving the acetabulum into a slender, straight subcompressed osseous style, bounding the upper part of the obturator foramen (*o*, *o*). It expands at the lower part of this foramen to blend with the ischium, and the plate of bone thus constituted passes inwards to join the corresponding plate at the symphysis pubis (*n*), where they are anchylosed together: the symphysis is very short, measuring only three inches in antero-posterior diameter: its anterior and outer part is produced into an angular tubercle. The under part of the acetabular extremity of the pubis is excavated by the canal for

* Pl. X. fig. 2.

† Pl. I.

‡ Pl. X. fig. 1. *l*.

§ Fig. 2. *p*.

the obturator vessels and nerves ; the inner side of which is bounded by a well-marked ridge of bone.

The ischium presents its usual character in the Edentata, being anchylosed by its broad posterior part with the transverse processes of the posterior sacral vertebræ, and contracting as it bends downwards and inwards to form the posterior boundary of the obturator foramen. The inner surface of the ischium is tolerably smooth and even ; its outer surface convex, and presenting a rough tuberosity opposite the broadest part of the outlet of the pelvis.

The outlet of the pelvis presents an obscurely pentangular form ; its longest and vertical diameter being sixteen inches, its transverse diameter fifteen inches. The upper part of the outlet is formed by the last sacral vertebra : the two upper sides reach from the extremities of the transverse process of the last sacral vertebra to an obtuse projecting part of the ischium, the margin so intercepted being slightly concave : the two lower sides of the boundary converge in nearly a straight line from the before-mentioned processes to the symphysis pubis.

Caudal Vertebræ.—Of these vertebræ twenty are preserved, beginning with the first, and forming a consecutive and uninterrupted series ; the last consisting of the body or centrum only, and, from its small size,—two-thirds of an inch in length,—probably not succeeded by more than one or two others in the living animal.

The bodies of the caudal vertebræ preserve a nearly equal size to the sixth, and then gradually decrease. The transverse processes of the second caudal are the longest, whence they gradually shorten to the nineteenth, and disappear in the twentieth. They maintain throughout the tail the same antero-posterior extent of their base, but increase in this direction at their extremity in the seventh to the fifteenth vertebræ inclusive. The neural arch progressively decreases in height and breadth from the second caudal. The spinous process, which is an inch and a half in height in the second vertebra, gradually sinks, and disappears in the fifteenth. The oblique processes begin to diminish at the fifth vertebra and disappear,—the posterior ones at the fourteenth,—the anterior ones at the eighteenth vertebra. The hæmapophyses* retain their primitive separated condition in

* The inferior vertebral plates forming the vascular arch, or chevron bone.

the first caudal vertebra*, but coalesce and develope a spinous process from their distal anchylosed extremities in the succeeding ones. The inferior spine increases in length in the third and fourth vertebra, and then progressively diminishes to the fifteenth; it disappears in the sixteenth, and all trace of hæmapophyses is lost in the seventeenth caudal vertebra.

The bodies of the anterior caudal vertebræ, in so far as they can be viewed apart from their large and numerous processes, are sub-cubical†, but slightly expand to form transversely-elliptical articular extremities. The transverse processes arise, in the anterior vertebræ, from the base of the neurapophysis and upper part of the side of the centrum, but descend in the rest to the middle of the side of the centrum. The long transverse processes of the anterior vertebræ are directed outwards, and a little backwards: they are depressed, flattened, and without tubercle or ridge below, convex above, and with a well-marked tubercle on this aspect: it is situated near the end of the process in the first caudal‡, but nearer the base in the second, third and fourth vertebræ; in the fifth it assumes the form of a ridge, and a second tubercle is developed near the end of the process, which also assumes the form of a ridge on the upper part of the transverse processes of the eighth to the fourteenth caudal vertebræ inclusive. The anterior margin of the transverse process forms a slight angle at its middle part in the sixth caudal; this angle is progressively extended forwards, and, by the shortening of the transverse process, external to and behind it, it comes to be situated at the anterior angle of the end of the process, which thus appears bifurcated in the tenth caudal vertebra. In the thirteenth the anterior production of the end of the transverse process is the longest, and in the seventeenth and following vertebræ it is the sole representative of that process. The extremities of the transverse processes in the fourth, fifth and sixth caudal vertebræ are the thickest. The neural arch rises from the anterior two-thirds of the body of the vertebra, and quickly expands into the large anterior and small posterior articular processes. The articular surfaces of the anterior processes in the first caudal are concave and look inwards§, embracing or clasping the posterior convex-articular processes of the last sacral vertebra. The articulations of the anterior oblique processes in the remaining caudal vertebræ are less con-

* Pl. VIII. fig. 5. *b, b*. † Fig. 8. ‡ Fig. 5. § Figs. 6 and 7. *d*.

cave at the upper part: these surfaces disappear in the anterior processes of the eleventh and succeeding vertebræ. The upper part of the neural arch * is quadrate, narrower posteriorly, and by the contraction of this part in the tenth and succeeding vertebræ taking on a triangular form, it is incomplete and open in the eighteenth vertebra. The spinous process rises from the whole antero-posterior extent of the middle line of the neural arch, which is concave on each side of its base.

The under surface of the bodies of all but the small terminal caudal vertebræ is quadrate and concave, with each of the four angles produced into an articular process †: the first caudal vertebra is distinguished by having only the two posterior angles so modified. To these and to the anterior articular angles of the second vertebra the separate hæmapophyses of the first caudal are articulated. These are rather irregular styliform processes, with the articular base extended in the antero-posterior direction, and having two articular surfaces ‡ for junction with the angles of the adjoining vertebra. The second and succeeding pairs of hæmapophyses have a broader base, with a rough process projecting inwards from the interspace of the two terminal articular surfaces: they are compressed and lamelliform, and the spine developed from their anchylosed ends is strong, compressed, and with a thick rugged extremity. The spine of the sixth, though shorter than the preceding ones, has a greater antero-posterior extent. A tubercle, developed on each side near the extremity of the second and third hæmal spines, is represented by a ridge situated nearer the base in the succeeding ones as far as the eighth; in this and the succeeding spines the ridge is continued into a process projecting from the posterior margin of the hæmapophyis. The canal formed by the confluent hæmapophyses and intervertebral space for the caudal prolongation of the aorta, extends from the second to the seventeenth vertebræ; beyond this a groove is continued, formed by the interspace of the two anterior inferior tubercles of the centrum. In the first and second caudal vertebræ a groove is continued from the middle of the lower angle of the centrum on each side obliquely backwards to the posterior margin of the transverse process, and thence, indenting the posterior part of the base of the neurapophysis, to the spinal canal. This groove plainly indicates the spinal or vertebral artery

* Pl. VIII. fig. 7. † Fig. 8. ‡ Fig. 5. *a* and *b*.

sent off from the caudal aorta. In the third and succeeding vertebræ to the ninth inclusive, the spinal artery perforates instead of indenting the angle or ridge dividing the under from the lateral surface of the centrum *: in the tenth, eleventh, and twelfth vertebræ this angle is again deeply indented.

The series of caudal vertebræ in their easiest and most natural juxtaposition forms a gentle curve with the concavity directed upwards and backwards; and the extremity, in the attitude in which the skeleton of the Mylodon is represented in the first Plate, rests by its under surface on the ground, plainly indicating that this robust tail aided in supporting the massive pelvis.

Comparison of the Pelvis.

The sacrum in the Sloths is broad and also unusually long; it includes in the Unau seven vertebræ, corresponding with the number of the true sacral vertebræ in the Mylodon; the Ai has six sacral vertebræ. The anterior of these, in both species of Sloth, are anchylosed at an early period to the broad and expanded ilia, and the posterior vertebræ extend outwards to coalesce with the ischia. Both ischial and pubic bones are long and slender; they circumscribe large obturator foramina, and bound by a narrow symphysis a very capacious pelvis. The existing Sloths thus offer a very close approximation to the Mylodon by the repetition of the most essential characters of its pelvis. They differ in the absence or feeble development of the spines and ridges which relate to the size and force of the muscles attached to the pelvis.

The Ant-eaters have five sacral vertebræ; the Pangolins three; the Orycterope six. In the great Ant-eater the sacral spines coalesce into a long crest of bone, and in an aged specimen I have seen the last lumbar vertebra anchylosed to the sacrum, both which are interesting features of resemblance to the extinct Mylodon; but the iliac bones of the Ant-eater are long and narrow, and the pelvis has the usual laterally-contracted form in quadrupeds. The pelvis is more expanded in the Manis, but the ilia are short, thick, straight, prismatic bones: they have the same form in the Orycterope. In all the Edentata the great ischiadic notch is converted into a foramen by the junction of the sacrum with

* The outlets of these canals are seen in Plate I.

the ischium ; this is not therefore an instance of the exclusive resemblance of the Sloths to the Mylodon. In the great length and continuous spinous crest of the sacrum, the Mylodon strikingly resembles the Armadillos, but here any special affinity, as indicated by the pelvis, ceases ; the iliac bones in the loricate Edentata are straight, strong, narrow prismatic beams, well adapted for transmitting the weight of the sacrum and carapace to the acetabulum and thigh-bone. In the Mylodon these bones are, as we have seen, relatively more expanded than in the Sloths, which have the broadest iliac bones amongst existing Edentata ; in this part of their osteology the Megatherioids resemble the Proboscidian Pachyderms.

By the anatomists who have favoured the view of the affinities of the Megatherium to the Armadillo-tribe, the small *Chlamyphorus truncatus* has been selected as its especial representative in the existing creation. I have therefore submitted the skeleton of this extremely rare species to a close examination and comparison with that of the Mylodon.

It is true that the Chlamyphore resembles the Mylodon more than the Armadillos do, in the greater expansion of the iliac bones ; but the direction or aspect of the expanded part is quite different from that in the Mylodon, and the Chlamyphorus deviates, more than other Armadillos, from the type of the Mylodon and Sloths in the disunited pubic bones, and in the singular development and supplemental junction of the posterior part of the sacrum to the ischia, viz. by the spinous as well as the transverse processes. The ilium in the Chlamyphorus extends in the form of a straight vertically compressed plate from the anterior part of the sacrum to the acetabulum, hereby essentially according with the Armadillo-type ; the broad and thin lamelliform process rises from the ilio-sacral anchylosis and from the upper or posterior border of the ischiadic foramen, and, after ascending vertically a short distance, terminates by bending outwards : these ilio-ischial plates have an obvious relation to the support of the unusually expanded posterior part of the bony carapace, and have consequently no analogues in the Megatherium or Mylodon. The spines of the sacral vertebræ form a continuous ridge, as in the Mylodon, but the proportions are reversed, the ridge being higher at the posterior than at the anterior part of the sacrum ; along the anterior half of the sacrum also, in the Chlamyphorus, two parallel ridges are developed, corresponding in position to the oblique processes of the preceding vertebræ; nothing analogous to which exists in the Mylodon, nor indeed in any other Edentate animal. The posterior part of the spinal ridge rises to an inordinate height in the Chlamyphore, and expands at its summit into a triangular plate, concave at its upper surface, and anchylosed by the sides of its base to two broad and thin osseous plates rising almost vertically from the upper part of the tuberosities of the ischia; by this structure two large pelvic foramina are formed in addition to the thyroid and ischiadic ones common to other Edentata, and neither the Mylodon nor Megatherium offer any approach in their pelvic organization to the above-described peculiarities in the Chlamyphorus. The two hinder buttress-like tuberosities which prop up the posterior part of the carapace are equally peculiar to the Chlamyphore.

It is to the Sloths therefore that the Mylodon most nearly approaches in its pelvic structure, and all the points in which it differs are instances of its closer resemblance to the Megatherium. The more developed and continuous spines of the sacrum, the more expanded ilia, their broad and flattened labrum, are points in which the Mylodon and Megatherium alike differ from the Sloths. In some points of its pelvic organization the Megatherium nevertheless differs in a marked degree from the Mylodon. It has only five true sacral vertebræ, and this consolidated segment of the spinal column is not augmented at the expense of the lumbar vertebræ*, which are distinct in both the Madrid specimen and in that in the Museum of the College of Surgeons. The transverse processes of the two last sacral vertebræ are relatively thicker and stronger than in the Mylodon; the spine of the fifth sacral vertebra is not confluent, at least at its base, with the thick and strong crest formed by the conjoined four anterior spines. The free margin of this crest, which is broken off in the specimen in the College Museum, would seem, from the figures of the Madrid specimen, to be divided, indicating that the continuous ossification had not attained, as in the Mylodon, the summits of the spinous processes. The broad arched labrum of the ilia gives the thickness of the bone at that part, and is not formed by a bending forward of the plate itself, as in the Mylodon. The ischium has a greater relative breadth, and the symphysis pubis a greater relative antero-posterior extent in the

* The anchylosed bodies of the three lumbar vertebræ of a second individual of the *Mylodon robustus* were transmitted with the entire skeleton described in this memoir to the College of Surgeons, thereby indicating it to be a specific structure, and not accidental to one particularly aged individual.

Megatherium ; the pelvis of which, in every differential feature, except the shorter sacrum, manifests stronger and more massive proportions in the Megatherium than in the Mylodon.

The sacrum of the Scelidotherium resembles that of the Megatherium in the number of component vertebræ, and in the free articulation of the first sacral with the last lumbar vertebræ ; but in its expanded form, especially at the posterior part where its transverse processes join the ischium, in its capacious medullary cavity and wide nervous foramina, this part of the vertebral column in the Scelidothere is conformable with that in the Mylodon and Megatherium, and manifests a corresponding relation to the massive proportions and muscular strength of the hind-legs.

No authentic part of the sacrum or pelvis of the Megalonyx appears yet to have been discovered.

The resemblance which the pelvis of the Elephant bears to that of the Megatherium in the broad iliac bones, ceases there ; in the narrow sacrum and the widely open ischiadic notches it adheres to the ordinary pachydermal type. In fact the pelvis forms the most peculiar and characteristic part of the skeleton in the Megatherian race ; it has been the centre from which muscular forces of very unusual extent and vigour have emanated to act in different directions upon the trunk and the anterior extremities, upon the hind limbs and the tail ; and the resistance which these forces collectively, through the great pelvic fulcrum or centre, have been employed to overcome, must have been of a very different nature and degree to any that now opposes itself to the labours of existing vegetable feeders in supplying their daily wants ; whence we may infer that the exertion of such forces was associated with equally peculiar habits in the Megatherioid animals.

Comparison of the Tail.

The part of the skeleton in which the Sloths differ most obviously from the Mylodon is the tail, which is so short as to be hardly visible in the entire animal. But if the Unau shows a nearer affinity to the extinct Megatherioid animals in certain features of its cranium and of the true and sacral vertebræ, it yields to the Ai in regard to the caudal region, which is reduced to six short vertebræ in the *Bradypus didactylus*, but numbers ten or eleven vertebræ, better developed and of larger proportional size, in the *Bradypus tridactylus*. The transverse processes of these vertebræ are large, especially in the anterior ones; but in neither species are the neural spines developed or the hæmapophyses present.

It is in the terrestrial Edentata only that the caudal vertebræ present the fully developed and complicated condition which has been described in the Mylodon. In all these species, however, the tail is relatively longer than in the Mylodon; it is even prehensile in the *Manis* and *Myrmecophaga didactyla*; but of the modifications of the terminal vertebræ, on which that power depends, there is no trace in the Mylodon. In the relative length of the tail, and in the shape of the hæmal or inferior spines, the Orycterope comes nearest to the Mylodon; but in no existing quadrupeds, not even in the Kangaroo, is the tail so thick and strong in proportion to its length as in the Mylodon.

It is, again, amongst its extinct congeners exclusively that we find a close repetition of this part of its organization. The great proportion of the tail of the Megatherium fortunately preserved in the collection of remains of that species transmitted to England by Sir Woodbine Parish, demonstrates a very close correspondence in relative size, in structure, and, apparently, also, number of caudal vertebræ, with the Mylodon.

The transverse processes of the analogous vertebræ are stronger, and trihedral, instead of being compressed; the superior spinous processes were developed along a greater extent of the tail; the form and relative size of the inferior spines and the mode of articulation of the hæmapophyses are closely similar. These vertebral elements remain separate from each other in the first caudal vertebræ, in the Megatherium as in the Mylodon; in the rest they are united to form the chevron-bone, developing a long and strong spine from their point of union.

Description of the Bones of the Anterior Extremity.

This powerful member does not exceed the hind-limb in length; it consists in the skeleton of a scapula, clavicle, brachium, antibrachial bones and manus, and includes every perfection of structure manifested in the Mammalian class, save the opposable thumb.

Scapula.—The scapula* is a large inequilateral four-sided plate of bone; the longest side, which is convex, forming the base; the shortest, which is concave, supporting the articular cavities for the humerus and clavicle: the upper and

* Plate I.

lower sides, or costæ, are straight. The outer surface presents two wide and shallow concavities separated by a slighter median convexity giving origin to the spine: the inner side has its undulations reversed, presenting two convexities divided by a median concavity. The spine of the scapula thus bisects, nearly equally, the outer surface of the bone, commencing at the middle of the base, having its origin extended in nearly a straight line to within an inch and a half of the glenoid cavity, and progressively increasing in height as it approaches this termination. The free margin of the spine begins to expand a few inches from its posterior origin, and progressively increases in breadth, forming thus a rough flattened plate, overhanging chiefly the supraspinal fossa, until it quits the supporting spine, and inclines, as acromion, obliquely forwards and downwards to join the flattened coracoid. This process reciprocally bends from the anterior angle of the scapula towards the acromion, and forms, by its junction with it, a broad flattened bridge of bone, arching over the anterior outlet of the supraspinal fossa. The articular cavity for the clavicle, of a transversely elliptical form, is situated on a thickened part of the anterior margin of this bridge, near the coracoid angle of the scapula. The supraspinal fossa is more capacious at its anterior half than the inferior one; it is perforated, a little obliquely, by a circular aperture, one inch in diameter, midway between the anterior margin of the spine and the superior costa: this aperture, which represents the supraspinal notch in other Mammalia, has its anterior margin broken by an oblique groove, from which a shallow channel may be traced downwards to the neck of the scapula. The anterior moiety of the superior costa is thickened, inclined outwards, and gradually increases in breadth as it bends along with the coracoid to be lost in the acromion. Ridges of bone traverse the wide supraspinal fossa in the direction towards its outlet, and indicate the fasciculi of the powerful muscle which once occupied that cavity. The surface of the infraspinal fossa is similarly broken by ridges of bone, not more developed than those above the spine. The straight inferior costa is not thickened: but on the inner surface of the scapula, a broad and strong ridge of bone, commencing at the posterior inferior angle, extends forwards, for some inches, so close to the inferior costa, as to seem part of it; it recedes from the costa as it advances forwards and gradually subsides in the lower convexity of the subscapular surface. Besides the three principal undulations of this surface, which upon the whole is convex towards the body of the Mylodon, there are many strong muscular ridges, but all inferior in breadth to the lowest one above described. The glenoid cavity is a narrow and shallow oval cavity, extended vertically or in the direction of the anterior border of the scapula. Its long diameter is equal to three-fourths of the corresponding diameter of the head of the humerus; its short diameter is half that of the same diameter of the head of the humerus. The want of proportion of the articular cavity to the bony sphere which plays upon it is thus unusually great: so that notwithstanding the close agreement of the humerus with the scapula in colour, fragility, and those characters which indicate the parts of the same fossil skeleton taken from the same place and bed, it was not until the observed analogy of the bones of the rest of the fore-limb, with the corresponding ones of the hind limb, had left no doubt of their belonging to the same animal, that the scruples arising from the disproportion between the glenoid cavity and the head of the humerus, were overcome.

Scapula compared.—Cuvier, in his description of the scapula of the Megatherium, has pointed out its exclusive resemblance to that of the Sloths, which offers, in the confluence of the acromion with the coracoid, a structure unique among existing Mammals; and the same character being present in the scapula of the Mylodon, renders it needless to pursue the comparison of this bone further in reference to existing species.

I may, however, remark that the Pangolins (*Manis*) and the true Anteaters (*Myrmecophaga*) make the nearest approach to the characteristic structure in the scapula of the Sloths and Megatherioids, having the acromion produced nearer to the coracoid than in the Orycterope and Armadillos; that they have likewise the coracoid united with the anterior angle of the scapula, which is not the case in the Orycterope and Armadillos; and that in other respects the scapula of the Armadillo is that which recedes furthest from the type of that bone in the Mylodon or Megatherium.

Cuvier in his comparison refers to the tridactyle Sloths (*Bradypus*), but the scapula of the two-toed species (*Cholœpus*) more closely resembles that of the Megatherium and Mylodon, in having the angles, especially the inferior one, less rounded. The characteristic union of the acromion with the coracoid takes place also at an earlier period in the didactyle than in the tridactyle Sloths; and the articular surface for the clavicle is better marked; the clavicle itself being complete in *Cholœpus*, whilst it is only a rudimentary appendage in *Bradypus* proper.

The scapula of the Megatherium, while it exhibits the same essential characters as that of the Mylodon, differs very recognizably in the position of the spine, which commences much nearer the lower angle, and, running parallel with the inferior costa, leaves above it a much greater proportional extent of supraspinal fossa, than in the Mylodon. The general configuration of the scapula is different in the Megatherium: the base is straighter and relatively longer; the inferior costa relatively shorter; the anterior border is longer, especially below the glenoid cavity, so that the blade of the scapula in the Megatherium presents almost the form of a trapezium, save that the greater extent of the posterior border destroys the parallelism of the upper and lower borders. The inferior and anterior angle of the scapula is bent outwards in the Megatherium, increasing the depth of the subspinal fossa. The ridge extending from the inferior and posterior angle forwards upon the under surface of the scapula is relatively stronger in the Megatherium, more abruptly terminated, and from its lower position and the bending outwards of the inferior costa, it seems to prolong the inferior surface of the scapula downwards, and, to the same extent, gives the everted inferior costa the character of a second spine. As such a second spine, and the greater prolongation of the blade-bone below it, is the characteristic of the scapula in the Ant-eaters, this indication, although slight, of the affinity of the Megatherioid quadrupeds to the Ant-eaters is not without interest.

Both the acromion and coracoid are relatively more produced in the Megatherium than in the Mylodon: the clavicular cavity is also deeper and more irregular, indicating a ligamentous union of the bones. The glenoid cavity is a broader ellipse.

Compared with the scapula of the Scelidotherium, that of the Mylodon is also more equally divided by the spine: it is evident from the remains of the inferior costa, at the anterior part of the scapula, that the infraspinal fossa was of relatively less extent in the Scelidothere. Both the superior costa and the base are straighter in the Scelidothere, and the upper and posterior angle is less rounded. The acromio-coracoid bridge is longer and narrower; the clavicular cavity relatively smaller, but of the same form and with a smooth surface.

The glenoid cavity is as narrow and bears the same disproportion to the head of the humerus, as in the Mylodon; a resemblance which is the more satisfactory, since in the specimen of Scelidotherium the humerus was cemented by the stony matrix to the scapula, in its natural position.

There is a closer correspondence between the scapulæ of the Scelidothere and Mylodon than between these and that of the Megatherium; yet all have the same essential characters in common with the scapulæ of the Sloths; the Mylodon, in the differences which we have indicated between it and the Megatherium in the form of the scapula, offering the nearest resemblance to the Sloths, especially to the two-toed species.

Clavicle.—The clavicles are strong subcompressed bones, extending from the acromial arch to the manubrium: they are slightly twisted into a double curvature. The acromial end is gently bent towards its articular cavity, and terminated by a smooth, elliptical, convex surface, adapted to that cavity. A tuberosity is developed from the lower surface of the bone near that extremity. The lower margin, near the more expanded sternal extremity, forms a ridge bounding an anterior concavity on half of the clavicle: the sternal extremity is compressed, expanded in the direction of the manubrium, to which it was attached by ligament above the articulation of the first rib.

Clavicle compared.—The closer affinity which the Unau presents, as compared with the Ai, to the Mylodon and Megatherium, is illustrated in no part of its organization more strikingly than by the complete clavicles which attach the scapula to the sternum; but they are relatively straighter, more slender, and more suddenly expanded at the sternal end than in the Mylodon. The three-toed Sloth in the Hunterian Museum has a small styliform clavicular bone, half an inch in length, appended to the coracoid process; not extending beyond a third of the distance between that part and the sternum.

The clavicles of the Orycterope and Ant-eaters, which are complete, have a single curvature.

The clavicle of the Megatherium is thick in proportion to its length, its extremities are equally developed and alike devoid of a smooth surface for synovial cartilage, and its double curvature is more strongly marked. The clavicle of the Mylodon is thus intermediate in its form and proportions between that of the Megatherium and that of the two-toed Sloth.

*Humerus**.—The humerus of the Mylodon surpasses every other bone of the extremities in the strong development of all those inequalities which bespeak the volume and force of the attached muscles.

The tuberosities, though not elevated so as to interfere with the rotation of the head of the bone, as in the large ungulate quadrupeds, are broad and well-defined. The rough deltoidal tract covers a great proportion of the fore-part of the shaft of the bone, from which it is separated by a more or less prominent marginal ridge. The pectoral ridge is well-marked. The musculo-spiral impression presents an unusual width and depth. The supra-condyloid plates are very broad and prominent. The trochlear articulation for the bones of the fore-arm indicates, by the regular convexity which it presents to the radius, the free rotation of that bone.

In these general characters the humerus of the Mylodon resembles that of the Megalonyx and Megatherium; but it differs in its greater strength, the shaft being relatively much thicker, with a stronger deltoidal platform, and the proximal tuberosities are larger and higher, particularly the external one. The humerus of the Mylodon differs in a more marked respect from that of the Megalonyx, in the absence of the perforation of the internal condyle, which in the Mylodon is simply notched at its upper part by the brachial nerve and vessels, as in the Megatherium; but the notch is less strongly marked in the more gigantic species. The form of the articular surface for the ulna offers another well-marked distinction between the Mylodon and the Megalonyx†. In the latter species, and likewise, to judge from the figures of Bru and Pander, in the Megatherium, this part of the distal articular surface of the humerus is convex in every direction; in the Mylodon it is only convex, and that in a very slight degree, from before backwards, and is concave from side to side.

The proximal articular surface of the humerus in the Mylodon is sessile, regularly convex, of an elliptical form, with the long axis parallel with the antero-posterior diameter of the bone. In the Megalonyx, and apparently also in the Mega-

* Plates XI. XII. XIII. fig. 1.

† The comparison here pursued is founded on the cast of the humerus of the Megalonyx, discovered in the great depository of the Mastodon's remains called Big-bone-lick, Ohio, and described by the accomplished anatomist and naturalist Dr. Harlan, in his instructive 'Medical and Physical Researches,' p. 325, pl. 13. fig. 10.

therium, the degree of convexity is greater, the head rises higher, and is separated by deeper depressions from the outer and inner tuberosities: again, the inner tuberosity is the largest in the Megalonyx, but the smallest in the Mylodon. The deltoidal tract, especially the ridge or margin which overhangs the musculo-spiral canal, is comparatively very feebly developed in the Megalonyx, and is even less strongly marked in the Megatherium than in the Mylodon. The musculo-spiral canal is of great breadth and depth, and divides the deltoid ridge from the strong process which is continued outwards from the back and outer part of the distal third of the humerus to form the supinator plate above the external condyle *.

The vertical outline of the back part of the Mylodon's humerus is slightly concave ; in the Megalonyx it presents a double curve, being slightly convex at its lower part. The posterior surface of the broad distal portion of the humerus in the Mylodon is slightly concave from side to side, and the depression for the olecranon is feebly marked at its lower part : this is much deeper in the Megalonyx. The internal supra-condyloid, or pronator plate, has a pointed form in the Megalonyx and Megatherium, but in the Mylodon it has a greater relative vertical extent, with a convex outline. The thicker and shorter shaft of the Mylodon's humerus makes the expansion of the distal end, great as it is, less sudden and disproportionate than in the hammer-shaped humerus of the Megatherium.

In one humerus there was no trace of a medullary artery ; in another the orifice was present, but of unusually small size, a little below the middle of the posterior surface of the bone. The canal led directly, widening a little, to a small cell or rudiment of a medullary cavity in the centre of the cancellous substance ; the arterial canal there divided into two or three branches ; the principal of which passed straight to the ulnar surface, through the cancellous and dense outer wall, to open by a small foramen two inches above the internal condyloid plate.

On comparing the humerus of the Mylodon with that of existing Mammalia, we find its characters more closely repeated by the fossorial Ant-eaters and Armadillos, than by the arboreal Sloths, yet not so closely as by the gigantic extinct

* Plate XII.

Edentata which have just been compared with the Mylodon in this respect. But these, like the Mylodon, combine with such a humerus all the essential dental and osteological evidences of their close affinity to the phyllophagous Edentata; if, therefore, the locomotive extremities of the Megatherioids should exhibit many marked deviations from those of the Sloths, whereby they approach nearer to those of the insectivorous Edentata, it is to be regarded as the inevitable consequence of their having to support bodies of far too great bulk and weight to be suspended from the boughs of trees; and as the teeth and jaws of the gigantic sloth-like Edentals prove them to have fed on the foliage of trees, they must have possessed limbs organized for a different and more violent mode of obtaining such food, than are those of the existing Sloths, which have no other resistance to overcome than the light weight of the body, which the long and slender limbs are accordingly adapted to transport from bough to bough.

In general form, and in the development of the proximal tuberosities, deltoidal crest, and distal condyles, the humeri of the great Ant-eater, of the Orycterope, and among Armadillos, that of the Chlamyphore, more nearly resemble the humerus of the Mylodon; but in all these existing Edentals the internal humeral condyle is perforated.

With respect to this osteological character there is the same variety in the existing Sloths as in the extinct Megatherioids: the Ai, or three-toed species, has an imperforate humerus, as in the Megatherium and Mylodon; in the two-toed Sloth the bone is perforated, as in the Megalonyx and Scelidotherium. The humerus of the latter extinct Edental* resembles that of the Megalonyx and Megatherium in the less marked development of the deltoidal crest; but in the size and position of the proximal tuberosities, in the proportions of the shaft to the extremities, and in the slight convexity of the ulnar division of the distal trochlea, it more resembles the humerus of the Mylodon.

In all the known extinct Megatherioids the humerus is destitute of a medullary cavity, and is filled with a light spongy texture, as in the Sloths: this is a more important mark of their natural affinity, than any which the superficial muscular modifications of the bone might indicate.

Ulna †.—The proportions of the ulna of the Mylodon are such that it might

* Fossil Mammalia of the Beagle, *loc. cit.* p. 90, pl. XXV. figs. 1 and 2.

† Plates XI. XII. XIII. fig. 2.

be classed, like the humerus of the Mole, with the flat instead of the long bones of the skeleton. Viewed from the inner or ulnar side, it presents the form of an elongated inequilateral triangle, with one of the angles scooped out for the humeral articulation, and the other two angles obliquely truncated: the inner surface of the bone is smooth, and concave to near the distal end, where it is traversed by an oblique ridge. The compressed shaft of the ulna is more irregular on the outer side*, which is traversed by a thick and strong ridge, running parallel with the posterior border, from the radial angle of the proximal articular surface to the corresponding side of the distal end. Along this broad and rough ridge the shaft of the radius was evidently connected with the ulna by strong ligaments. The surface between this ridge and the posterior border is deeply concave at its proximal half, slightly convex at the distal half, which is traversed obliquely by a narrow ridge, and supports near its extremity a large oblong protuberance.

The olecranon, a process of great length, breadth and thickness, is bent obliquely inwards; the broad and rough back part of the olecranon gradually contracts into the posterior flattened border of the ulna†. The great sigmoid, or rather reniform articular surface, extends almost transversely across the base of the olecranon, and plays upon the inner and back part of the outer condyle of the humerus, being divided by a median convexity into two compartments: the inner portion is produced forwards upon the anterior angle of the ulna, and is very slightly concave: the outer division is more deeply excavated. The articular surface is continued for a few lines upon the large rough depression for the head of the radius. Much of the non-articular surface of the ulna is sculptured by fine reticular ridges. The distal extremities of the bones of the fore-arm were attached to each other by syndesmosis: below the rough surface for this union the ulna is obliquely truncated, leaving a triangular space between it and the radius: it then terminates by a flat smooth articular surface applied to the os cuneiforme, which surface is continued for half an inch upon the ulnar side of the distal end, where a part of the pisiform bone plays upon the ulna.

Cuvier, in pointing out the nearer resemblance of the ulna of the Megatherium to that bone in the Ant-eaters than in the Sloths, indicates the differences

* Plate XIII. † Plate XII. fig. 2.

which it presents in its shorter and stronger proportions, as being more suitable to the enormous weight which it assisted in supporting. The more elongated and slender form of the ulna in the Megalonyx might be thought to correspond with the diminished bulk of that extinct Megatherioid quadruped; but the ulna of the more robust, though smaller genus, Mylodon, has shorter and broader proportions even than in the Megatherium, whilst the olecranon is relatively longer than in any Ant-eater. In the *Myrmecophaga jubata* this process does not equal a fifth part the length of the whole ulna: in the Orycterope it is rather more than a fifth: in the Mylodon the olecranon—measured, as in the above-cited Edentals, from the upper margin of the sigmoid cavity—is more than one-fourth the length of the bone. In the Megatherium it is more than one-fifth the length of the ulna: in the Megalonyx it is rather less than one-fifth. In the Scelidothere* the olecranon is rather less than one-fourth the length of the ulna, but is longer in proportion to its breadth and thickness than in the Mylodon. The sigmoid articulation of the ulna in the Megatherium and Megalonyx corresponds with the distal articulation of the humerus, and the inner division is consequently more concave than in the Mylodon. The flatness of this part of the ulna in the Scelidothere corresponds with that modification of the distal end of the humerus, in which it resembles the Mylodon. But a greater difference is manifested in the outer division of the sigmoid, or proximal articulation of the ulna in the Megalonyx, and probably also in the Megatherium. When the bones of the fore-arm of the Mylodon, for example, are viewed in natural juxtaposition, as in Plate XIV. fig. 3, the radial or outer division of the great sigmoid cavity is as large and more concave than the inner one: when the same bones of the Megalonyx are viewed in the same position, the outer half of the sigmoid cavity, above the head of the radius, is much smaller than the inner half, and is convex. Below this there is a large, concave, triangular surface for the radius, divided from the previous convex facet by a groove.

The shaft of the ulna is relatively longer and more slender in the Megatherium than in the Mylodon: its distal extremity presents, at its radial side, a well-developed convexity, which is not present in the Mylodon. The ulna of the

* Fossil Mammalia of the Beagle, *loc. cit.* p. 91, pl. XXV. fig. 2.

Megalonyx has the same distal convexity for articulating with the radius, and deviates still further than in the Megatherium from the Mylodon in the length and slenderness of the shaft of the bone, and in the feeble development of the muscular ridges. The general proportions of the ulna of the Scelidotherium are intermediate between those of the Megatherium and Mylodon.

Radius *.—As the entire radius of the Megatherium and Scelidotherium, and the cast of that of the Megalonyx, form part of the collection of Fossils in the Museum of the College, I shall combine, with the description of the radius of the Mylodon, that of the same bone in its extinct congeners.

The radius of the Mylodon is thicker in proportion to its length, stronger, and much more deeply impressed by the muscles of the fore-arm, more especially by the extensors of the hand, than in the Megatherium or Megalonyx; it differs in the shape of the proximal articular cavity, which is more oblong; the marginal surface which rotates upon the ulna is narrower and more convex. The rough tuberosity for the insertion of the biceps is further from the proximal joint and more advantageous for the action of the muscle in the Mylodon. The rough external margin of the radius, which, in the Megatherium, partially subsides and becomes thinner as it extends downwards, and which would appear to stand out as a distinct process in the Madrid specimen, gradually increases in the Mylodon until it expands into the tuberosity above the styloid process. The most marked modifications of the Mylodon's radius are seen by comparing its posterior surface with that in the Megatherium. In the more gigantic Edental this surface presents a moderate and even convexity, whilst in the Mylodon † it is traversed by a longitudinal ridge or elevation, separating an outer from an inner depression. Of these depressions the outer one is the broadest and deepest; and between it and the radial edge there are two narrower longitudinal canals, bounded by well-defined rough ridges. The internal longitudinal shallower cavity is continued obliquely across the distal end of the bone, impressing that part, above the styloid process, with a well-marked canal, which is wanting in the Megatherium; the angular eminence bounding the distal side of that depression is represented, in the Megatherium, by a convex rough protuberance. The longitudinal contour of the posterior part of the radius is concave in the Mylodon, but convex

* Plate XIV. figs. 3, 6, 7, 8, 9.

† Plate XIV. fig. 6.

in the Megatherium and Megalonyx. The anterior part of the distal end of the radius is more concave in the Mylodon than in the Megatherium. The distal articular extremity has its posterior boundary shorter transversely, and more produced downwards than in the Megatherium. In the Scelidotherium the general proportions of the radius much more nearly approach those of the Mylodon, but the proximal articular cavity is subcircular, as in the Megatherium and Megalonyx. The distal half of the outer margin of the radius is convex: the bicipital tuberosity is nearer the proximal end, and nearer the inner margin of the bone: the posterior surface of the radius more resembles that in the Megalonyx. Like the perforated humerus, the present bone in the Scelidothere also exhibits modifications which connect the Mylodon with the Megalonyx.

Both the radius and ulna of the Mylodon are destitute of a medullary cavity, like the same bones in the Sloths. The radius of the Mylodon presents, however, a small orifice for the medullary artery on the outer side, about two inches from the proximal end, the canal of which leads obliquely downwards to an irregular cavity in the middle of the bone, three lines in length by one line in breadth; this rudiment of a medullary cavity communicates by many apertures with the surrounding closer cancellous texture.

Bones of the Manus or Fore-foot *.—The fore-foot of the Mylodon participates with the fore-arm and arm in the characteristic massiveness and strength of its bony fabric. It is pentadactyle, rather short in proportion to its breadth, and has evidently been provided with both claws and hoofs, or had a callous covering for the stunted terminations of two of the digits, analogous to a hoof. In the reality of this, hitherto unknown, combination of ungulate and unguiculate characters in the same animal, full confidence may be placed, for the series of bones of both fore-feet of the Mylodon have been collected and transmitted in so complete a state as to leave nothing to be guessed at or desired in the acquisition of just ideas of this complicated and significant part of its Osteology.

Carpus.—The carpus includes seven bones, four in the first, and three in the second row, or rather there are three bones proper to each row, and one which is common to both. This latter bone is the *scaphoides* (*a*), which, besides its usual relations to the radius, lunare, and trapezoides, sends down a process (*a'*)

* Plates XV. and XVI.

which represents the os trapezium, and supports the metacarpal bone of the thumb.

This process, or confluent bone, gives to the scaphoid an unciform figure, which the true os unciforme nowise presents. It is short or depressed in the direction of the axis of the limb, broad from side to side, convex towards the back of the carpus, and made concave on the opposite side by the production of the two angles, and especially of that formed by the anchylosed trapezium. The articulation of the radius covers all the proximal surface, save the trapezial angle ; the surface is very slightly concave at its broad outer part for the reception of the styloid process of the radius, and is convex in the rest of its extent, especially in the direction from the dorsal to the palmar aspect. The articular surface is continued at right angles to its radial portion upon part of the ulnar side of the scaphoid for the junction with the os lunare. The distal surface of the scapho-trapezial bone is excavated by two concave articular surfaces for the os magnum and trapezoides : these surfaces are separated by a rough concavity from the small and nearly flat one, at the outer side of the trapezial process, for the metacarpal bone of the thumb. The dorsal surface of the scaphoides is convex, rough, perforated by vascular canals, and slightly raised between the radial and trapezoidal articulations. The palmar surface is smoother, and presents a narrow groove below the radial articular surface : the chief vascular perforations of the bone are in this groove.

The *os lunare* (*b*) equals the scaphoides in size, and resembles a cone or wedge more than a crescent, being much thicker at its dorsal than at its palmar side. The rough dorsal surface is slightly convex transversely, subconcave or flat longitudinally, bounded by six sides, of which the upper, forming the margin of the convex articular surface for the radius, is the longest : the two lateral surfaces are the shortest ; of these, the one next the scaphoides is concave : the remaining three sides, which are straight, bound two angles ; one of these is applied to the interspace between the cuneiform and unciform bones ; the other, which is longer and more acute, is wedged into the angle between the os magnum and cuneiforme. The narrow palmar side of the lunare forms a rough convex protuberance on that aspect of the carpus. The radial articular surface is nearly flat transversely, but describes a semicircular curve from behind forwards : it is continuous with the narrow lateral one joining with the scaphoides, but is separated by a rough tract, half an inch broad, from the surface on the opposite side of the lunare, for the os cuneiforme: the two remaining articular surfaces which converge and meet at the lower angle of the lunare are adapted, the one to the os magnum, the other to the unciforme.

The *os cuneiforme* or *triquetrum* (*c*) is the largest of the carpal bones and approaches to the cubical figure; the rough quadrilateral dorsal surface is nearly flat, with an oblong protuberance near the radial margin, and a concavity above the edge of the lower articular surface. The upper or proximal end presents an almost square flat articular surface for the truncated distal end of the ulna, which surface bends over upon the outer and posterior surface of the bone, to form the slightly convex semioval articulation for the os pisiforme. The articular surface of the opposite side for the lunare is divided by a rough tract from the ulnar surface, but is continuous with the broad and slightly sinuous one by which the cuneiforme articulates with the unciform bone: on the outer or ulnar side of this surface, a small articular facet is marked off, by which the cuneiform assists in supporting the huge metacarpal bone of the little finger. Thus the proximal row of carpal bones is brought into contact with the metacarpal series at both its extremities, and circumscribes, with this series, the space including the three distinct bones of the second carpal row.

These bones consist, as already stated, of the trapezoides, os magnum and unciforme, and progressively increase in size in the order in which they are enumerated. The *trapezoides* (*e*) resembles a patella in form, but has an articular surface on its convex as well as concave side: its rough base is at the dorsal surface of the carpus, subconvex, subtriangular, with the apex turned towards but separated by an interspace from the trapezial process of the scaphoid. The proximal articular surface connecting the trapezoides with the scaphoid proper is semicircular and slightly convex; that which joins with the os magnum is a small, circular, subconcave surface. The distal articular surface supporting the second or index metacarpal is convex next the dorsal part of the carpus and concave towards the palmar side, in the vertical direction, with opposite curvatures in the transverse.

The *os magnum* (*f*) is wedged in between the scaphoides, lunare, trapezoides, unciforme and middle metacarpal bone, and its rugged dorsal surface is bounded by sides corresponding with each of these bones: of these the one connected with the scaphoid is the shortest, that joined to the metacarpal bone is the longest: towards the dorsal part of the carpus this surface is divided into two parts by a rough depression; on the opposite or palmar side a small portion of the articular surface is bent outwards at a right angle, so as to support part of the second metacarpal bone. The chief part of the proximal surface of the os magnum is convex, and is received into the concavity of the os lunare.

The *unciform* bone (*g*) has its flat dorsal surface bounded by five sides and supporting an oblong protuberance extending from the radial margin to the middle of the dorsal surface; the letter *g* is placed on this protuberance in Plate XV. Part of the radial side of the dorsal surface bounds a slight vacuity between the unciforme and os magnum. The two proximal sides are nearly straight; one is formed by the dorsal margin of the articulation between the unciforme and the lunare, the other by the more extensive one between the unciforme and cuneiforme. The three distal surfaces are articulated with part of the base of the third, fourth, and fifth metacarpal bones. The palmar side of the unciforme presents, as its most striking character, a wedge-shaped process, convex on both sides, which is impacted in the interspace between the lunar and cuneiform bones; immediately below this process the surface is excavated, and then swells out into a rough tuberosity, near the margins of the articular surfaces by which the unciforme is united with the third metacarpal. This surface is divided from that for the os magnum by a narrow rough channel. The six articular surfaces covering the rest of the circumference of the bone are uninterruptedly continuous; so that the rough dorsal and palmar surfaces of the bone are connected by a similar non-articular tract along the radial, instead of the ulnar margin.

The *pisiform* bone is attached, as usual, by a single articular surface to the cuneiforme, and unites with no other bone of the carpus, but it is articulated by a narrow portion of the surface to the ulna. It is of an oval flattened form, rough, convex, and traversed by a ridge on its outer side.

The articular surface presented to the fore-arm by the scaphoid, lunar, and cuneiform bones is curved obliquely so as to throw the hand inwards and bring its outer or ulnar margin to the ground when used for supporting the trunk.

The *metacarpal bones* progressively increase in length from the first to the fourth; the fifth is longer than the third, but this is the thickest of all. The first metacarpal, or that of the pollex (*m* 1), presents a very singular and anomalous figure, in consequence of a thick and short process which is sent off from the ulnar side of its base, which gives it the appearance of being bent at a right angle. By this form it acquires two distinct proximal articulations or points of support: one at its base, or in the normal position, by which it joins that process of the scaphoides which represents the trapezium; the other on the beforementioned process, with its plane at right angles to the basal articulation and abutting upon the proximal end of the adjoining metacarpal. An oblong subangular eminence extends along the dorsal surface of the first metacarpal; a convex rough protuberance projects from the palmar aspect of its base, and is divided from a smaller protuberance beyond it by a deep transverse groove. The two articular surfaces at the proximal end of the bone are quite flat; the distal articular surface is a simple elliptical smooth convexity, occupying little more than the ulnar half of the distal end of the bone; two small smooth angular surfaces at the lower end of the articulation indicate the sesamoid bones at the palmar aspect of this joint of the thumb.

The second metacarpal bone, besides being longer than the first, is proportionally thicker and stronger, especially at its distal extremity, which is characterized by its large, vertically extended, trochlear articulation. The proximal end of the bone is triangular, with the apex towards the palm, and obliquely truncated to form the surface abutting upon the os magnum: the principal part of the base is occupied by the surface, gently convex below, concave above, for the trapezoides. On the radial side of the base is the subtriangular flat surface against which the first metacarpal abuts; the ulnar side of the bone is excavated by a deep elliptical cavity for the reception of a corresponding convex process of the middle metacarpal. The dorsal non-articular surface is transversely quadrate, slightly concave, with the two proximal angles raised into tuberosities: the palmar surface of the bone is rough and convex. The distal trochlea is most extended from above downwards, is convex in this direction, with a strong ridge produced, with a slight obliquity, from along the middle line, becoming rather sharp at the lower end of the joint; on each side of this rising the trochlear surface is concave transversely, broadest on the radial side, and terminating on each side by a sharp lateral ridge. The great vertical length of this articular surface indicates the extent of motion of the claw in that direction, while its form equally demonstrates the strength of the joint and the close restriction of the motion to one plane. Two oblong sesamoids play upon the inferior end of the double trochlea.

The metacarpal of the middle digit presents a very singular form and is of prodigious strength; the sides of its base are so produced as almost to equal the length of the bone, and give it a resemblance to the letter T. The middle part of this extended base is occupied by two articular surfaces, both adapted to the os magnum: the larger surface traverses the vertical extent of the base, but is narrow from side to side; it is separated from the smaller facet by a deep cavity with a somewhat rough and perforated surface. The smaller facet is continuous with that of the convex process from the radial side of the base, which is received into the corresponding cavity of the second metacarpal: the ulnar extension of the proximal end of the bone is terminated by the sharp angle formed by the meeting of the articular surfaces for the unciforme and fourth metacarpal. The dorsal surface of the third metacarpal is nearly flat, slightly concave on the ulnar process: the under side is smooth, concave lengthwise, convex transversely: on the middle of the ulnar side there is a rough prominence. The distal trochlear surface is similar to that of the second metacarpal, but is larger, and there is no lateral channel on the ulnar side of the median ridge, except for the sesamoid bone; the upper end of the trochlear ridge is nearer the ulnar side of the joint, and consequently more oblique; the lower end, which projects into the interval of the two sesamoids, is rather sharper and more produced.

The fourth metacarpal bone is longer and less thick than the preceding; its base is slightly expanded, obliquely truncated, and of a triangular form, occupied by a continuous smooth articular surface, divided between the unciform bone and the ulnar process of the middle metacarpal. To the latter it presents a convexity and a concavity; the surface for the carpal bone is slightly and uniformly convex; the ulnar side of the base presents a flat triangular surface for articulation with the fifth metacarpal. The upper, radial and under surfaces of the body of the bone are pretty smooth; the ulnar side is rough, with many vascular perforations and a median tuberosity. A similar tuberosity projects from the upper part of the proximal end: the articular surface is here limited to the middle convex rising of bone, which extends vertically in nearly a straight line; it is therefore very narrow in proportion to its length, and only at its lower end, where it is rather sharp, is there a slight depression for the articulation of a sesamoid bone.

The distal articular surface of the fifth metacarpal (*m* 5) is reduced to a small, vertical, oblong, nearly flat surface, below which is a convex surface for a sesamoid bone; the surface for the digital phalanx is on the radial side of the distal end, the rest of which forms a rough irregular tuberosity, the sharp margins of which overhang the smooth shaft of the bone. The articular surface at the proximal end of the fifth metacarpal is confined to the radial half of the base, which is obliquely truncated: the rest forms part of a rough, flattened protuberance on the ulnar side of the proximal expansion: the opposite side of this presents the flat articulation for the fourth metacarpal. The under surface of the fifth metacarpal is rough at its proximal half, and smooth in the rest of its extent, the two surfaces being divided by an oblique ridge running nearly parallel with that which bounds the distal protuberance: these two ridges include a wide oblique channel.

Phalanges.—The metacarpal bone of the thumb supports two phalanges; the first presents a slight and simple articular concavity at its proximal end, which is produced downwards to form the small articulations for the sesamoid bones. The distal articulation is a trochlea with a median vertical channel between two parallel convexities for the ginglymoid joint of the second phalanx. This is a very rugged bone consisting principally of an osseous sheath, extending from the proximal half of the upper part of the bone and the margins of the under and lateral parts of the base: this sheath arches over the upper and lateral parts of the base of the supporting process of the claw, which is a short oblique, subcompressed cone with a sharp superior margin. The base of this ungual phalanx is excavated by a deep double trochlear articular surface; and the under part of the base of the sheath is perforated by two large vascular foramina.

The second digit has three phalanges, of which the terminal one is also modified for the support of a long and strong claw, and is double the size of the preceding ungual phalanx. The proximal phalanx is very short in most Edentata, but is unusually so in the present subject, the vertical breadth being double the length of the bone. Both articular surfaces of this phalangeal plate are concave transversely along their middle part; the proximal one being slightly convex in the same direction on each side, while the distal surface is also convex from above downwards. The proximal surface is continued upon the two inferior tuberous angles of the phalanx, to form the sesamoid articulations: the bone slightly contracts transversely to the upper part. The middle phalanx is longer in proportion to its breadth, which is greatest in the vertical diameter of its base, both upper and lower ends of which are produced in the form of tuberosities beyond the trochlear articulation, limiting the extent of vertical movement, and giving attachment to the tendons. Anterior to these tuberosities are cavities, one on the upper, the other on the lower surface of the bone; the upper one being the deepest, and receiving the projecting part of the proximal end of the last phalanx. The sides of the middle phalanx are nearly flat: the proximal articulation is concave vertically, and traversed by a median obtuse ridge: the distal articulation describes a semicircle, and is excavated by a deep median groove. In this groove the corresponding ridge on the articular surface of the distal phalanx plays, while the deep lateral concavities of that surface receive the semicircular convexities of the preceding joint: a very powerful ginglymus, restricted to vertical movements, is thus produced, while the backward production of the upper part of the joint permits the claw-bone to be bent only downwards. The broad, rough, quadrilateral base of the claw-sheath presents the two usual perforations; and from the sides of this base the bony sheath arches over the basal half of the supporting process. This is conical, nearly straight, with an oblique base which gives the under only half the length of the upper part; the upper part presenting a regular convexity from side to side, flattened towards the apex, and divided by two sharp edges from the less convex under surface. The transverse and vertical diameters of this phalanx are equal.

The three phalanges of the middle digit very closely resemble those of the preceding except in size, which exceeds that of the second as much as this does the first digit. The proximal phalanx is characterized by the greater protuberance of its outer and inner sides, and the proportionally larger surfaces for the sesamoid bones. The middle phalanx is rather shorter in proportion to its breadth and depth than in the second digit. The ungual phalanx has double the dimensions of that of the second digit: the basal, or inferior plate, is flatter, but is raised into one protuberance. The claw-process is more curved, and its sides converge more to the upper surface, which is, however, convex, except near the apex, where it is slightly excavated longitudinally *. The under surface presents a median convexity between two slight concavities, separated by a sharp angle from the sides of the claw-process. The rugged and perforated surface of all the preceding ungual phalanges gives them the appearance of models in cork.

The distal articular surface of the fourth and fifth metacarpals would of themselves have announced a considerable modification of the digits which they supported, so much diminished and simplified are these surfaces. The phalanges, nevertheless, exhibit so considerable an abbreviation and simplification of form, that only the exact adaptation of their articular surfaces could have produced the conviction of their true nature. The proximal phalanx of the fourth digit is, like the preceding ones, shorter than it is broad, and of greater vertical than transverse extent. The proximal articulation is a long oval concavity, adapted to the convex upper two-thirds of the distal articulation of the metacarpal; the lower third of that surface, on which alone a median ridge is developed, being adapted to two large sesamoids, which articulate, also, with a small portion of the under surface of the phalanx. The radial side of the phalanx is flat; the ulnar side forms a rough protuberance. The distal articulation is less than half the size of the proximal one, and occupies only the upper half of the distal surface of the phalanx: it is convex vertically, concave transversely: below it is a rough and deep cavity separating two tuberosities. The second and last phalanx is not longer, but is narrower, especially in the vertical direction, than the first; its proximal articulation is precisely adapted to the concavo-convex surface on the first phalanx; the upper surface of the bone forms a protuberance above that surface: the lower and broader part is flattened, but has a central depression: the upper and distal surfaces meet at a right angle: the distal surface is rounded off transversely, and is rough, like the terminal phalanx of a multungulate quadruped: and there is not the slightest trace of any other joint than that to which the first phalanx is adapted. Thus the fourth finger of the Mylodon has but two phalanges, wanting the terminal one which supports the claw; the second phalanx being modified like the third phalanx of the same toe in the Hippopotamus, which is enveloped in a callous hoof. The atrophy of the fifth finger has proceeded to a greater extent: a small, simple oblong bone is

* This character has not been expressed sufficiently strongly in the plate.

attached to the nearly flat distal surface of the huge metacarpal, but does not exceed in size the sesamoid which plays upon the convex surface below the phalangeal joint: a very small slightly concave surface on the distal end of the rudimental phalanx indicates the existence of a second, as simple as, but relatively smaller than, that of the fourth finger. In the right fore-foot the distal end of the metacarpal is enlarged and diseased; the articular surface for the phalanx being destroyed by ulceration. Such a morbid change is far from unlikely to have happened in a part so immediately concerned in the support and progressive motion of the peculiarly bulky Mylodon.

The sesamoid bones, as the account of the articular surfaces of the metacarpals and phalanges has already indicated, are numerous and large; most of them are oblong and trihedral: the contiguous surfaces of the large pair which play upon the distal articulation of the middle metarcarpal bone, form a wide and smooth cavity for the passage of the strong flexor tendon of the second and distal phalanges. Besides the sesamoid bones, three other bones belonging to the Mylodon appear to have been connected with tendons. They are flattened, of a broad irregular oval figure, with rounded margins, moderately and uniformly smooth, but without any articular surface: some parts of the surface present an appearance of decussating straight fibres, as in the detached dermal bones of Saurians. Two of these ossicles, however, form a symmetrical pair; and I am therefore disposed to regard them as belonging to the fore-paws, and to have been imbedded in the flexor tendons, one in each palm, for the purpose of augmenting the force of these tendons, as do the analogous bones in the fore-feet of the Armadillos. The third bone, which is of a similar form, but somewhat larger, may have played a similar part in the hind-foot.

Comparison of the Bones of the Fore-foot.—In comparing the osseous structure of the fore-foot of the Mylodon with that of existing quadrupeds, a cursory survey would lead to the selection of the Great Ant-eater and the Manis, as offering the closest resemblance to the Mylodon in this part of their skeleton; the fore-foot in both being pentadactyle, with the middle toe conspicuous for its large proportional size, and the rest diminishing to each end of the digital series, whilst the terminal phalanges of the larger toes are provided with an osseous sheath and process for the support and fixation of a long and strong claw, and can only be bent downwards. Of all unguiculate Mammals the Sloths would seem to have the least claim to an alliance with the Mylodon on the score of the organization of the fore-feet, which are reduced in one species to three digits, and in the other to two; the digits in both species being unique in their proportions and rigidity of structure. How far real affinities may be masked under extreme modifications of a fundamentally uniform type, a deeper insight into the structure of the carpus and metacarpus of these and other Edentata will clearly show.

With regard to the carpus of the Mylodon the coalescence of the scaphoides and trapezium forms its chief characteristic. In the *Myrmecophaga jubata*, which, in the proportions of the digits and in the shape of the ungual phalanges, and more particularly in the want of this phalanx in the fifth digit, approximates closer than the Manis to the Mylodon, the carpus, nevertheless, differs in structure in having the trapezium separate from the scaphoides, and in thus consisting of eight distinct bones. Other differences present themselves in the proportions and connections of the carpal bones: the lunare is articulated to both ulna and radius; the cuneiforme is separated by a wide interval from the fifth metacarpal, which is articulated with an outwardly extended process of the unciforme: the os pisiforme is here styliform, instead of being flattened into an elliptical disc.

In the Manis the carpus is reduced to seven bones, but it is by the same modification as in the Carnivora, viz. by the confluence of the scaphoides and lunare: whilst the trapezium is free, of large size, and assists in supporting the second metacarpal bone. The fifth metacarpal is here also separated from the cuneiforme, and the pisiform bone is long and slender.

In the Orycterope, although the thumb is reduced to a mere rudiment, the trapezium exists independently, and not as a process of the scaphoides: the medius digit no longer presents the characteristic magnitude which forms the conspicuous feature of the hand in the Ant-eaters and Mylodon; the proximal end of the middle metacarpal is contracted, not expanded; the terminal phalanges are not characterized by osseous claw-sheaths; yet it is interesting to notice in this remarkable quadruped, that the fifth metacarpal articulates with both unciform and cuneiform bones, as in the Mylodon.

In the Armadillos the scaphoides and trapezium are distinct bones. Some species are tetradactyle, like the Orycterope, but the normal number of digits is reduced by the atrophy of the little finger instead of the thumb. The pentadactyle species have the middle toe the largest, and some, as the Cabassou (*Dasypus unicinctus*, Gm.) and the *Dasypus gigas*, Cuv., have two of the digits of a strikingly different form from the rest: but these digits are the two inner ones, or the thumb and index, which are long and slender, with simple ungual phalanges; while the medius, annulus and minimus, or little finger, are robust, and their large ungual phalanges are provided with osseous sheaths: these three digits progressively and rapidly decrease in size, in the order in which they have been enumerated.

Cuvier truly observes *, that the hand of the *Dasypus gigas* is one of the most extraordinary among quadrupeds; but when he adds that it alone would give the key to all the anomalies in that of the Megatherium, we must suppose that the precise nature of these anomalies had not been rightly understood by the great Palæontologist. This at least is certain, that the three digits armed with large and sheathed claws, which successively decrease in size in the hand of the *Dasypus gigas*, are placed on the opposite side of the hand to those digits which offer the same characters in the Mylodon. In the *Dasypus gigas*, moreover, the trapezium is a distinct bone, and supports part of the second, as well as the whole of the first metacarpal bone. These metacarpal bones, which we have seen to be short and thick in the Mylodon, especially the first metacarpal which is as broad as it is long, are elongated, very slender, and of a simple form in the *Dasypus gigas*. The os scaphoides is disproportionately small; and the sole feature by which the organization of the hand of this existing Edental has any essential correspondence with that of the Mylodon, is the articulation of the fifth metacarpal, with both the cuneiform and unciform bones. In the only species of Armadillo (*Das. sexcinctus*) in which two of the normal carpal bones are blended into one, it is the trapezium and trapezoides which so coalesce, not the trapezium and scaphoides.

In the little Chlamyphore the fifth metacarpal is unusually broad and strong, and articulates with the styloid process of the ulna. The second metacarpal is the longest, but the fourth and fifth are the thickest in this species; the trapezium is distinct from both the trapezoides and the scaphoides. The ungual pha-

* Ossemens Fossiles, *loc. cit.*, p. 242.

langes of the Armadillos, which offer in other respects the nearest resemblance to those of the Mylodon, differ by their obliquity more than do those of the Ant-eaters and Sloths. In the large proportional size of the middle digit the hand of the *Dasypus gigas* offers only a repetition of the secondary feature of resemblance, which is better marked and is associated with fewer deviations from the Mylodontal type in the Ant-eaters.

If now, having searched in vain among the pentadactyle Edentata for a repetition of the most characteristic and essential modification of the carpus of the Mylodon, we find this very modification present in that of the Sloths, we cannot avoid acknowledging the essential affinities of these remarkable quadrupeds to the extinct Megatherioids. Even in the didactyle Unau, in which the adaptive modifications of the Megatherioid type of manual organization are carried to an extreme in relation to the exclusively arboreal life of the species, the carpus consists of seven bones, as in the Mylodon, and the diminution of the normal number results from the same coalescence of the scaphoid and trapezium, This structure, which Cuvier was the first to recognize in the recent Sloths, he continued to affirm in the latest edition of the 'Ossemens Fossiles,' to be wholly peculiar to them. The manus of the Megatherium he regarded as most resembling that of the *Dasypus gigas*, and the able Editor of the posthumous edition, although inferring, from a cast of that part of the Megatherium in the Royal College of Surgeons, that it had a greater analogy with the manus of the *Myrmecophaga jubata*, yet seems not to have detected, what in the original is plainly evident, the repetition of the anchylosis of the scaphoid and trapezium in the carpus of the Megatherium. In no existing quadrupeds, save the Sloths, and in no extinct species, except the Mylodon and Megatherium, has this peculiar modification of the carpus been observed. The form of the scapho-trapezial bone in the Unau corresponds also pretty closely with that in the Mylodon: it presents a smooth convexity to the radius, parallel with that of the os lunare, and both sloping towards the inner side of the wrist: it describes a deep concave curve towards the palmar aspect, and the trapezial portion * is relatively longer than

* M. de Blainville (Osteographie des Paresseux, 4to, p. 22) prefers to regard this process as the sesamoid of the thumb, notwithstanding that it supports the base of the metacarpal bone; a determination which is the more singular, because the sesamoid bones are developed to augment the force of the flexor tendons, and here the phalanges which such tendons should bend are wanting, and the rudiment of the thumb in the Ai is itself inflexible.

in the Mylodon. The base of the metacarpal bone of the thumb is expanded transversely, and abuts by one extremity against the trapezium, and by the other, at right angles to its axis, against the base of the second phalanx. The trapezoides is a small bone, articulated, as in the Mylodon, with the scapho-trapezial, the os magnum, and the second metacarpal: the os magnum presents almost the same pentagonal contour as in the Mylodon, the anterior facet being also convex, for adaptation to a median concavity in the base of the middle metacarpal, both sides of which are expanded, one to abut against the base of the second metacarpal, the other extending to the os unciforme, and interposing itself between the os magnum and the fourth metacarpal. The atrophy of the fourth and fifth fingers, which we observe to have commenced in the Mylodon by the disappearance of the ungual phalanges, has proceeded in the Unau to the removal of all the bones, save the metacarpal of the fourth finger, which is only half the size of that which forms the vestige of the thumb on the radial side of the hand; it rests, as a great part of the corresponding metacarpal in the Mylodon does, upon the expanded base of the third metacarpal. The os cuneiforme presents a cuboid form, rather less regular than in the Mylodon, with a flat surface for the truncated end of the ulna, but it extends further in the direction of the ulna than it does in the Mylodon, and so has led M. de Blainville * into the belief that it represents the styloid process of that bone permanently detached. The cuneiforme, however, presents a distinct articulation for the subcircular surface of the depressed pisiform bone, which closely resembles that in the Mylodon; the connections of the cuneiforme with the lunare and unciforme likewise correspond with those in the Mylodon, but that with the little finger is of course wanting, since the finger itself does not exist.

The first or proximal phalanges are very short, and offer, as in the Mylodon, a median channel on both articular extremities, one for the ridge on the distal end of the metacarpal, the other for that on the proximal end of the second phalanx; the other phalanges present modifications of length adapted to their prehensile offices; but the ungual phalanges, except in the less development of the osseous sheath of the claw, maintain a close correspondence of structure with those of the Megalonyx; they are more compressed than in the Mylodon, but

* Osteographie des Paresseux, p. 13.

have the same mode of articulation which restricts their bending in any other direction but downwards, as in the Megatherioids generally.

In the Ai, or *Bradypus tridactylus*, the metacarpal bone of the thumb is anchylosed at its lateral joint to the side of the base of the index, but retains its articulation with the scapho-trapezial bone. This characteristic bone is less concave towards the palm than in the Unau, and resembles more that bone in the Mylodon. The lunare is relatively smaller than in the Unau or Mylodon, and the part which penetrates the carpus is more wedge-shaped; the subcubical cuneiforme offers its flat surface more obliquely to the ulna, which here is more prolonged upon the carpus, and the pisiform intervenes between it and the rudiment of the fifth metacarpal. The chief modifications of both hand and foot in the three-toed Sloth are the extensive anchyloses of different bones: this character is manifested in the carpus by a coalescence of the trapezoides with the os magnum: the resulting bone supports the base of the second metacarpal, and a great part of that of the middle metacarpal; thus fulfilling the same relations to the metacarpus as do the separated bones in the Unau. The rest of the middle metacarpal, and the base of the conjoined fourth and fifth metacarpals, with the exception of a small portion of the latter, are supported by the unciforme*, here, in conformity with the normal development of the fourth finger, of larger relative size than in the Unau. The rudiment of the fifth finger appears as a process from the outside of the base of the fourth metacarpal, but is less than the corresponding process which represents the thumb. The proximal phalanges are anchylosed, as Cuvier has shown, to the metacarpal bones in the three-toed Sloth; the terminal phalanges have the same amount of resemblance to those of the Megalonyx and Mylodon, as in the two-toed Sloth.

In proceeding to compare the fore-foot of the Mylodon with that of its extinct congeners, it becomes necessary to recompose and redescribe the bones of the hand of the two species in which alone they have hitherto been obtained in-

* This bone M. de Blainville (*loc. cit.* p. 24) prefers to regard as the os magnum; but, admitting that the styloid process is not detached in the Ai, he gives its right name to the os triquetrum, which is his unciforme in the Unau; and consequently he states that the unciforme is absent in the carpus of the Ai. After I had recomposed the carpus of the Mylodon, I proceeded, with the new and valuable light which it afforded, to study the analogies of the carpus in the Sloths, and before referring to the works of Cuvier and M. De Blainville, I wrote down my conclusions, which are those in the text. They are identical with those of Cuvier.

any approximative degree of completeness; these are the Megatherium and the Megalonyx. The collection of bones of the Megatherium, presented to the Royal College of Surgeons by Sir Woodbine Parish, fortunately includes the entire carpus, and the first, third and fourth metacarpal bones of the left fore-foot, with probably some of the terminal phalanges of the same foot.

The carpus consists of seven bones, three in each row, and the seventh common to both. This bone consists, as in the Sloths and Mylodon, of the conjoined scaphoid and trapezium*. It has the same tendency to the unciform figure, being bent towards the palmar aspect of the wrist. The radial articulation is convex, oblique, with the part corresponding with the anterior angle of the scapho-lunar in the Mylodon truncated, and the articular surface continued at right angles upon the dorsal surface of the bone, for the overlapping ridge of the radius. The facet by which it joins the lunare, and the concave palmar surface much resemble those in the Mylodon; the trapezial portion is relatively smaller; and the surface for the metacarpal of the thumb is still more so, being absolutely less than in the Mylodon; it does not extend to the extremity of the process, but is confined to the dorsal or outer side. The whole dorsal surface of the scaphoid is narrower in the axis of the hand than in the Mylodon, and is excavated for the reception of the trapezoides by an angular notch. The process for the articulation with the os magnum separates the trapezoides from the lunare, and much resembles that in the Mylodon, save that the articular surface for the os magnum is convex instead of concave; but the most essential difference between the scapho-trapezium of the Megatherium and that of the Mylodon, is the presence in the former, on its concave or distal surface, of a second detached articular surface for the os magnum, which surface is oval, flat, and close to the palmar margin.

The os lunare of the Megatherium bears a general resemblance to that of the Mylodon, but it preserves a more equal thickness as it arches from the fore to the back part of the carpus; its radial surface is more convex transversely, but is separated by a similar rough tract from the concavity which receives the cuneiform bone. The cuneiforme is proportionally smaller in the Megatherium than in the Mylodon. The articular surface for the ulna is absolutely smaller,

* It is the bone called 'cuneiforme' by Cuvier, and marked *r* in the copy of Pander's figure introduced into pl. 217, fig. 13, of the Ossemens Fossiles, ed. 1836.

and is of an oval shape ; convex at the anterior and concave at the posterior part* ; it is separated by a relatively wider space from the radial surface of the lunare than in the Mylodon. The dorsal rough surface of the bone is more convex, and has a smaller but better marked mammilloid protuberance at the upper and radial angle. The trapezoides is a relatively smaller and flatter bone than in the Mylodon : the proximal or scaphoidal surface is convex transversely, concave from behind forward, and plays in a corresponding concavo-convex surface in the scaphoides. The distal surface is principally convex : both surfaces are joined by a small articular facet on the radial side of the bone, which is adapted to a corresponding facet in the small metacarpal bone of the thumb ; and by a more extended articular surface on the ulnar side of the bone for junction with the os magnum. This carpal bone has a close correspondence of form with that of the Mylodon, and has the same connexions in the carpus : its articular surface for the trapezoides is of course much narrower, whilst the adjoining one for the scaphoides is broader : the outer facet for the unciforme is narrower, and the two anterior surfaces which enter the base of the great middle metacarpal meet at a less open angle than in the Mylodon : the dorsal rough flattened surface of the bone has thus a more regular transversely extended hexagonal figure, the outer and inner sides being the shortest.

The os unciforme of the Megatherium differs most in form from that of the Mylodon : it is a transversely elongated hexahedron, the outer side formed by a rough projection, separating the surfaces for the os cuneiforme and fifth metacarpal, which meet at an acute angle in the Mylodon. The opposite side, which articulates with the lunare and os magnum, is rounded off. The three distal surfaces for the three outer metacarpals are nearly in the same transverse line, which runs parallel with that applied to the os cuneiforme. The dorsal surface is traversed at its outer half by a transverse ridge analogous to that marked *g* in the figure of the Mylodon's hand, Plate XV.; but this ridge is continued in the Megatherium to the middle of the outer surface of the bone, where it forms a projection between two deep grooves ; the inner surface of the unciforme is characterized by a median tuberosity as in the Mylodon.

The metacarpal bone of the thumb of the Megatherium resolves one of the

* In the Mylodon the pisiform bone is adapted to the flat surface of the cuneiforme, corresponding to this concavity.

doubtful points in the structure of the fore-foot of this animal, by proving that it was the sole representative of that digit: the bone seems to be analogous to the transversely extended base of the same bone in the Mylodon, and offers two articular surfaces: one of these is adapted to the small flat oval surface, before-described, on the trapezial process of the scaphoid; the other is a larger convex surface, nearly at right angles to, and remote from the preceding, and divided into three facets: the smallest of these is for the trapezoides; the other two form the convexity entering the outside of the base of the second metacarpal bone. This bone is figured with tolerable accuracy in right proportions and relative position in pl. 4. fig. 28 of Pander and D'Alton's Treatise.

The form and position of the middle metacarpal bone in the same figure correspond with those of the specimen now before me, except that the four basal facets are separated by sharp and well-defined angles, whilst they are too much rounded in Pander's figure. Compared with the corresponding bone in the Mylodon, this middle metacarpal of the Megatherium is longer in proportion to its breadth; especially along the dorsal surface, owing to the anterior production of the dorsal half of the distal trochlear ridge, and the large protuberance above that ridge. The middle facet of the basal articulation has no rough, non-articular depression anteriorly, but is everywhere smooth and concave, though least so towards the palm: the outer or radial facet, which is a convex protuberance in the Mylodon, is here nearly flat, and extends from the dorsal to the palmar aspect of the base: the ulnar facet is not separated by a rough depression from the middle one, as in Mylodon, but meets it at a sharp angle: the distal surface of the ulnar extension of the base of the middle metacarpal presents a moderate and regular convexity, upon which the radial half of the base of the fourth metacarpal rests. The under or palmar surface of the middle metacarpal in the Megatherium is flattened, and at right angles to the very rugged outer and inner sides of the bone: the radial side is produced at its distal half into an oblong protuberance; but the general form of the bone is a four-sided short and strong column. The most important difference between the middle metacarpals of the Mylodon and Megatherium is in the form of the distal articulation, the median ridge in the Megatherium being slightly concave in the vertical direction instead of convex, and joining the rough dorsal surface of the bone at a right angle. The lateral depressions of the pulley are relatively narrower, especially the ulnar one, which hardly can be said to extend beyond the base of the ridge. A surface for a sesamoid bone is extended upon the under part of the articulation only on the right side, and the vertical inflections of the phalanx must have been more limited than in the Mylodon.

The fourth metacarpal bone, as compared with the third, is longer and more slender in the Megatherium than in the Mylodon; but its articulation by an obliquely extended base, with the third and fifth metacarpals, and the unciform bone, closely corresponds with that in the Mylodon: the characteristics of the fourth metacarpal of the Megatherium are these; the two oblique metacarpal surfaces are nearly parallel, and are both separated by a sharp angle from the intermediate or carpal articular surface, which is nearly square and slightly concave. The proximal half of the bone is four-sided, the upper and lower sides nearly smooth and slightly concave, the outer and inner side rugged for ligamentous attachments to the adjoining metacarpals: the distal half of the bone expands in vertical breadth; the angle between the upper and radial sides is rounded off, while that between the upper and ulnar sides advances upon the upper surface, and is developed into a sharper ridge. The distal articular surface is less simple than in the corresponding metacarpal of the Mylodon, and is more like that of the middle phalanx; it is not merely confined to the broad convex vertical ridge, but extends upon the concavity to the radial side of that ridge: a single flat surface for a small sesamoid bone is situated below, but distinct from this part of the articulation. Unfortunately, the proximal phalanx of the fourth toe is wanting; and whether, therefore, this toe actually terminates by a large ungual phalanx, as is represented in the figures of the Madrid specimen; or whether that phalanx be wanting, and the fourth toe terminates as in the Mylodon, and like the fifth toe of the Megatherium itself, still remains to be decided.

The analogy of the Mylodon leaves scarcely any doubt as to the accuracy of the condition of the fifth toe, as represented in the different figures of the Madrid skeleton. This analogy confirms the opinion of M. Laurillard, who, in an annotation to the text of Cuvier descriptive of the manus of the Megatherium, dissents from the conjecture of the author as to the transposition of the fore-feet in the Madrid skeleton.

The valuable light yielded by the same analogy guides us still further in the right interpretation of this remarkable and most important part of the organization of the Megatherium. In the essential character of the carpal organization, viz. the scapho-trapezial confluence, the Megatherium, like the Mylodon, resembles the Sloth, not the Ant-eater. In the modification also by which the hand of the Megathere differs from that of the Mylodon, viz. the rudimental pollex, it is to the Sloths that it the more nearly approximates by that mutilation. In the Orycterope, on the contrary, the thumb is represented by two very small ossicles; in the *Myrmecophaga jubata*, though it be the least of the five digits, it is complete with all its phalanges. Only in the Sloths do we find the thumb represented by a broad based metacarpal articulated by two points, one to the trapezial process of the scaphoid, the other to the trapezoides and second metacarpal.

In the Mylodon the thumb is succeeded in the digital series by two large unguiculate digits, as in the *Bradypus didactylus*; in the Megatherium it would appear that it was followed by three large unguiculate digits, as in the *Bradypus tridactylus*. The huge terrestrial predecessors of these small scansorial leaf-devouring quadrupeds retained the two outer toes, minus their terminal phalanges, it is true, yet of great size and strength, and modified expressly for the purpose of supporting the ponderous body in terrestrial progression. The fore-foot of the Mylodon thus exhibits the type of that of the Unau, with the superaddition of the phalanges of the thumb, and of the two mutilated outer digits probably imbedded in a modification of the integument analogous to a hoof: the fore-foot of the Megatherium manifests the type of that of the Ai, with only this essential difference, that the fifth digit, instead of existing as a rudiment, was developed to those proportions which progression on the ground required. If, however, the fourth digit terminated in the Megatherium, as in the Mylodon, by two stunted phalanges, and was encased together with the fifth digit in a hoof, the external resemblance of its fore-foot to that of the Unau, would, on account of the atrophied pollex, be closer than in the Mylodon.

With respect to the other existing Edentata, the *Myrmecophaga jubata* ought, by reason of the clawless condition of its fifth digit, to immediately succeed the Sloths as next of kin to the Megatherioid quadrupeds.

A few remarks now remain to be offered in regard to the differences which the bones of the fore-foot of the Mylodon present when compared with their known analogues in the Megalonyx, Scelidotherium, &c. With regard to the Megalonyx, which, from its correspondence in size with the Mylodon, and its imperfectly-known dentition, might well be supposed to be generically identical, the casts of the series of bones on which the genus Megalonyx was originally founded, afford the means of a comparison with their analogues in the Mylodon, which will be followed in the order in which the bones of the Megalonyx have been described by Cuvier.

The ungual phalanx of the middle digit of the left fore-foot* is of the same length and depth as in the Mylodon, but has only half the breadth; the median ridge of the articular surface is sharper; the position of the joint which favours the downward inflection of the claw, and that of the inferior perforated osseous plate, are the same in both species. The osseous sheath is more developed in the Mylodon, and the upper margin of the claw, which in the Megalonyx is trenchant, is in the Mylodon broadly convex, with a longitudinal indentation near the apex.

The second phalanx † of the middle digit of the Megalonyx is twice as long in proportion to its breadth as that of the Mylodon, and has a more symmetrical figure. The distal trochlea is narrower, but with a much deeper median canal. The median ridge of the proximal articulation is more developed, and the inferior boundary of that articulation is more produced than in the Mylodon.

As the second and ungual phalanges of the second digit in the Megalonyx are equal in size to those of the third, they differ in a corresponding degree from their analogues in the Mylodon, which are much less than those of the third digit.

The proximal phalanx ‡ of the third or middle digit in the Megalonyx corresponds more closely than the other phalanges with that in the Mylodon; but its characteristic abbreviation is the more remarkable in the Megalonyx on account of the greater length of the second phalanx. A greater proportional vertical diameter of the bone, and a greater depth of the proximal and distal articular canals, especially of the former, are the only modifications that distinguish this proximal phalanx in the Megalonyx.

The general proportions of the middle metacarpal bone of the Megalonyx § are very similar to those in the Mylodon; but in the more vertical position and greater projection of the distal articular ridge, and in the flatter under surface of the body of the bone, which is more distinctly separated from the radial surface, the Megalonyx more closely resembles the Megatherium. The ulnar angle of the base of this metacarpal is proportionally less produced in the Me-

* Ossem. Fossiles, 1836, 8vo, pl. 216, fig. 1. † Ibid. fig. 2. ‡ Ibid. fig. 3. § Ibid. fig. 4.

galonyx than in either the Megatherium or Mylodon. The articulation on the radial side of the base is nearly flat, but is confined, as is the corresponding convex protuberance in the Mylodon, to the upper half of that side of the base. The flatness of the preceding surface governs a corresponding modification in the articular surface of the adjoining metacarpal.

This metacarpal * is proved by the analogy of the Mylodon not to belong, as Cuvier supposed, to the annular or fourth, but to the index or second digit. It is, however, relatively longer and narrower than in the Mylodon, in which the concavity adapted to the tuberosity on the radial side of the third phalanx, occupies nearly the whole of the ulnar surface of the bone. The triangular base of the second metacarpal in the Megalonyx is more inequilateral than in the Mylodon: the emargination of the anterior border is deeper: the flat surface on the radial side of the base, for the metacarpal of the pollex, very closely resembles that in the Mylodon, whilst in the Megatherium it is concave. We may infer from this that the entire pollex in the Megalonyx resembled that in the Mylodon, instead of being reduced to a rudimental metacarpal bone as in the Megatherium. The distal articulation of the second metacarpal corresponds pretty closely with that in the Mylodon, the projecting ridge having a more convex contour than in the third metacarpal; the second finger, therefore, of the Megalonyx must have had a greater extent of vertical motion than the third. The surface on the inner or ulnar side of the base of the middle metacarpal, which Cuvier thought to be the outer side, and to indicate the existence of a considerable metacarpal of the index, gives of course the same indication in regard to the annular or fourth digit, to which in truth it was adapted.

From the analogies of both Megatherium and Mylodon, the fourth metacarpal of the Megalonyx may be concluded to have been longer and more slender than the middle metacarpal; and with the greater probability, because its articulation with that metacarpal was of relatively less extent than in the Mylodon or Megatherium. The metacarpal bone †, which Cuvier supposed to belong to the index finger, corresponds with the fifth metacarpal in the Mylodon, but like that in the Megatherium, it is relatively longer and more slender, and its shaft is smoother and more cylindrical. The proximal expansion presents two articular surfaces, a terminal one for the os unciforme, and a lateral one on the radial side for the

* Cuvier, Ossem. Fossiles, *Ed. cit.*, pl. 216, fig. 8.

† Ibid. fig. 11.

adjoining surface of the fourth metacarpal. The carpal facet is relatively larger than in the Mylodon, and its radial half is convex from above downwards, indicating a corresponding modification in the unciform bone: on the ulnar side of the base is a rough, flattened protuberance, as in the Mylodon, without any trace of an articular surface. The cast of the bone here described will not adapt itself to the middle metacarpal; and if, as Cuvier supposed, it even did not belong to the same hand, yet if it were a fourth metacarpal, it ought, from the analogy of both Megatherium and Mylodon, to have had a smooth, broad articular surface, where the rough flat protuberance actually exists. The distal end of the metacarpal in question presents the same modifications as in the fifth metacarpal of the Mylodon: a simple vertically-oblong surface presents an arthrodial instead of a ginglymoid joint for the proximal phalanx, below which there is a surface for a sesamoid bone. The phalangeal surface is more uniformly convex in the Megalonyx, and the sesamoid surface is flatter. The upper surface of the bone does not present the oblique ridge which the figures of the Madrid Megatherium, and the bone itself in the Mylodon present, but all the essential characters prove the metacarpal in question to be the fifth of the same hand as the middle and index ones; and whilst these are modified in accordance with the long and powerful claws which terminated their digits, it is evident, from the simplification of the distal articulation of the fifth metacarpal, that the finger which it supported was as mutilated and short as in the Mylodon and Megatherium.

The examination of the bones of the fore-foot of the Megalonyx, aided by the comparison of those of the Mylodon, has thus conducted to very different conclusions from those to which Cuvier arrived, guided by the analogy of the Cabassou Armadillo. The Megalonyx had at least two of the digits of the fore-foot short, strong, and armed with long claws; but these were the index and medius; the fifth digit was more slender, and its phalanges were probably only two in number, and invested by a thickened and callous integument like a hoof. Whether the fourth digit offered a corresponding modification, as in the Mylodon, or whether, assuming the accuracy of the figures of the Madrid Megatherium, it also was terminated by a claw, must be decided by the evidence of further discoveries of the bones of the Megalonyx. A pollex unquestionably existed, and it is most probable that it was not rudimental, as in the Megatherium, but completely developed as in the Mylodon, and that the small ungual phalanx (fig. 9, in Cuvier's plate, above quoted) belonged to it.

The remains of the Scelidotherium collected by Mr. Darwin offer the following bones of the hand for comparison with those of the Mylodon and Megatherium, viz. the os lunare, the os cuneiforme, and one of the ungual phalanges, probably that of the large middle toe. The lunare is intermediate in its characters between those of the Megatherium and Mylodon: it is chiefly distinguished by the very slight angle formed by the surfaces for the os magnum and cuneiforme: the radial articular surface is less contracted towards the palmar aspect of the wrist than in the Mylodon. The cuneiforme and lunare are separated by a deeper and wider cleft than in the Mylodon, and the tuberosity which projects from the cuneiform bone into that interspace is more developed. The surface adapted to the truncated extremity of the ulna is flatter, and relatively larger than in the Megatherium; and it resembles that of the Mylodon in being continuous with a slightly convex oval surface at the back part of the os cuneiforme, placed at right angles to the ulnar surface, for the articulation of the os pisiforme. The rough dorsal surface of the cuneiforme is neither so extensive nor so flat as in the Mylodon, but rather resembles that surface in the Megatherium. The ungual phalanx has the general proportions of the large one of the Mylodon, and is consequently less compressed than that of the Megalonyx: it is nearly equal in size to that of the middle digit in both. The chief distinctive character of this phalanx in the Scelidothere is the flatness of the basal plate, and the development from its middle line of a ridge-like process: the margins of the plate appear as if obliquely bevelled off, or bent upwards to form the osseous sheath. The ulnar cavity of the trochlea is deeper, as in the Mylodon, than the radial one; the ridge dividing them is narrower and better marked: the upper part of the claw-process is rather sharper than in the Mylodon, but it is indented near the apex as in that species and the Ant-eaters. Like the ungual phalanx of the Mylodon, this of the Scelidothere illustrates in every particular the argument by which Cuvier established the ordinal affinities of the allied extinct genus Megalonyx.

Thus whilst the resemblance that can be traced between the bones of the fore-foot in the four genera of Megatherioid animals, above adduced, is sufficient to establish the unity of family-type on which that member was constructed, the recognizable varieties concur with those presented by other bones, and by the dental system, in establishing so many generic modifications of that peculiar type.

Description of the Bones of the Posterior Extremity.

*Femur**.—The femur is a short, broad and very strong bone, flattened from before backwards, with a subquadrilateral outline, but having the parallelism of the two longest sides affected by the concavity of the inner one. The proximal outline is nearly horizontal and at right angles to the lateral ones, but with the inner angle rounded off and slightly expanded to form the head of the bone: the distal outline runs parallel with the proximal one, the condyles being of equal length, but the angles dividing it from the outer and inner borders are obliquely truncated. The transverse diameter of the proximal end, taken across the head and great trochanter, exceeds that of the distal end.

The head, supporting the smooth surface presented to the acetabulum, is in form hemispherical; the articular hemisphere is directed obliquely upwards and inwards, encroached upon at the middle of its posterior margin by an oblong and moderately deep depression for the round ligament; the rest of its circumference is slightly sinuous, and anteriorly overhangs the shaft. The upper part of the neck of the femur expands, as it passes obliquely from behind forwards to the great trochanter, which scarcely rises above the horizontal line of the neck, and is on a lower level than the head. This trochanter is flattened at its summit and outer side, these surfaces meeting at a right angle: it is produced both forwards and backwards, but chiefly in the latter direction, where it descends, like a strong round column or buttress, along the outside of a large and deep cavity, before it subsides into the level of the shaft†. Viewed from the outer side, the broad external rugged surface of the great trochanter hides the rest of the proximal third of the femur from view, so much does it surpass that and every other part of the bone in antero-posterior diameter. It gradually contracts to form the strong external ridge, which descends, interrupted by only a slight emargination, to be continued into that which surmounts the external condyle. The anterior production of the great trochanter is narrower, and more rugged than the posterior one: it is also flattened and separated by a ridge from the outer convex surface of the process, with which it is placed nearly at right angles: the external border of the shaft of the femur seems to be more immediately continued from the lower angle of the anterior surface of the trochanter, and is slightly bent for-

* Plates XVII., XVIII., XIX. fig. 1. † Plate XVIII.

wards, bounding the concavity which extends along the outer third of the anterior surface of the shaft of the femur *. The ridge which defines the inner boundary of that concavity commences at the upper, anterior and internal angle of the great trochanter, and running vertically down the shaft of the bone, gradually subsides towards the end of the middle third. Two shorter ridges, equidistant at their origin from each other and from the preceding, run in parallel lines downwards and a little inwards, along the midspace of the anterior surface of the femur, between the great and small trochanters : they likewise bound shallow depressions, the seats of attachment of muscular masses subservient to the movements of the leg. The small trochanter is a vertically oval, depressed tuberosity, situate directly upon the inner border of the femur, two inches below the head, from which it is separated by a smooth and shallow concavity. The posterior intertrochanterian space is smooth and convex, except where it sinks into the cavity which partly undermines the posterior columnar prominence of the great trochanter. A narrow rugged tract is continued from the lower part of the small trochanter, obliquely downwards upon the posterior surface of the shaft, near the middle of which it expands, then terminates. The surface of the femur,at the middle of the anterior part of the shaft, is marked by the same slight reticulate risings which characterize many other parts of the skeleton, affording attachment to muscular fibres. A vascular groove leads obliquely from the long vertical ridge to the rising above the inner rotular articular surface, but the rest of the anterior surface of the femur is pretty smooth. The posterior surface of the distal half of the femur offers a more rugged and irregular character : many ridges at the middle and outer part of the back of the bone descend, converging, to a rough elevation forming the outer boundary of a wide and somewhat shallow depression on the outer half, and just below the middle of the back part of the shaft of the femur. This depression is smooth, as is also the surface adjoining the condyles. The orifice of the canal of the medullary artery, which is of disproportionally small size, is situated at the back part of the femur, a little above the middle in one, rather below it in the other bone ; in both the canal is directed downwards : its small size relates to the absence of a medullary cavity in the femur of the Mylodon. The outer border of the shaft terminates by forming a projecting angle above the outer condyle. The upper part of the outer boundary of the femur is

* Plate XVII.

the thickest, being formed by the broad and flattened part of the great trochanter: it gradually contracts to the emargination, where the femur offers its smallest antero-posterior dimension, and is there almost thinned off to an edge. In forming the upper side of the terminal angle the outer margin enlarges to a thick convex protuberance, which slightly overhangs by a well-defined concave ridge, the broad shallow depression forming the outer side of the external condyle. The plane of this depression forms the lower side of the terminal angle, and gives to the distal end of the femur the appearance of having had its external angle obliquely and abruptly truncated. The inner border of the femur is slightly concave and smooth below the head, then convex and rough where it defines the small trochanter; it next describes a wide and moderately deep concavity, bounding the middle and part of the lower third of the shaft, and it terminates by falling rather abruptly to the margin of the internal condyle, a projecting angle being thus formed between this sloping surface and the preceding concavity: the margin of the condyle, which terminates the inner boundary of the femur, slightly projects. The articular condyles, though contracted by the sloping in or convergence of the outer and inner angles, are broader from right to left than from before backwards. The rotular and tibial articulations form one continuous surface: the two transversely convex parts of the surface for the patella are joined by a middle concavity: the inner convex rotular surface projects more forwards, and rises higher than the outer one, which, on the other hand, descends lower; so that their vertical diameter is alike. The tibial, or inferior and posterior parts of the condyles, which are continued backwards from the rotular articulation, are separated from each other by a wide and deep depression. The inner condyle is broader posteriorly, and rises higher upon the back part of the femur than the outer one; it also projects a little further back and maintains the same breadth to its convex posterior termination. The outer condyle slightly contracts to the same part, which is terminated by a more nearly straight transverse line. There is a slight depression at the middle of the lower part of the anterior surface of the femur, just above the middle of the bilobed rotular articulation: the posterior projections of the condyles leave a deep and wide vertical concavity on the surface of the femur above them, which is slightly convex from side to side. As the head of the femur inclines a little forwards, and the condyles are bent backwards, the femur, viewed sideways, presents a double curve, like the italic *ſ*, but is thicker at the two extremities than in the middle *.

Patella †.—This is a comparatively large and strong triangular bone with rounded angles: the base is uppermost and oblique; the external surface moderately convex, rough, longitudinally and coarsely striated, giving the appearance of an ossified fibrous ligament; the inner margin is longer and straighter than the outer one, which is slightly concave. The internal or posterior surface is traversed at its upper and broader part by the transversely oblong and bilobed articular surface, which is convex transversely in the middle, and slightly concave in the same direction at the sides: the inner lateral surface is the longest. A narrow transverse strip of non-articular bone is situated above the articulation, and a greater longitudinal extent of rough concave surface is continued below that part to the obtuse apex, indicating the prolongation of the ossified substance into the short and strong ligamentum patellæ.

Tibia ‡.—If the femur of the Mylodon be remarkable for its shortness and breadth, these proportions are exaggerated in the tibia, the breadth of the upper extremity of which exceeds three-fourths of the length of the entire bone. The shaft is more flattened than the femur in the antero-posterior direction, but is as strongly marked by muscular ridges and ligamentous grooves. The upper or proximal surface of the tibia§ is horizontal, and presents a reniform figure, concave posteriorly, and with a small notch at the middle of the anterior convexity; it supports two articular surfaces, separated by a depression corresponding with the intercondyloid groove in the femur. The outer surface (*b*) is the smallest, and has a nearly circular figure; it is very shallow, and occupies the posterior half of the external moiety of the head of the tibia, the anterior portion of the same moiety being rough and irregular, partly convex, partly concave, and perforated by vascular foramina. The inner surface (*a*) is elliptical, and occupies the whole of the corresponding division of the head of the tibia: a small portion of its anterior part is convex, and rises to a slight eminence near the middle excavation; the rest of the surface is slightly concave. The part of the tibia which supports the articular surface for the external condyle is produced backwards, in the form of a thick horizontal platform of bone overhanging the shaft. A small

* Plate XIX. † Plates XVII. and XVIII. fig. 2. The bone is figured upside down.

‡ Plate XIX. fig. 4. Plate XX. figs. 1, 2, 3, 4. § Plate XX. fig. 3.

patch of smooth synovial surface is continued from the outer articular cavity upon the back part of this projection, for a post-tibial sesamoid bone. The under part of the process supports a flat elliptical articular surface *, not quite parallel with the upper one, but sloping from without inwards and downwards: this is adapted to the head of the fibula, which thus underprops the projecting bony platform, and supports, by the intervention of this and the semilunar cartilage, the outer condyle of the femur.

The shaft of the tibia is continued directly downwards from the rest of the circumference of the broad proximal end: it swells out anteriorly into irregular rough convexities, forms a smoother border about the inner articular surface, and falls in on every side to the lower third of the shaft, at the beginning of which the bone presents its smallest circumference. The anterior surface, below the proximal rough swellings, is flattened, and meets the posterior surface at a concave edge externally; the inner concave border of the shaft is thick and rounded. A short rough ridge is continued from the middle of the anterior proximal tuberosity obliquely downwards and inwards. Fine reticular risings mark the smoother parts of the anterior surface. A broad but shallow groove runs from the lower part of the outer concave edge downwards upon the anterior surface of the expanded distal end of the bone. The outer malleolus projects as a somewhat square-shaped protuberance. The opposite side of the distal end, or the inner malleolus, forms a less prominent convex tuberosity. The posterior surface of the tibia is smooth at the concavity beneath the overhanging fibular articulation, and along the outer half of the posterior surface as far as the rugged rising which overhangs the distal articular surface. The inner half of the back part of the tibia presents a rougher surface: a rugged rising extends across its upper part, a little below the convex boundary of the condyloid articular surface: a thick rough ridge extends downwards to the middle of the internal concave border of the shaft: a narrower ridge descends along the middle of the upper half of the posterior surface and then divides, the inner branch extending obliquely to the angle terminating the concavity of the inner margin of the shaft. Below this ridge a wide and deep canal extends obliquely from above downwards and inwards, its lower edge being about an inch above the distal articular margin: this deep posterior excavation forms a well-marked character of the internal

* Plate XX. fig. 2. *c.*

malleolus, and indicates prodigious strength in the flexors of the toes and adductors of the foot.

The distal articular surface of the tibia * presents the most singular modifications: it is divided into three compartments, which are well-defined, although the synovial surface is uninterrupted. The external compartment, *d*, is semi-elliptical, flat, nearly horizontal, inclining from without inwards and downwards: it forms the lower surface of the outer distal protuberance of the bone, and rests upon a corresponding surface, *g*, at the lower part of that excavation of the fibula, which receives the said protuberance. The second compartment of the distal articulation of the tibia is slightly concave, of a crescentic figure, with the horns directed inwards and forwards: its plane is more nearly horizontal than the fibular facet. The third compartment, *e*, is formed, as it were, by an excavation of the anterior and inner side of the distal articular surface, causing the concavity of the preceding crescentic surface, and the wide and deep semicircular notch which characterizes the fore-part of the distal end of the tibia. The third and crescentic compartments of the distal articulation are exclusively articulated with the astragalus, the singular form of which they sufficiently indicate.

Fibula †.—This is a detached strong subprismatic bone, enlarged at both extremities. The proximal end is obliquely truncated, and capped by the flat circular surface (*f*), which underprops the horizontal articular plate extended from the outer and posterior angle of the head of the tibia. A rough and slightly compressed ridge extends downwards for about two inches from the outer side of the proximal end; below this the outer side of the fibula is impressed by a rather oblique, smooth, shallow concavity: a ridge formed by the meeting of the anterior and posterior surfaces of the bone is then continued along the rest of the outer margin to its obtusely pointed distal end. The inner surface of the distal expansion presents a concavity, two flat synovial articular surfaces, and an intermediate rough ligamentous tract. The upper part of the concavity is very irregular; its lower part is formed by a flat oblique articular surface (*g*). When the outer prominence of the distal end of the tibia is therein impacted, as it was in its natural connections, the small outer compartment of the distal articular surface rests on the above-described articulation of the fibula. A narrow, slightly concave, transverse tract divides the upper from the lower articular sur-

* Plate XX. fig. 4.

† Plate XX. fig. 1, in conjunction with the tibia, and fig. 5.

face (*h*); this is of less extent than the one above; its plane is vertical, looking directly inwards, and is adapted to the flat surface on the outer side of the astragalus; it is situated towards the anterior part of the inner surface of the malleolus; the posterior rough tract is of nearly equal extent.

*Bones of the hind-foot**.—The terminal segment of the hinder extremity is remarkable both for its strength and especially its length, measuring not less than sixteen inches in the latter dimension: the tarsal portion is a model of massive organic masonry: the toes maintain a close analogy with those of the fore-foot, and, like them, are modified, some for the envelopment of a hoof, others for the support of long and powerful claws.

Of the tarsus there have been preserved the astragalus, calcaneum, cuboides, naviculare, the external cuneiform and a smaller cuneiform bone; which six bones, it will appear by the following descriptions, are all that the Mylodon possessed in this segment of the foot.

The *astragalus*† is of an irregular pyramidal form, the posterior end forming the apex, and the base, which is turned forwards, being rudely divided into three large tuberosities. If the foot be placed with the sole flat on the ground, as in Plate XXI., the astragalus, naturally coadapted to the other tarsal bones, has its fibular or outer side uppermost, and a great part of the articular surface for the tibia looks inwards; when articulated, therefore, to the leg, placed vertically above it, the foot rests upon the ground by its outer edge, not by its sole, and the peculiarities of the metatarsal structure relate to this inversion of the foot. The articular surface which the astragalus presents to the bones of the leg is divided into three parts, the general planes of which are at right angles to each other. The middle division of the surface‡, which, in the naturally inverted position of the foot, is horizontal, presents a reniform figure; it is slightly convex anteriorly, concave in a less degree posteriorly: at the antero-lateral part of its outer convex border the articulation adapted to the malleolar process of the fibula is continued upon the external surface of the astragalus, presenting anteriorly the form of a semi-oval slightly convex smooth tract, and contracting suddenly behind this part to the breadth of two or three lines. The third or internal division§ of the upper articular surface of the astragalus, which in ordinary cases receives the internal

* Plates XXI. and XXII.

† Ibid., *a*, and Pl. XXIII. figs. 1 and 2.

‡ Pl. XXIII. fig. 1. *a*.

§ Pl. XXIII. fig. 1. *b*.

malleolus and descends upon the inner side of the astragalus, here on the contrary ascends at nearly a right angle to the plane of the middle reniform surface, as it were, from its pelvis, in the form of a full convex semi-elliptical tuber, which ascends to fill the corresponding concavity or excavation on the fore and inner side of the distal articulation of the tibia. Below the extremity of this surface the astragalus swells out into an oblong tubercle; and below this there is a wide channel sinking into a deep depression at the fore and at the back part of the base of the above process, the channel and the two depressions separating this part of the astragalus from the calcaneo-navicular articulation: in these depressions open many large vascular canals. A third rough and perforated depression separates the fibular articular surface from the cuboidal one: a more shallow depression indents the outer side of the astragalus behind the fibular surface. The inferior and anterior part of the astragalus is occupied by one extensive elongated articular surface adapted to the calcaneum, cuboides and naviculare. The navicular surface* is flat at its upper half, convex at its lower half; the latter part being continued uninterruptedly into the convex cuboidal surface†. The calcaneal surface‡, which is continued backwards from the cuboidal one, is elongated, being continued to the posterior apex of the bone; it is rather narrow, and is constricted near its middle part. It is slightly convex at its posterior extremity; in a still less degree convex through the rest of its extent, and that only from side to side; it is gently concave from before backwards: it is perfectly smooth through the whole of its extent.

The *os calcis*§ of the Mylodon, which equals in size that of the Elephant, is chiefly remarkable for the great breadth and length of its rugged posterior portion, for its broad, concave, triangular basis, perforated by many large vascular foramina, and for the large and deep tendinous groove, sometimes converted into a canal, at the outer side of the bone, which canal or groove is nearly an inch in diameter. Above it, at the anterior part of the outside of the bone, there is a wider and shallower canal, with a less smooth surface, bounded above by a small tuberosity, and in front by a depression and a second tuberosity: the broad and deep outer surface of the calcaneum behind the foregoing canals is of a rhomboidal figure and is slightly concave, separated from the inferior surface

* Pl. XXIII. fig. 1. *c*.

† Pl. XXIII. fig. 2. *d*.

‡ Pl. XXIII. fig. 2. *e*, *f*.

§ Plates XXI. and XXII. *b*.

by a broad, rugged, elevated border, and from the superior articular surface by a well-defined margin. The posterior surface of the calcaneum is high but narrow, rising from the tuberous extremity of the heel obliquely upwards with a gentle concave curve, to the superior surface, from which it is separated by a small rugged tubercle: this tubercle, and a corresponding one on the extremity of the astragalus above, indicate the points of attachment of a strong posterior ligament. The inner surface of the calcaneum is separated from its posterior surface by a broad and rugged oblique ridge: it gradually deepens to a wide concavity bounded by three large tuberosities; one above, which supports the inner extremity of the astragalar articulation; another below, forming the internal and anterior angle of the inferior subconcave surface; the third in front, constituting the anterior prolongation of that surface. There is but one articular surface in the os calcis of the Mylodon, which occupies the whole of the narrow superior facet, and bends down over part of the anterior surface: the upper division of the articular surface supports the astragalus: it is slightly concave transversely, convex from behind forwards at its middle part: its breadth is not quite equal to the surface of the astragalus which plays upon it, and it is evident that a certain freedom of lateral motion was allowed between these two bones. The anterior deflected division of this long and narrow articular surface is equal to one-fourth of its entire extent; it is slightly concave, and is adapted to the os cuboides.

The *naviculare** is an irregular, thick, oval plate of bone, concave towards the astragalus, convex next the metatarsus. Its thickest part is towards the upper and outer end, where the articular surface for the astragalus is slightly convex; the rest of that surface which extends to the tibial and lower border of the naviculare is concave. The upper and posterior border of the bone presents accordingly a sigmoid curve. The thickest part of the margin of the bone, which is above the convex articulation with the astragalus, is rough and flattened: the angle between this and the outer margin is formed by a thick tuberosity. Only a small part of the anterior convex surface is modified for articular union, and this part presents two distinct surfaces for two cuneiform bones: of these articulations, the outer one is more than double the extent of the inner one, and forms an oval of one inch and a half by one inch in diameter;

* Plates XXI. and XXII. *c.*

it is gently convex and situated towards the lower half of the fibular part of the anterior surface. The inner cuneiform surface is about ten lines by seven lines in extent, situated, with its long axis transversely, close to the inner margin of the bone, nearer the lower than the upper margin, and separated by an uneven non-articular tract of two lines in breadth from the outer cuneiform surface.

The *os cuboides** has the form rather of a thick and short wedge, the base of which is formed by the rough flat subquadrate surface, which appears at the upper and outer part of the tarsus: the outer and anterior margin of this surface is developed into a rough eminence. On the outer side of the cuboides there is a slightly convex surface for the calcaneum; the whole of the back part is excavated to receive the astragalar convexity: a narrow vertical strip of articular surface on the inner surface joins the naviculare, and these three facets are continuous with each other. At the fore and upper part of the inner side of the cuboides there is a small surface which touches the base of the third metatarsal; this is separated from the navicular strip by a rough depression, bounding the interspace between the cuboid and adjoining cuneiform bone: the anterior surface of the cuboides supports a very large articulation divided by a vertical narrow groove into two parts, for the two outer metatarsal bones. The under part of the cuboides is excavated by a rough depression, bounded anteriorly by a rugged protuberance. Although the cuboides articulates with six distinct bones, it has only two distinct smooth articular tracts; that for the middle metatarsal being continuous with the large outer metatarsal surfaces.

A vacant interspace in the skeleton divides the cuboid from the *external cuneiform* bone†, which has the usual triangular form, with the base shorter than the sides. This bone presents only two articular surfaces, a posterior one, slightly concave, for the naviculare, and an anterior one, in a less degree convex, for the oblique base of the middle metatarsal; the outer angle of the anterior surface is more produced than that of the posterior surface. The external cuneiform diminishes in antero-posterior thickness from the base towards the apex, which is rounded off. The three margins of the bone are flat or slightly convex, rough, and perforated by vessels: there is no trace of an articular surface for the cuboides on the outer margin, or for a middle cuneiform bone on the inner one.

* Plates XXI. and XXII. *d.*

† Ibid. *e.*

The internal* of the two cuneiform bones is about half the size of the external one, and of nearly the same antero-posterior diameter, but more compressed laterally, and of somewhat less depth: its convex base is uppermost; its obtuse apex downwards: the inner and outer sides are nearly flat, rough, without trace of smooth articular surface, which is limited to the anterior and posterior extremities of the bone. The posterior surface is elliptical, slightly concave, adapted to the distinct circumscribed articular surface on the naviculare: the anterior articular surface is nearly circular, and very slightly convex. There is no articular surface upon the tibial or inner side of this cuneiform bone, nor any indication of a third or internal cuneiform on the os naviculare; from which it is to be concluded that the internal cuneiform bone and first toe, or hallux, were altogether wanting in the Mylodon, and that the mutilation by which its hind-foot is reduced to the tetradactyle type has commenced, according to the ordinary law, from the inner side.

The toe articulated with the foregoing cuneiform bone is the smallest of the series, and consists of three phalanges and a metatarsal bone. The metatarsal† is a moderately long, subcompressed bone, having its proximal end obliquely truncated, and supporting a circular and nearly flat surface, below which there is a rough tuberosity. A narrow vertical channel with a large perforation in the middle, and with a convexity before and behind, characterizes the outer side of this bone; its inner side is rough and similarly unequal: on neither side is there the least trace of an articulation with an adjoining metatarsal. The distal end presents a simple ovate articular convexity, with the small end upwards.

The proximal phalanx is wanting in both feet; but the large sesamoid bone *s*, part of the surface of which adapts itself to the inferior facet of the distal articulation of the metatarsal, indicates the former existence of such phalanx, as does likewise the size and form of the proximal surface of the second phalanx: it is, therefore, introduced of its probable size, in the figure, at *m* 2, 1.

The second phalanx (*m* 2, 2), though small, is longer in proportion to its breadth than in the great adjoining toe: it is slightly compressed, like the metatarsal bone: the proximal surface is moderately and uniformly concave, of a vertically oval form, turned slightly inwards, and with the larger end termi-

* Plates XXI. and XXII. *f*.

† Plates XXI. and XXII. *m*, 2. The articulator has separated, in the foot here figured, the inner toe a little too far from the adjoining or third toe.

nating below in two tubercles. The phalanx suddenly diminishes in vertical thickness, the sides being convex, the under part slightly concave. The distal articulation is a pulley of three surfaces; the middle one concave, the two lateral strongly convex: the vertical extent of this trochlea is less than half that of the proximal articulation. The length of this phalanx is a character in which it resembles the second phalanx in the other unguiculate toes, and this resemblance is preserved in the form of the distal articulation, which moreover corresponds with, and can only be adapted to, the short and strong ungual phalanx, which, therefore, I have assigned to the present toe.

The proximal articulation of the ungual phalanx (*m* 2, 3) presents a median longitudinal ridge and two lateral canals, overhung by a pointed process continued backwards from the upper part of the base of the bony ungual sheath, so as to preclude effectually extension beyond the straight line: the median articular ridge is continued into a similar but shorter process below, limiting flexion to nearly a right angle; and the rough margins of the lateral concavities are produced backwards, so that the distal articular end of the supporting phalanx is buried in a deep fossa. The base of the ungual sheath swells out at its under part into a thick rugged bed of bone extending along the proximal half of the under part of the phalanx, forming the chief foundation of the claw-process, and developing from its margins the osseous sheath of the claw. From each lateral space between the claw-process and the sheath a large canal is continued downwards, which opens upon the rugged base of the phalanx. The supporting process of the claw has the form of a nearly straight, obliquely compressed cone, with a very oblique base, reducing the under side to half the length of the upper side; the two surfaces being separated by a ridge which is most strongly marked on the tibial or inner side.

The disproportionate shortness of the metatarsal bone of the middle toe (*m*, 3) is more striking in the hind-foot than even in the fore-foot: but the base wants production from its inner side, which gives the bone of the middle metacarpal its characteristic malleolar figure: in the metatarsus it is laterally compressed between two nearly flat vertical surfaces, and is bent obliquely to the outer side to be wedged between the os naviculare and the fourth metatarsal; with the produced angle truncated to abut upon the anterior angle of the cuboid bone. There is a large articular surface on the outer side of the base for junction with the fourth metatarsal; but there is no trace of an articular surface on the opposite or inner side of the base for the second metatarsal. The distal articular surface is a compound pulley similar to that on the third metacarpal; with the median ridge sharpest and most produced below, where it is wedged into the interspace of the two large sesamoid bones.

The proximal phalanx of the middle toe (1) is as wide as it is long, and nearly twice as deep: the upper surface, which has a transversely quadrate form, presents a convex transverse rough bar above the proximal articulation, and a depression in front of the bar. The outer side of this phalanx is nearly flat, the inner side gibbous towards its lower end. The proximal articular surface is concave, adapted to the upper two-thirds of the convex trochlea of the metatarsal bone, and widening as it descends. The distal articular surface presents a vertical concave channel, also widening as it descends, and almost meeting the proximal surface at the middle of the under part of the phalanx, which is notched, with a tubercle on each side.

The proportions of the middle phalanx (2) differ much from those of the preceding bone: its antero-posterior diameter exceeds by one-eighth part the vertical diameter, and by one-third part the transverse diameter. The depth of the phalanx rapidly contracts from the proximal end; the sides are flattened, and slightly concave in the middle: they terminate anteriorly in the convex borders of the distal trochlea, which describe two-thirds of a circle; the median depression of the pulley follows the same curve, and terminates both above and below in a wide and deep cavity. The proximal articulation consists of two vertical concavities separated by a median ridge; the upper extremity of which is more produced than the lower one; but both combine to restrict the movements of the middle upon the proximal phalanx in the vertical direction, in which alone any motion is permitted by the form of the articular pulley.

The greater length of the second phalanx, and the more extensive curve of its distal trochlea, allows much freer motion to the ungual phalanx (3), which can be made to describe a quarter of a circle in the direction to which its movements are restricted. The position of the trochlear cavity, which extends obliquely from above downwards and forwards over the base of the ungual phalanx, and the backward production of the upper end of the median trochlear ridge, cause this phalanx, in extreme extension, to have its long axis parallel with that of the middle phalanx: in extreme flexion the point of the claw is bent down at right angles to the middle phalanx. The lateral concavities receiving the trochlear convexities of the adjoining phalanx, and the median ridge fitting the median canal of the same, are so deep as to prevent any lateral motion, and give great strength to the joint. The upper production of the basal articulation of the ungual phalanx is flattened vertically, and rough, serving probably for the implantation of the extensor tendon. The osseous sheath of the claw is continued forwards from the upper and lateral margins of the articular cavity, and from those of the flat rough oval surface at the proximal half of the base of the claw. The osseous sheath, which varies from half a line to one line and a half in thickness, appears to have extended forwards over at least the basal third of the long process supporting the claw; but it is broken away more or less in both the feet. The claw-process, which forms the chief part of the ungual phalanx, is conical, slightly deflected, and inclined inwards; convex above and at the sides, which are divided from the under surface by sharp edges: the under surface, owing to the oblique line from which the sides of the ungual sheath arise, is less than half the length of the upper surface; it is convex transversely along its middle part, concave on each side; these lateral channels are bounded externally by the sharp edges above-mentioned, and deepen as they approach the base of the phalanx. The vessels and nerves which supplied the secreting organ of the enormous claw were lodged in the above channels: of the two large oval perforations in the lower rough tract, the external one leads directly to the beginning of the corresponding channel; the internal one conducts to the cancellous structure of the phalanx. The claw-process for the extent of one inch and a half from its apex is impressed above with a shallow longitudinal channel.

The ungual phalanges of both the claw-bearing toes of the hind-foot resemble those of the fore-foot in the perforated and grooved character of their outer surface.

The two outer metatarsal bones are the only ones the size and strength of which are proportionate to that of the principal bones of the tarsus, as the calcaneum and astragalus. That which supports the fourth toe (*m*4), counting as if the normal number had existed on the inner side of the foot, presents a short trihedral body, expanding into two extremities. The proximal end is obliquely truncated on the tibial or inner side, with the lower angle produced downwards. A smooth articular surface, slightly concave vertically, and slightly convex transversely, occupies this oblique base, and is divided by a moderate constriction into an anterior smaller ovate surface, adapted to the outer basal process of the middle metacarpal, and into a posterior, vertically elongated, larger surface applied to the tibial anterior facet of the os cuboides. A very slightly concave semi-elliptical articular surface extends obliquely upwards upon the outer side of the proximal end of the bone, and is adapted to a corresponding convex surface on the adjoining side of the fifth metatarsal. A shallow canal with many vascular perforations surrounds the margin of this surface, both above and below which there is a rough tuberosity. The outer or fibular side of the body of the present metatarsal is rugged, and rather flattened: the other surfaces are smooth and convex. The distal end of the bone expands in the vertical direction, and supports a narrow, vertically elliptic, convex articular surface, surmounted by a large and rough tuberosity, and terminating below in slight concavities, placed somewhat obliquely, for two large sesamoid bones, separated by a short convex ridge. A narrow ridge traverses vertically the inner side of the distal end of the fourth metatarsal; and a smooth tuberosity rises from the middle of the outer side of the same extremity.

The proximal phalanx of the fourth toe (*m* 4, 1) is an elliptical subcompressed piece, the antero-posterior diameter of which is equal to two-thirds of the vertical diameter: its proximal surface is excavated by a simple articular cavity, corresponding with the convex portion of the preceding articulation; and is bounded below by a pair of surfaces for the sesamoid bones. The distal end bears a much smaller and very slightly convex surface. The non-articular surface is concave beneath, rough, and much perforated by the nutrient vessels.

The second phalanx (*m* 4, 2) is a small irregular hemisphere of bone, with a rugged exterior surface, except at the proximal shallow articular surface. There is no trace of a joint for a third or ungual phalanx, which was wanting, together with the claw.

The metatarsal bone of the outer or fifth toe (*m* 5) is of extraordinary size and strength; its length equals that of the adjoining toe; in the circumference of its base it surpasses the same bone by more than one-half. It presents the form of a rugged and irregular three-sided cone, with an oblique base and an obtuse apex. The distal articular surface is of small extent, of a triangular form, with the angles rounded off, and is divided into two parts; the larger portion is placed on the tibial half of the base of the bone, and is applied to the outer facet of the anterior cuboidal articulation; the remaining portion encroaches upon the tibial side of the bone, and abuts upon the outer articular surface of the adjoining metatarsal. A slight concavity divides the basal articular surface from the large rough protuberance, by which the bone is prolonged backwards and outwards towards the os calcis. The strong tendon which traverses the outer groove of the calcaneum had, doubtless, an expanded insertion into this protuberance and the rough margin continued from it along the outer side of the metatarsal bone. The upper surface of the bone is concave, with small elevations and vascular foramina; near the distal end the elevations assume the size of, or blend into a rough protuberance: the short inner side of the bone is convex: the under-side concave, divided by a rough ridge from the inner side. The signs of the great pressure to which the outer rugged surface of this bone has been subject are too obvious to be mistaken, and the position of the articulation of the foot with the leg shows this to have been the surface which mainly transferred the superincumbent weight of the massive hinder parts of the animal to the ground. The proximal articulations of the fifth metatarsal are so placed as to make it the focus or centre upon which almost the whole weight of the foot is concentrated. The distal end of the same bone is bevelled off almost to an edge, set vertically; on the outer side of which there is a small vertically elliptic and slightly convex articular surface; on the inner side and above there is a rugged protuberance and ridge; below there are two oblique surfaces for sesamoid bones.

The proximal phalanx is a diminutive shapeless rough bone, with the proximal surface adapted to the foregoing convexity. A very small and nearly flat distal surface indicates the existence of some still more abortive representative of a second, and doubtless terminal phalanx.

The shape and superficial markings of the bones leave no doubt that the curtailed and, as it were, amputated extremities of the two outer toes were sunk in a hoof-like modification of the integument of the corresponding portion of the foot.

Comparison of the Bones of the Posterior Extremity.

In surveying successively the forms of the femora of the larger Mammalian quadrupeds, we find in some of the great Pachyderms alone the shaft of the femur flattened from before backwards, and thereby approaching to its characteristic modification in the Mylodon. But in the Elephants and Mastodons the length of the femur so far exceeds its breadth, that, strong as these bones are and well-proportioned to the weight they had to sustain, they appear weak and slender when placed by the side of the femur of the Megatherium or Mylodon. The Rhinoceros, which has the thigh-bone relatively broader and flatter than in the Proboscidian or other Pachyderms, differs more markedly from the Mylodon and Megatherium in the presence of the third trochanter.

The flattened form of femur is common to all the Edentata; but the Orycterope and Armadillos, in which this character is conspicuous, differ, like the Rhinoceros, from the Megatherioids in having the third trochanter. This process is not present in the Sloths, Pangolins and Ant-eaters; but in all these the femur is relatively longer and more slender than in the Mylodon, that of the great Ant-eater offering the nearest resemblance as to form amongst the Edentata; while the Sloths alone, amongst the existing terrestrial Mammalia, repeat the remarkable Mylodontal character of the absence of a medullary cavity in the shaft of the femur.

The general characters of the femur of the Mylodon are present in all the other species of Megatherioids in which this bone has been discovered. In the great Megatherium they are even exaggerated, and instead of there being any closer approximation to the form of the femur in the Mastodon or Elephant, the shaft of the bone is relatively shorter and broader than in the Mylodon. The only character in which the Megatherium offers a resemblance to the great Proboscidian Pachyderms, not found in the smaller Megatherioids, is the absence of the depression in the head of the bone for the ligamentum teres, but in this respect it equally agrees with the Sloths. We may, however, connect the absence of the ligament in the Megatherium, unless a slight emargination at the posterior circumference of the head indicate a vestige of the ligament, with the same vertical position of the head of the bone under the nearly horizontal acetabulum, which seems to govern the like deficiency in the Elephant and Mastodon. The Sloths may probably, like the Orang-utan, derive some advantage from the absence of the ligamentum teres by the greater freedom thus allowed to the lateral movements of the hinder-limbs in the act of climbing. The concavity between the head and great trochanter at the proximal end, which can scarcely be termed the neck of the femur, is deeper, while the trochanterian depression at the back of the bone is much shallower in the Megatherium than in the Mylodon. The distal expansion of the femur is relatively greater in the Megathere, but is characterized by the same great angular projection above the outer condyle. The distal articulation presents as marked a distinguishing character as the proximal one; the rotular surface is formed by the anterior continuation and expansion of the articulation upon the outer condyle, and is divided by a rough isthmus two inches broad from the inner condyle: in the Mylodon the rotular articular surface is continuous with those of both the condyles.

From the cast of the distal epiphysis of a femur in the Museum of the College, which is as much compressed in the antero-posterior direction as in the Megatherium, the genus Megalonyx would appear to offer a third modification of the knee-joint, the rotular surface being distinct from those of both condyles. Thus the knee-joint of the Mylodon must have consisted of one large and complex synovial sac, that of the Megatherium of two, that of the Megalonyx of three distinct sacs. The distal end of a femur of a Megatherioid animal, transmitted with the bones of the *Mylodon robustus*, was at once distinguished and set apart by presenting the same modification of the distal articular surface as in the North American Megalonyx, but in its transverse and antero-posterior diameters it approaches nearer to the Mylodontal proportions; it consequently differs from the above-mentioned Megalonyx in the narrower interspace of the condyles; and the inner condyloid surface has a peculiar excavation at its anterior termination. The fragment of the femur here compared, which may indicate a second species of true Megalonyx, differs from the femur of the *Mylodon robustus* in the less angular production of the outer margin of the femur above the condyle, and in the deeper excavation at the back of the femur near that margin, but more especially by the existence of a well-defined but small medullary cavity, with a strongly reticulated surface.

The remains of the Scelidotherium in the Museum of the College include a perfect os femoris*. This is intermediate in its proportions between those of the Megatherium and Mylodon, but as compared with the other parts of the skeleton, its breadth is more remarkable than in either of those genera: compared with its antero-posterior diameter, the transverse diameter exceeds that in the Megatherium, but, compared with the length of the femur, it does not surpass the transverse diameter of that bone in the Megatherium. The head of the femur of the Scelidotherium is as deeply and extensively impressed by the ligamentum rotundum as in the Mylodon; it is not so much produced inwards as in the Mylodon or Megatherium: the small tro-

* Voyage of the Beagle, 'Fossil Mammalia,' 4to, pl. 25, fig. 5.

chanter is more developed, attaining the vertical line dropped from the inner surface of the head. The distal articulation of the femur is relatively smaller than in the Mylodon or Megatherium: the rotular surface is continuous with both condyles as in the Mylodon. The angle above the outer condyle in the femur of the Scelidotherium is not formed by a projection of the bone, but by the truncation of the lower and outer angle, the outer vertical margin of the femur being thus continued by an oblique line to the margin of the condyle. The prominence above the inner condyle is more marked in the Scelidothere than in the Mylodon. In all these modifications of the thigh-bone the *Scelidotherium Cuvieri** agrees with the *Scelidotherium leptocephalum*, but some slight specific differences may be discerned in the sculpturing of the back of the femur, and in the form of the outer condyle.

In the great extent of the trochanter major, and in the strong development of the ridges and inequalities which are at once the result and indication of the muscular forces, the femur in all the Megatherioids surpasses that bone in any known recent or extinct mammal. These striking characters harmonize with our conceptions of the nature of the support required by the vast pelvis, and bespeak the strength of the powerful muscles, which, in the peculiar exertions put forth by the living animal, must have acted and reacted upon the trunk and the hind-extremities.

The femur of the Mylodon is distinguished from that of any existing mammal by its great breadth, but the bones of the leg are more remarkable for the extent to which they surpass any recent type in their peculiarly massive proportions, being as strong but relatively shorter even than in the Megatherium. Nevertheless it is in this segment of the hind-extremity of the small Sloths that we have the first recognisable evidence of a resemblance to that of the Megatherioids: it is manifested by the unusual breadth of the leg, produced however by the mutual divarication of the tibia and fibula by outward curvatures†, leaving an unusually wide interosseous space, which, in the heavy Mylodon, is reduced by the ossification of the broad tibia to a small compass. The Mylodon agrees with both Sloths and Ant-eaters in the persistent articulations between the tibia and fibula: these bones coalesce at the proximal extremity in the Orycterope, and at both extremities in the Armadillos.

* Lund, *loc. cit.* pl. 4, fig. 1, '*Megalonyx Cuvieri.*'

† Cuvier, *loc. cit.* p. 360.

The most peculiar feature in the tibia of the Mylodon is the form of the distal articular surface. In no existing Edentate quadruped does this part of the tibia agree with the extinct type. Neither the Sloths nor any other Edentates, nor indeed any known existing mammal, present the hemispherical excavation on the fore and inner part of the distal joint of the tibia: only in the Megatherium and Mylodon has this peculiarity been observed, and in the extinct congeners only of these gigantic leaf-devourers can such character be inferred from the structure of the astragalus*. This unusually secure interlocking of the foot to the leg bespeaks some singular habits of the lost species to which it is peculiar, and is evidently connected with the requirement of unusual resistance in the foot to the forces acting upon it from the leg and thigh.

In the Megatherium the hemispherical excavation is nearer the inner or tibial side of the bone than in the Mylodon, and the broader articular depression external to it is deeper, and is separated by a more extended and marked convex ridge in the Megatherium. The leading difference, however, between the Mylodon and Megatherium, in the structure of the bones of the leg, arises from the tibia and fibula being anchylosed together at both extremities in the more gigantic species. The shaft of the fibula of the Megatherium is relatively more slender than that of the Mylodon.

From a cast of the tibia of the *Megalonyx Jeffersoni*, it would seem that the fibula was detached in that species as in the Mylodon; but as the specimen compared has belonged to a young animal, and has lost the distal epiphysis, it may possibly acquire the character of the tibia of the Megatherium by age. The cast demonstrates that the tibia of the Megalonyx, like that of the Megatherium, is relatively longer than in the Mylodon, and is more slender than in either of those genera. At the proximal articular surface the division for the outer condyle is slightly convex in the Megalonyx, but slightly concave in the Mylodon: in the Megatherium the same surface is more convex than in the Megalonyx, and is continued by a regular curve into the surface for the popliteal sesamoid, which surface, in the Mylodon, meets the condyloid surface for the femur at an open angle.

The tibia of the *Mylodon Harlani* is longer in proportion to its breadth than in the *Mylodon robustus*, but is shorter than in the Megalonyx: the proximal

* See the description of the astragalus in the Scelidotherium, Megalonyx and Megatherium in the Fossil Mammalia of the Beagle, p. 94, plates 26 and 28.

articular surface for the inner condyle of the femur is relatively larger. The large tendinous groove which crosses obliquely the back of the inner malleolus, is less deep and further from the distal margin than in the *Mylodon robustus*. The excavation for the astragalar tubercle is more sloping, but relatively deeper and wider.

The proximal articulation of the tibia of the Scelidotherium closely resembles that of the Mylodon, and the articular surface below the outer expansion indicates that the fibula was likewise a separate bone in this species. The repetition of the separate state of the bones of the leg in three different genera of Megatherioids much diminishes the value of the evidence which Cuvier deduced from their anchylosed condition in the Megatherium in favour of its affinities to the Armadillos, although, as this structure is known among existing quadrupeds only in the loricated family of Edentata, it forms an interesting additional proof of the essential relations of the huge extinct animals under consideration to that anomalous order of Mammalia.

Astragalus.—It is worthy of observation, that, although the astragalus of the Sloth differs much from that of the Mylodon, it offers modifications as peculiar and as distinct from those of the same bone in any other mammalian genus. The outer part is excavated by a deep cell in which the pivot-like end of the fibula rotates; the inner side is applied, as usual, against a malleolar process of the tibia. In the Ant-eaters and Armadillos the upper surface of the astragalus has the normal configuration, and is sunk deeply, as in most other mammals, into a tibio-peroneal mortice. Other recent mammals offer, in this bone, no comparisons by which further light can be thrown on the peculiarities of the Megatherian race.

The astragalus and distal articulation of the leg-bones being coadapted, the principal modifications of that tarsal bone in the Megatherian family relate to the peculiarities already pointed out in the tibia; and, as its mode of articulating with the os naviculare is almost as peculiar, it forms the most characteristic single bone in the skeleton of the Megatherioid quadrupeds. The chief and most distinctive character of the astragalus is the convex protuberance on the inner half of the upper articulation already described; but, with this modification common to all the known Megatherioids, the astragalus presents striking and recognisable differences in the different genera. Different species of the same genus present also appreciable modifications of the astragalus: thus, in the *Mylodon Harlani* the tuber at the anterior and internal side of the tibial articular surface is longer than in the *Mylodon robustus*: this difference is indicated indeed by the tibia. The generic modifications of the astragalus are of a more striking character. In the Megatherium* it presents a more convex and deeper external division of the upper articulation (*a*), and a relatively broader and shorter internal tuberosity (*b*); but the more marked differences are observable in the articulations for the naviculare and calcaneum. The upper half of the navicular surface (*c*), which is flat in the Mylodon, is deeply excavated in the Megathere. The calcaneal surface (*e*, *f*) is single and continuous with the navicular one in the Mylodon, but is bisected by a deep rough canal in the Megathere; the posterior portion (*f*) being thus insulated, and the small anterior division (*e*) alone being continuous with the convex part of the naviculo-cuboidal articulation (*d*), as it is in the recent Sloths.

An astragalus brought by Mr. Darwin from South America, and which may have belonged to the Megalonyx†, agrees with that of the Megatherium in the depth of the outer portion (*a*) of the tibial surface, and in the bisection of the calcaneal surface, but resembles that of the Mylodon in the flatness of the upper half of the navicular surface (*c*). The astragalus of the Scelidotherium‡ agrees with that of the Mylodon in the less depth of the outer division of the tibial surface (*a*), and the more open angle with which it joins the inner convexity (*b*); it agrees with the astragali of the Megatherium and Megalonyx (?) in the division of the calcaneal surface (*e*, *f*) by a rough groove; but it differs from the astragali of all the other known Megatherioids by the presence of two deep concavities§ upon the naviculo-cuboidal surface, the portion to which the os cuboides articulates being concave (*d*) instead of convex, as in the other known Megatherioids. By the astragalus alone, therefore, not only might the existence of a large Megatherioid animal be inferred, but also the particular genus to which it belonged could be determined.

Calcaneum.—As the modification of the calcaneal surface of the astragalus

* Plate XXIII. figs. 5 and 6. † Ibid. figs. 3 and 4. ‡ Ibid. figs. 7 and 8.

§ This character is well shown in the figure of the astragalus of the *Scelidotherium leptocephalum* in the Fossil Mammalia of the Beagle, pl. 26, figs. 2 and 6; and in that of the *Scelidotherium Cuvieri* in Dr. Lund's Blik, &c., pl. 4, fig. 3.

governs a corresponding structure in that of the bone to which it is adapted, the os calcis of the Mylodon might be distinguished from that of the other known Megatherian genera by the uninterrupted continuity of the articulation presented to the astragalus, with which that for the cuboides is continuous. In the Megatherium the small anterior concave astragalar surface is continuous with the cuboidal facet : the insulated posterior surface for the astragalus is more convex than the corresponding part in the Mylodon : the posterior prolongation of the heel-bone is relatively longer and more pointed in the Megatherium than in the Mylodon : the posterior wall of the wide and deep outer groove of the calcaneum is less developed in the Megatherium. In the Scelidotherium the posterior termination of the calcaneum is broader, and terminated by a less angular convexity than in the Mylodon ; but in the separation of the posterior from the anterior part of the astragalar surface it agrees with the Megatherium and with the Sloths. These, of all recent Edentata, most resemble the Megatherioids in the posterior prolongation of the calcaneum, but it is slender and compressed. The thickness and strength of the great lever for the extensors of the foot are among the most striking peculiarities of the skeleton of the extinct Megatherians.

The os cuboides of the Megatherium, in addition to its size, differs from that of the Mylodon in having the surface for the fifth metatarsal placed at right angles to that for the fourth metatarsal, while they are in nearly the same plane in the Mylodon. The surface of the cuboid which joins the astragalus is concave in the Mylodon as in the Megatherium, and most probably also in the Megalonyx ; but it must be convex in the Scelidotherium, since the corresponding surface of the astragalus forms the second concavity on its anterior prominence already mentioned.

The anterior surface of the cuboides gives the number and size of the external metatarsals, and shows that these two bones must have been of nearly the same relative size in the Megatherium as in the Mylodon, but that the external or fifth toe was directed more outwards, and the figure of the hind-foot of the Megatherium* agrees with these indications. As the os cuboides teaches the relative size and position of the two outer metatarsals, so the os naviculare indicates the number of the remaining toes, or at least of the cuneiform bones, which respectively support them.

* Pander and D'Alton, *loc. cit.* tab. 4, fig. 36.

If only the os naviculare, for example, had been preserved in the present collection of the bones of the Mylodon, it would have proved, by the presence of its two anterior articular surfaces, that only two toes, or their rudiments, had existed, in addition to the two outer ones supported by the os cuboides ; in other words, that the hind-foot was tetradactyle. Hence the importance of the os naviculare in determining the doubtful structure of the hind-foot of the Megatherium. This bone is fortunately preserved entire in the collection of remains of that species presented to the College of Surgeons by Sir Woodbine Parish. It has only two smooth articular surfaces, as in the Mylodon, on its anterior part ; the outer surface is large, triangular, exceeding in size either of those on the os cuboides ; the inner one is of a narrow oblong form, continuous with the outer one superiorly, and receding from it as it descends along the inner or tibial side of the bone, with its slightly undulated plane looking forwards and inwards. In the Mylodon the corresponding surface is relatively broader and shorter ; the outer surface bears the same proportional size. The posterior or astragalar surface of the naviculare in the Megatherium differs from that of the Mylodon in the greater convexity of its upper half ; the entire bone is relatively narrower. The next point to be determined is therefore the nature of the two inner toes of the tetradactyle hind-foot of the Megathere, and their amount of correspondence with those of the Mylodon.

From the size and shape of the surface for the support of the external cuneiform bone in the Megatherium, it is evident that the middle toe which it supported was relatively as large as in the Mylodon. The very close correspondence in shape as well as relative size of the external cuneiform bones in both species, strongly bespeaks the correspondence of character in the toe which they respectively supported. The anterior convex articulation of the external cuneiform in the Megatherium shows that the base of the middle or third metatarsal must have been four inches in vertical and three inches in transverse extent, which agrees with the size of that bone figured by Bru * and Pander † in the Madrid skeleton. This metatarsal bone does not exist in the College collection, but a second and an ungual phalanx, very nearly equalling in size those of the median digit in the fore-foot, must, in my opinion, be referred to the corresponding toe of the hind-foot. The osteological structure and analogies of the fore-foot of

* Garriga, *loc. cit.* pl. 5, fig. 5.

† *Loc. cit.* tab. 4.

the Megatherium already discussed, have proved that only the middle digit could have supported a claw-bone so large as belongs to that digit, and that those of the other unguiculate digits of the fore-foot were much smaller: the existence of an ungual phalanx of almost equal size with, but of a different form from that of the middle toe of the fore-foot, in the collection of Megatherian bones transmitted by Sir W. Parish, proves, therefore, that the hind-foot must have been similarly armed; and the evidence of the navicular and cuneiform bones, with the analogy of the Mylodon, concur in referring such phalanx to the third toe, or that which adjoins the two outer ungulate toes supported by the os cuboides. This induction establishes, therefore, the accuracy in this respect of the figures of the hind-foot of the Madrid Megatherium. The ungual phalanx of the third hind-toe of the Megatherium presents the same differences, in its greater relative depth, and compression, as compared with that of the Mylodon, which have been pointed out in the comparison of the corresponding bones of the fore-foot of these extinct Edentata. The great claw-bone, as it may be emphatically termed, of the hind-foot differs from that of the fore-foot in the Megatherium, in its somewhat smaller size, being shorter in proportion to its depth, in the deeper articular cavities, in the downward production of a rough tuberosity from the base of the osseous sheath anterior to the foramina of the ungual arteries, in the greater breadth of the upper part of the claw-sheath, and in the straighter cone which supported the claw. This latter character accords well with the position of the bone on the hind-foot, which must have been more habitually resting on the ground than the fore-foot, and therefore perhaps required its claw to be less curved.

The middle phalanx supporting the great claw-bone of the hind-foot is singularly compressed from before backwards in the Megatherium. Its vertical diameter is more than twice the antero-posterior diameter or length of this phalanx. At the upper half of the anterior surface are the two convexities which are received into the double trochlear cavity of the ungual phalanx. The posterior surface for the proximal phalanx is concave above, convex below: the inferior prolongation of the middle phalanx is deeply and obliquely notched, and the inner surface of the notch is smooth and probably articulated with a large sesamoid: it thus differs considerably from the corresponding phalanx in the Mylodon.

We have next to compare the second, which is the innermost toe in the Mylodon and Megatherium, there not being a rudiment of the first toe, or even of its cuneiform bone in either of these extinct genera. In the Mylodon we have seen that the second toe, though small, is complete, and supports a claw: in the Megatherium the second toe is unquestionably represented by its cuneiform bone, or if the metatarsal be blended therewith the traces of the original separation have disappeared. This bone, in the collection presented to the College by Sir Woodbine Parish, is compressed and of an irregularly semicircular form: its proximal margin or base is occupied by the long, narrow, undulating surface adapted to that on the os naviculare. On the outer side, near the upper end of the base, there is a flat, subcircular articular surface, which has been applied to a corresponding surface on the metatarsal of the third toe: there is no other articulation, but the distal convex margin is as rough as the rest of the non-articular surface of the bone.

All the existing Edentata, except the Sloths, have the toes of the hind-foot of the normal structure and number. The Chlamyphorus not only differs from the Mylodon in the distal confluence of the tibia and fibula, but also in the normal mode of the articulation of these bones with the astragalus, which consequently has the same essential form as in the Glyptodon and recent Armadillos. The foot, as a corollary to this structure of the ankle-joint, is planted firmly on the ground by its flat surface, not by its outer margin. The proportions of the toes are the reverse of those in the Mylodon and Megatherium: the middle metatarsal is the longest; the second is also longer than the two outer ones; and the innermost or first toe is not only present in the Chlamyphore, but is longer than the outermost toe. All the five toes are armed with claws; and strange and anomalous as the two-toed or three-toed feet of the Sloths may at first sight appear, they have more real correspondence, in the structure of the tarsus and the proportions of the digital bones, with the feet of the Mylodon and Megatherium, than have those of any of the Armadillo tribe. The Glyptodon agrees with the Chlamyphorus in the pentadactyle structure of the hind-foot, the os naviculare having three facets for as many cuneiform bones, the innermost of which supports a metatarsal bone and two phalanges, which is the ordinary structure of the hallux.

In both species of Sloth the hallux or first toe is abortive and represented by a single small compressed bone, consisting apparently of the confluent cuneiform and metatarsal, with probably a sesamoid, which may form the posterior prolongation in the Unau. In this species the middle and external cuneiform bones are distinct, and each supports completely developed toes; but in the Ai the cuneiform bones are confluent with the metatarsals of these toes, and also with the navicular and cuboid bones. Both species of Sloth have three fully developed toes, with long claws, corresponding with the second, third and fourth in the pentadactylous foot: the fifth toe is represented by a rudiment of the metatarsal, which is a little more developed in the Unau than in the Ai.

We have seen that in the Megatherioids the mutilation of the foot has commenced on the outer side by the removal of the ungual phalanx from the fifth and fourth toes; and that the Sloths alone, amongst the existing Edentate animals, offer any real or well-marked affinity to the Megatherioids, in the degree in which they manifest this characteristic modification of the hind-foot; but the differences in this respect between the existing and extinct Phyllophagous Edentata are such as might be expected in creatures so different in size, in habitat, and in mode of progression.

The degradation of structure on the outer side of the foot in the Megatherioids affects two toes equally, but is accompanied by modifications which adapt these toes to the important office of the support and progression of the body on plane ground: in the scansorial Sloths the three middle digits being equally developed for prehensile offices, one toe on the outer and one on the inner side of the foot are reduced to their metatarsal basis. In the Megatherioids the mutilation of the foot on the inner side is carried to a greater extent; the innermost or first toe, with its cuneiform bone, is wholly removed: in the Megatherium the second toe is represented, like the first in the Sloths, by its cuneiform bone, or at most by a rudimental metatarsal early and very completely confluent therewith: in the Mylodon the second toe is fully developed, but of small size. In both the extinct species only the third toe can be compared, by its size, and especially by that of the claw which it supports, with the condition of the three perfect hind-toes in the climbing Sloths.

Thus the great extinct Sloths present an unequivocal exception to the rule that Unguiculate quadrupeds have pentadactylous feet; since not even a vestige of the bones of the inner toe, or of the tarsal bone immediately supporting it, exists.

Physiological Summary.

In the foregoing pages it has been my aim to place the new facts yielded by the study of the skeleton of the Mylodon in a clear and intelligible light, and in their true relations to those before acquired in the osteology of existing and extinct Edentate animals: I now proceed to endeavour to deduce the consequences which necessarily and legitimately flow from them; as without this additional, and, as in all similar cases, most difficult task, the full value and meaning of the phenomena would not perhaps be fully comprehended.

That animals with the same dental structure have the same kind of food is a well-established and safe physiological inference, at least as applied to members of the class Mammalia, and more especially to those in which the modifications of the teeth are of an extreme nature, as in the strictly carnivorous and herbivorous families. Yet this rule, from which all the other physiological consequences flow in the interpretation of the remains of extinct animals, requires much caution in its application. In the Ruminantia, for example, which are remarkable for the uniformity of their peculiar dentition, there exists a certain range of variety in their vegetable food: most of the species feed on grass; others browse as well as graze, and combine with herbage the buds and leaves of trees; one genus (*Camelopardalis*) subsists exclusively on foliage; another (*Rangifer*) on lichens.

The Sloths, however, are characterized by a dentition still more peculiar and extreme in its modifications than that of the Ruminants, and this character is apparent not only in the form, number, and general composition, but also in the intimate structure and mode of growth of their teeth, which are especially adapted for acting on the tender buds and leaves of trees. And since we have seen that all the dental characters of the Sloths coexist in the extinct Megatherioids with the bradypodal modifications of the jaws and cheek-bones, implying the same development and disposition of the masticatory muscles, we cannot but conclude that these concurrent conditions of dental and maxillary organs must have related to the comminution of the same vegetable substances.

But the few large quadrupeds which at the present day derive the whole or a chief proportion of their sustenance from trees, present very remarkable modifications of organic structure in relation to the acquisition of such food: and the inference above deduced from the teeth and jaws of the Megatherioids ought therefore, if correct, to be confirmed by corresponding peculiarities of the rest of the skeleton.

The whole frame of the Giraffe is so strikingly modified in harmony with the vegetable substances which it selects for its sustenance, that had this anomalous animal been extinct, the Palæontologist might have inferred from the fossil skeleton that the long stilt-like legs, the short trunk, the lofty withers and tall tapering neck, had coexisted to enable the living animal to browse on branches beyond the reach of the largest of its nearest congeners, the Deer; and that, though by its teeth a Ruminant, the Giraffe must have been, of all its order, the most independent of the herbage of the field for its support. Observation of the living animal shows how admirably the soft parts, for instance, the muscular extensile lips and the long, flexible, prehensile tongue, cooperate with the general proportions of the skeleton in the act of acquiring its leafy provender.

The massive proportions and short thick neck of the colossal Elephant offer the most striking contrast to the outward characteristics of the Giraffe; but by the endowment of that wonderful prehensile organ the proboscis, it is enabled to obtain a similar food.

The general proportions of both the Megatherium and Mylodon resemble those of the Elephant; their body was relatively as large, their legs shorter and thicker, their neck very little longer. Cuvier thought he could perceive evidence of the attachment of a proboscis in the figures of the skull of the Madrid Megatherium, but the size of the nervous foramina proves that such a prolongation of the nose and upper lip could not have exceeded that in the Tapir; and a Hog's snout might be supposed to have been more serviceable than a Tapir's proboscis to a quadruped which was conjectured to have supported itself by digging for roots. The head in all known Megatherian quadrupeds is, moreover, diminutive as compared with that of the Elephant, and the skull of the Mylodon presents no more trace of a proboscis than does that of the Sloth. It is plain, then, assuming the Megatherioids to have subsisted on the foliage and smaller branches of trees, that they could not have obtained their food either after the manner of the Giraffe or of the Elephant.

By what new and equally striking modifications of the bodily frame quadrupeds of approximate bulk to the Elephant and Giraffe, yet neither proboscidian nor of towering altitude, could have been sustained, like them, by the produce of trees, and have been able to browse even on the slender terminal twigs, affords a difficult and interesting problem to the comparative anatomist: it is one that probably would never have suggested itself, and certainly could never have been resolved without the discovery of the fossil bones of the Megatherioids.

The light and diminutive Sloths, the nearest living congeners of these great extinct quadrupeds, climb for their sustenance; and it is very true that in all the modifications of the osseous frame-work of the Mylodon, by which it differs most from the large Herbivora, it gains for its extremities prehensile as well as locomotive powers; this acquisition is most strikingly manifested by the possession of clavicles, by the free rotation of the fore-arm, by a slight inversion of the hind-foot, and by the great size and curvature of the claws, which terminate certain digits on each foot.

And inasmuch as the Megatherioids hereby deviate from the Giraffe and Elephant, they correspond with the Sloths: but whether from such correspondence it may as surely be concluded that their mode of obtaining the food was the same, as from identity of dental and maxillary structure the same kind of food has been inferred, demands some further and deeper consideration.

The mere existence of clavicles cannot be allowed much weight in the argument that the Mylodon or Megatherium climbed trees, since in one of the species of Sloth these bones are incomplete, without affecting, so far as is known, its scansorial powers. The Bears, which are the heaviest quadrupeds now gifted with the faculty of climbing, and some of which, the Sun-bears of the Eastern tropics, for example, habitually obtain their food by this means, are destitute of even the rudiment of a clavicle, as I have ascertained by the dissection of different species. Clavicles, therefore, in any degree of development not being essential to a climbing quadruped, we must seek for other relations and uses of the remarkably strong and perfect collar-bones of the Mylodon, and of its congeners the Scelidothere, Megalonyx, and Megatherium.

Clavicles are usually present in those mammals which carry their food to the mouth, either by one hand, as the Quadrumanes, or by both fore-paws, as many Rodents and Marsupials. The claviculate species of Sloth has been likewise observed to grasp its food by bending its long claws upon the wrist *. But

* Daubenton, who had the opportunity of observing the actions of a living Unau in the menagerie

the absence of the dentes primores, or incisors, and of the requisite disposition and flexibility of the fingers in the Megatherioid quadrupeds, negatives the conjecture that their clavicles bore an exclusive relation to such an action.

Clavicles, though more commonly present in burrowing than in climbing mammals, are by no means indispensable adjuncts to the fore-limbs in excavating the soil. The badger, for example, is destitute of clavicles ; and these bones are incomplete in both the rabbit and the fox.

None of the feline animals, although they possess the requisite freedom of lateral and rotatory motion of the fore-extremities for striking and seizing their prey, have more than mere rudiments of clavicles.

It appears, then, that these bones are fully developed in reference to giving due strength and stability to the shoulder-joint, for actions of the fore-arm not necessarily employed in climbing, burrowing, or seizing a living prey ; and that, when they are present in very excellent climbers, as the Unau and Orang, or in the strictest and swiftest burrowers, as the Moles and Armadillos, they are associated with modifications of other parts more immediately determining the peculiar powers of such species. It must be, therefore, by a critical comparison of the rest of the skeleton of the Mylodon that we can alone hope to determine the nature of the actions in which its strong and perfect clavicles co-operated.

A complete development of both bones of the fore-arm coexists, with free rotation of the hand, in both digging and climbing quadrupeds ; but the climbers which the Mylodon most resembles in the construction of the fore-feet are the Sloths, and these are as remarkable for the length and slenderness of the arm and fore-arm, as is the Mylodon for the shortness and robustness of the same segments of the anterior members. Not that the Mylodon equals in these characters the true fossorial quadrupeds, such as the Mole; but it thereby approximates them too closely to admit of its being regarded as a mere climbing animal.

To ascertain, on the other hand, whether the claviculate and strong arm, and the freely rotating fore-arm of the Mylodon were used exclusively, when not engaged in ordinary locomotion, for turning up the soil, it will be requisite to con-

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of the Marquis de Montmirail, thus describes this action :—" L'Unau saisit avec le pied de devant comme avec une main, et s'en sert pour porter ses alimens à sa bouche ;"—" l'animal en approchant de son poignet l'extrémité de ses ongles serre les choses qu'il veut saisir et les enlève."—Buffon, *Histoire Naturelle,* 4to, tom. xiii. p. 51.

sider the construction of the fore-foot, and especially the number and form of the claws.

In the habitual burrowers, whose feet are best organized for displacing the dense earth, as the Mole, the Mole-rat, the Condylure and Echidna, the claws are long and broad, of nearly equal size on each digit, and can be extended in the same plane as the hand, which is of considerable breadth. In those Armadillos which are most remarkable for their rapid perforation of the soil, as the *Dasypi gigas* and *unicinctus*, the three outer claws, which are principally developed for that office, are scarcely less remarkable for their great breadth, than for their length, but they are of unequal size. The breadth of the long fossorial claws of the Orycterope also surpasses their depth.

In the Sloths, on the contrary, the depth or vertical diameter of the claws, which are unusually long, much exceeds their transverse diameter or breadth; they are also more curved than in the burrowers, and are much restricted in their movements, especially in that of extension. The fore-foot of the Sloths is likewise long and narrow, and only three fingers in one species and only two in another species, are furnished with claws, which are nearly of equal length. The climbing Ant-eater (*Myrmecophaga didactyla*), which destroys the tree-termite, has its two toes shaped nearly as in the Sloths. The Great Ant-eater, which breaches the strong fortresses of the terrestrial termites, has its long fore-claws of nearly equal breadth and depth, and the chief power of the fossorial extremity is concentrated on one digit, which is much superior in size to the rest. In the work to which this modified digging instrument is put the soil has not to be displaced in great quantities as in the excavation of a hiding-place or burrow, but it needs only to be partially disturbed in order that something which is hidden may be exposed.

The Megatherioid quadrupeds are not characterized by the true fossorial hand in which all the five digits are provided with sub-equal, long and broad claws; but at most only two or three of the digits were provided with claws. The depth of these claws exceeds their breadth in the Megatherium, especially in the longest and largest claw: the more curved and more compressed claws of the Megalonyx very nearly resembled those of the Sloth. In the Mylodon, the claws, though equally remarkable for their length, and nearly as much curved as in the Megalonyx, were neither depressed as in the burrowers, nor compressed as in the climbers, but had their vertical and transverse dimensions equal. A portion of the hand in all the Megatherioids, including the two outer digits in the Mylodon, was modified after the ungulate type for the exclusive office of supporting the body in ordinary terrestrial progression.

In the investigation of the nature of the collateral uses of the anterior extremity of the Megatherioids, to which uses all that is superadded to the ordinary structure of an ungulate limb relates, we must consider these superadditions independently, or exclusively of the parts which were merely concerned in progressive motion. The unguiculate portion of the fore-foot, thus viewed apart from the ungulate portion, agrees with the scansorial type, being long and narrow, with long and curved claws, which appear to have been habitually in a state of flexion, and could hardly be extended in the same plane as the hand. These characters, though not manifested in so extreme a degree as in the Sloths, evidently indicate a fore-foot better fitted for grasping than for digging. Such a foot is not, however, an instrument unfitted for cleaving or displacing the earth; but rather, in so far as it differs from that of the Sloths and is less fitted for climbing, it gains in fossorial power.

It may be justly inferred from the diminished curvature and length, from the increased strength and from the inequality of the claws, especially from the disproportionate size of that of the middle finger, that the hand of the Mylodon was occasionally applied by the short and strong fore-limb in the act of digging; but its close analogy with that of the Ant-eaters, teaches that the fossorial actions were limited to the removal of the surface-soil in order to expose something there concealed, and not for the purpose of burrowing. Such an instrument would be equally effective in the disturbance of roots or ants; it is, however, better adapted for grasping than for delving. But to whatever task the unguiculate part of the hand of the Mylodon might have been applied, the bones of the wrist, of the fore-arm, of the arm and of the shoulder, alike attest the prodigious force which would be brought to bear upon its execution.

The general organization of the anterior extremity of the Mylodon appears to me to be incompatible with the idea of its having been a strictly scansorial or burrowing animal, and at the same time both teeth and jaws decidedly negative the supposition that it was an eater of ants; for the two extremes in the length of the jaws are presented by the phyllophagous and myrmecophagous species of the Edentate order, and the anomalous brevity of the face which characterises the leaf-eating Sloths, is repeated, even to exaggeration, in the Mylodon.

We have then further to interrogate the remains of this extraordinary gigantic Sloth for more definite information as to the mode in which it obtained its food. The answers which the osteological characters of the fore-limb have yielded are valuable, as we have seen, rather for their negation of erroneous conjecture, than for the truths which they directly affirm. Reference must therefore be made to the organization of the hind-limbs to ascertain whether any light may thence be reflected on the functions of the fore-feet and on the general habits of the Mylodon.

In existing Mammals the modifications of the pelvis and hind-limbs are well-marked and highly characteristic of the strictly burrowing and climbing species. The whole or chief part of the digging actions is performed by the fore-feet in the best burrowers, the Mole for instance; the pelvis and hind-feet being remarkably slender and feeble in that animal, and presenting no notable development or structure in the less powerful or less habitual excavators. In the best climbing animals, such as the Sloths and Orangs, the hind-legs are much shorter than the fore-legs; and in all climbing animals, in which the hind-feet are endowed with a more or less perfect power of grasping, this is never combined with excessive bulk and weight of the limbs themselves, or of the hinder parts of the body, not even in those species in which a prehensile tail is superadded, as it is in the American Spider-monkeys. Certain small Kangaroos (*Dendrolagus*, Müller), which by a curvature of the long claw of the hind-foot are enabled to spring up the trunk and thus attain the branches of trees, form no exception to this rule, since their organization is essentially saltatorial, although by a slight modification this power may be exercised in a different sphere than that of the surface of the earth. The terrestrial Ant-eaters offer nothing extraordinary in the size or structure of their hind-limbs: the arboreal species are distinguished by the inferior size of these members.

When, therefore, after a review of the pelvis and hind-limbs in existing scansorial, fossorial, or semi-fossorial quadrupeds, we turn to the contemplation of the same parts of the skeleton of the Mylodon or Megatherium, the sudden and extraordinary increase of size, and the massive proportions which meet the eye, and arrest the attention of the most indifferent beholder, become eminently suggestive to the physiologist and clearly imply powers and actions as peculiar to the gigantic animals when living, as are the modifications of these most striking parts of the enduring framework of their long since decomposed bodies.

The enormous pelvis of the Mylodon proclaims itself the centre whence muscular masses of unwonted force diverged to act upon the trunk, the tail, and the hind-legs*. Those muscles originating from the sacrum and the broad and extended lip of the ilium, as the sacro-lumbalis, the longissimus and latissimus dorsi, &c., and which pass forwards to extend the trunk and retract the anterior limbs, have left the most marked evidence of their size and energy of action in the long and strong spinal crest of the sacrum, and in the broad, rugged, and anteriorly produced margin of the ilium. The fore-limbs being well adapted for grasping the trunk or larger branches of a tree, the forces concentrated upon them from the broad posterior basis of the body are manifestly adequate, and are precisely such as might be expected to have cooperated in the act of uprooting the tree or of wrenching off the branch so seized. But in order that the pelvis should possess stability and resistance equivalent to the due effect of the forces acting from it and so applied, it was necessary that it should be bound down as it were, and supported by members of corresponding strength.

Accordingly, we find a thigh-bone, which, though surpassing the humerus in length, is yet not less than half as broad as it is long, and provided with trochanters and ridges, the fit attachments of the tendinous insertions of muscular masses which expanded upon the back-part and on the fore-part of the broad and capacious pelvis, and have there left, in strong and numerous inter-fascicular bony crests, unequivocal evidence of the power by which they resisted the efforts of the antagonizing muscles attached to the trunk and fore-limbs to draw forwards the pelvis and hind-legs. The preponderating weight of both these parts and the extraordinary power of the muscles connecting them together, are quite inexplicable on the scansorial hypothesis of the Megatherioid animals; since, if they attained their food by climbing, the fore-legs would be the fixed point when the muscles attaching these to the pelvis were called into action, and the hind-extremities, needing only the requisite prehensile power, ought to have had their bulk reduced as far as was consistent with such power, in order to facilitate their being drawn upwards towards the fore-legs.

* The muscles of the Megatherioid animals, besides their mass and the mechanical advantages afforded by the peculiar development of their bony attachments, were most probably characterized by the great energy of their vital contractility; since this quality of the muscles of the Sloth is so striking as to have forced itself upon the notice of the Marquis de Montmirail, who, in describing the habits of a living Unau in his menagerie, says "la force de ses muscles est incroyable."—Buffon, *Hist. Naturelle*, 4to, t. xiii. p. 48.

A palæontologist, who has earned a just celebrity by his successful exertions in the discovery of the fossil Mammalia of Brazil, has pushed the hypothesis of the climbing habits of the Megatherioids so far as to hazard the conjecture that the Megalonyx, and in all probability the Megatherium, were furnished with a prehensile tail. Those arboreal quadrupeds, however, which have the advantage of this fifth hand, as it may be termed, such as the prehensile Porcupine, the didactyle Ant-eater, and the Spider-Monkeys, have a light body, a small pelvis, and slender hind extremities; and the colossal proportions of these parts in the Megatherioids would be still more enigmatical than they appear when applied to the ordinary scansorial hypothesis, if the tail had really been so important an instrument in the climbing actions as Dr. Lund conjectures. But it would seem from this able naturalist's allusion to the claws of his *Megalonyx Cuvieri*, viz. "that they are not compressed as in the Sloth," such compressed claws being, in fact, one of the distinctive characters of Cuvier's genus *Megalonyx*, that the extinct Megatherioid which Dr. Lund had in view was a species of *Scelidotherium* or *Mylodon*.

Now we know that the Mylodon had a strong and powerful tail, but too short for prehensile purposes; its proportions being exactly such as to enable it to complete, with the two hind legs, a tripod strong enough to afford a firm foundation for the massive pelvis and adequate resistance to the forces acting upon and from that great osseous centre. The large and thick transverse, and upper and lower spinous processes, and especially the prolonged and capacious spinal canal, indicate the bulk and strength of the muscular masses which surrounded the tail and connected it with the pelvis: the natural co-adaptation of the articular surfaces shows that the ordinary inflection of the extremity of the tail was backwards, as in a 'cauda fulciens,' not forwards, as in a 'cauda prehensilis.'

Viewing, then, the pelvis of the Mylodon as the fixed point towards which the fore-legs and anterior parts of the body were to be drawn in the gigantic leaf-eater's efforts to uprend the tree that bore its sustenance, the colossal proportions of the hind extremities and tail lose all their anomaly, and appear in just harmony with the robust claviculate and unguiculate fore-limbs, with which they combined their forces in the Herculean labour. The uncommon length of the sole of the foot, equalling in the Mylodon, perhaps surpassing in the Megatherium, the length of the femur; the prolongation of the os calcis which affords the strong posterior fulcrum, and the very powerful claw of the middle toe by which the opposite end of the foot would be kept fixed upon the ground*, become clearly intelligible, and their final purpose explicable on the above-developed idea of the exertions during which the well-based hind-limbs worked in steadying, and reacting upon, the trunk of the Megatherian wrestling with its passively but sturdily resisting source of subsistence. And thus the expanse of the pelvis, the superior bulk and strength of the hind-legs compared with the fore-legs, the peculiar length and organization of the hind-feet, the proportions and construction of the tail, all of which form a combination of characters common to the Megatherioids, and present in no other animals, yield the required explanation of the uses of the fore-extremities, which too nearly resemble those of other claviculate Edentata, to indicate, apart, their own proper functions in the Megatherioids.

If the foregoing physiological interpretation of the osseous frame-work of the gigantic extinct Sloths be the true one, they may be supposed to have commenced the process of prostrating the chosen tree by scratching away the soil from the roots; for which office we find in the Mylodon the modern scansorial fore-foot of the Sloth modified after the type of that of the partially fossorial Ant-eater. The compressed or subcompressed form of the claws, which detracts from their power as burrowing instruments, adds to their fitness for penetrating the interspaces of roots, and for exposing and liberating them from the attached soil. This operation having been duly effected by the alternate action of the fore-feet aided probably by the unguiculate digits of the hind-feet, the long and curved fore-claws, which are habitually flexed and fettered in the movements of extension, would next be applied to the opposite sides of the loosened trunk of the tree: and now the Mylodon would derive the full advantage of those modifications of its fore-feet by which it resembles the Bradypus; the correspondence in the structure of the prehensile instruments of the existing and extinct Sloths, extending as far as was compatible with the different degrees of resistance to be overcome. In the small climbing Sloth the claws are long and slender, having only to bear the weight of the animal's light body, which is approximated

* This use of the large hind-claw was first pointed out by Dr. Buckland (Bridgewater Treatise, i. p. 158); but the full value of the structure to the Megatherium could not be appreciated, when the hind-legs were supposed to merely aid in supporting the trunk, whilst one fore-leg was used to dig up roots.

by the action of the muscles towards the grasped branch, as to a fixed point. The stouter proportions of the prehensile hooks of the Mylodon accord with the harder task of overcoming the resistance of the part seized and bringing it down to the body. For the long and slender brachial and anti-brachial bones of the climbing Sloth we find substituted in its gigantic predecessor a humerus, radius and ulna of more robust proportions,—of such proportions, indeed, in the *Mylodon robustus*, as are unequalled in any other known existing or extinct animal. The tree being thus partly undermined and firmly grappled with, the muscles of the trunk, the pelvis and hind limbs, animated by the nervous influence of the unusually large spinal cord, would combine their forces with those of the anterior members in the efforts at prostration. And now let us picture to ourselves the massive frame of the Megatherium, convulsed with the mighty wrestling, every vibrating fibre reacting upon its bony attachment with a force which the sharp and strong crests and apophyses loudly bespeak: —extraordinary must have been the strength and proportions of that tree, which rocked to and fro, to right and left, in such an embrace, could long withstand the efforts of its ponderous assailant.

A few observations remain to be offered touching the most singular modifications of the feet of the Mylodon, viz. the thick and stunted outer toes, which were evidently enveloped in a kind of hoof. It would be difficult to conceive any modification of the Sloth's structure, whereby such a creature might, with dimensions rivalling those of the largest Pachyderms and unfitting it for an abode in trees, still continue to derive from them its sustenance, more simple and more effectual than those which the skeletons of the Mylodon and Megatherium have brought to light. Their power of standing and walking freely on the ground was gained by the addition of these strong hoofed digits to a tridactyle or didactyle unguiculate and prehensile foot. With this addition some minor modifications in the proportions of the claws were combined, and strength was given to other parts of the frame, to enable the animal to prostrate the trees it could not climb.

How admirably the superadded parts of the feet, employed in sustaining the Megatherioids in their heavy march, have been introduced, a glance at the coadapted bones will show. In the fore-foot, for example*, which, in the ordinary

* See Plate XV.

dependent position of the limb, has the outer edge turned towards the ground, the stout metacarpal bone of the external digit receives the superincumbent weight by three distinct points, from the cuneiform bone, the unciform bone, and the fourth metacarpal: the middle metacarpal, by its peculiarly expanded base, transmits to the fourth metacarpal a great part of the weight which it receives from the radius, by the medium of the os magnum, the trapezoides, the lunare and the scaphoides: the burthen sustained by the ulna and part of that by the radius are concentrated upon the unciforme, and thus transferred to and divided between the two hoofed digits. The great development of the metacarpal bones of these digits, especially as compared with their stunted phalanges, is called for by the important share which they take in transmitting to the ground the superincumbent weight.

Physiological inferences might seem to be exhausted in the demonstration of the admirable adaptation of the foregoing structure of the carpus and metacarpus of the Mylodon to the support and progressive motion on the ground of so ponderous a quadruped without detriment to the serviceable condition of long and sharp prehensile claws; but this is far from being the case. A principle characteristic of organic mechanism, and beautifully set forth by the poet*, is nowhere perhaps more strikingly exemplified than in the fore-foot of the extinct Megatherioid quadrupeds. The very same arrangement of the bones, which permits the coexistence of hoofs and claws in the same foot, in a great degree expressly provides for the efficiency of the unguiculate digits in their application to the violent exertions which the whole skeleton of the Mylodon indicates to have been habitual to the living animal.

The modification of the middle metacarpal, by which it transmits the weight it receives in progressive motion to the fourth and fifth metacarpals, adapts it to its own proper office of overcoming the enormous resistance it must meet in the act of uprooting and prostrating trees. The dislocation of the middle digit when so applied, is resisted by the interlocking of both ends of its thick expanded base between the contiguous metacarpal and carpal bones. The fourth meta-

* "In human works, though labour'd on with pain,
A thousand movements scarce one purpose gain:
In God's, one single can its end produce;
Yet serve to second too some other use."
Essay on Man.

carpal directly opposes the drawing forward of the outer end of the base, and, being itself similarly overlapped by the fifth metacarpal, both these bones must give way before the middle metacarpal, which bears the chief strain in the attempt to tear off a bough or to prostrate the tree, could be displaced. On the radial side we see the base of the middle metacarpal extended into a prominent tuberosity, which is locked into a cavity in the side of the second metacarpal; this bone being itself strengthened by the abutment of the first metacarpal against the opposite side of its base. Thus, before the middle metacarpal could be wrenched out, all the rest of the metacarpal series must give way; in other words, the bones of that series are so arranged as to combine in strengthening and wedging down the middle metacarpal. This strong organic masonry equally characterizes the hand of the Megatherium, and cannot be contemplated without the conviction that it has been designed for actions of the fore-limb, in which very unusual resistance had to be overcome; a resistance surpassing in degree any that the fingers of the Mole have to contend against in their subterraneous excavations, and of a different kind from that which would be experienced in merely scratching up the soil. In fossorial actions the fingers must overcome the tendency to backward inflection as well as direct extension, and the joints of the great middle finger of the *Dasypus gigas* give it due strength in both directions; but the metacarpal of this finger might be dislocated forwards without involving the displacement of the fourth or fifth metacarpals. The whole of the interlocked metacarpal arch in the Megatherian quadrupeds opposes the drawing out of the key-stone to which the digit supporting the great prehensile claw is articulated.

The obstacles to dislocation afforded by this mechanical arrangement of the bones must have derived a great accession of force by the stout flexor and extensor tendons, inserted into or bound down upon the fore and back part of the short, thick and strongly jointed phalanges, which, with their built-in metacarpal, formed the principal centre upon which the muscular forces converged. The carpus would obtain its requisite stability by the mode in which the three bones of the second row are interlocked together, and inclosed by the proximal carpal bones and the metacarpals, and by the tendons passing over it; of the strength of which tendons, and of their muscles, ample evidence exists in the deep grooves and sharp ridges of the bones of the fore-arm.

The hind-foot of the Mylodon, partly by the position and shape of the upper articular surface of the astragalus, partly by the articulations of the metatarsal with the cuboid and cuneiform bones, is slightly inverted, so as to rest upon its outer edge, and receive the superincumbent weight upon that edge, and chiefly upon the two external toes: these are peculiarly adapted to that office by their singularly massive proportions, their form, and their mode of articulation*. The metatarsal of the fifth toe, by the rough, honey-combed surface of its broad outer and lower facet, bespeaks the thick and callous integument with which it was shod.

The weight sustained by the astragalus and calcaneum is transmitted to the fifth metatarsal in one direction immediately by the os cuboides, and in another direction by the astragalus, through the medium of an arch formed by the scaphoid, the external cuneiforme, the produced distal end of the middle metatarsal, and that of the fourth metatarsal: this powerful bone, by that part of its hoofed extremity which extends beyond the outer toe, likewise aids in sustaining the weight transmitted to it by the foregoing arch, and also more directly by the os cuboides. By this admirable arrangement the two unguiculate toes were absolved from all participation in the service of sustaining the animal while standing or walking upon the ground, and are left free for such other offices as it might have had occasion to apply them to. In the Feline animals the claws are kept sharp and serviceable by the mechanism for their retraction backwards upon the padded proximal phalanges: in the Mylodon the same effect was gained by their oblique inflection, and by the concentration of the superincumbent weight on the two outer toes in the manner shown by the figure of the right hind-foot in Plate I.

Dr. Lund† derives his strongest argument that the claws of the hind-foot were applied exclusively for grasping, and that the Megatherioids were therefore climbers, from this inversion of the sole; but the advantages which thereby accrued to the Mylodon in the preservation of the non-retractile claws from the habitual wear and tear of ordinary locomotion, appears to be the legitimate physiological explanation of that partial inversion, the true insight into the uses to which the claws were applied being gained by a study of the other peculiarities of the skeleton.

* Plates XXI. and XXII.

† *Loc. cit.* p. 20.

In the existing Sloths the sole of the hind-foot is, indeed, turned inwards, as it is in the Orangs and other excellent climbers; but the construction of the foot itself, not its mere inversion, determines its scansorial function. The Quadrumana, for example, enjoy this faculty by virtue of the hinder opposable thumb; and the Sloths by a so much greater degree of inversion of the foot than in the Megatherioids, and by so different a structure of the articulation of the tarsus to the leg, that the power of supporting and transporting the body on plane ground is sacrificed to the acquisition of the prehensile faculty.

The absence of the pivoted articulation of the astragalus to the fibula, and the introduction of the new modification of the tibial part of the ankle-joint, whereby a process of the astragalus fills a cavity in the part of the tibia from which, in the Sloths, the inner malleolus projects, are alone sufficient to suggest a corresponding difference in the actions to which the hind-feet of the gigantic extinct phyllophagous Edentata were applied.

The scansorial hypothesis of the Megatherioids is directly opposed by almost every other characteristic of their known organization, except the very few which might at first view suggest it. Thus, if the Megatherioids had been limited to the act of climbing in order to obtain their food, they could only have browsed on the largest and strongest branches of even such gigantic trees as Dr. Lund has conjectured to have coexisted with them: to animals of their size and weight the greatest proportion of the tree, supporting the most succulent, nutritive and abundant sprouts and leaves, which the light and slender Sloths now easily attain, must have been inaccessible, and have waved or shook before their hungry gaze in tantalizing unreachableness. By the modifications of the Bradypodal structure which gave the Megatherioids power to uprend the whole tree, every portion of their peculiar and coveted food would be brought within their reach; once prostrated, it could be disbranched and stripped of its foliage at leisure.

The inversion of the sole of the foot, slight as it is in the Mylodon and smaller Megatherioids, is attended with secondary advantages in addition to that chief one of securing to them the full use of both claws and hoofs; thus as the delver penetrates the soil more easily when the spade is driven in a sloping direction, so the hind claws, when employed in digging, would derive a like advantage from their oblique position. Also in the very possible case of trees too large to be uprooted by, yet with foliage tempting to, the smaller Megatherioids, they might attack the larger branches; in attaining which, they would derive advantage by the addition to its prehensile power which the hind-foot gains by its natural inversion; and to this extent the climbing hypothesis may be admissible.

But the preponderating development of the hind-quarters, and predominant modifications adapting the hind-foot to progression on the ground, forbid the supposition that its application to climbing could have been habitual or frequent. The probability however that it was an occasional action in the less gigantic species, is increased by the fact of the inversion of the sole being least conspicuous in the Megatherium, whose bulk and strength would be adequate to the prostration of trees too large for the efforts of the Mylodon, the Megalonyx or the Scelidotherium. I may here also remark, that the modifications of the claws and of the bones of the extremities, especially the calcaneum of the Megalonyx, by which it differs from other Megatherioids, would add to its power of climbing in the same degree as they detract from its strength.

With regard to the Mylodon, it is obvious, from the great disparity of size in the two claws of the hind-foot, that the larger one would be chiefly, if not exclusively used in the act of digging, of grasping, or of fixing the hind-foot to the ground. The total absence in the Megatherium of the toe corresponding with the small internal unguiculate one in the Mylodon, suggests the application of the claw of that toe to some purpose for which it was not required in the Megatherium. The position of this inner toe, divaricated from the large adjoining one, together with its small size, makes it so closely analogous to the two slender, coadunate, fur-cleansing inner toes of the hind-foot in the Kangaroo and other Marsupials, as to suggest a similar application of the inner claw of the Mylodon to scratching and dressing a hairy covering. And such an office explains its absence in the Megatherium, which we may well suppose to have differed from its less bulky congeners in having its thick and callous integument as scantily clothed with hair as in the Elephant.

The foregoing physiological review of the skeleton of the Mylodon has thus led to the conclusion, that as the teeth and jaws were expressly adapted for the comminution of foliage, so the trunk and extremities derived from their apparently ill-assorted proportions the requisite power of obtaining such food by the uprooting of trees. The Megatherium or Mylodon having completed this task, would have abundant food before it for some days at least; and I now proceed to point out some peculiarities in the structure of the cranium which indicate the chief instrument by which the foliage was stripped from the prostrate tree and introduced into the mouth.

These indications are the deep and well-defined cavity in the mastoid bone for an unusually strong and secure articulation with the os hyoides, and the great capacity of the anterior condyloid foramina which give issue to the motor nerves of the tongue; they combine with the ascertained size and structure of the bones of the tongue in affording unequivocal evidence of a very remarkable development of the muscular part of that organ.

The above-mentioned nervous foramina in the Giraffe, which, besides being the largest species of its order, is that which makes most use of its tongue in obtaining its food, are but half the size of those in the Mylodon; and, indeed, when these capacious outlets first attracted my attention in a separate fragment of the cranium of a cognate species, without any other part of the skeleton to throw light on its habits and food, I had no other analogy to guide me in forming an idea of the use of the much-developed muscular organ indicated by them than that of the Ant-eaters*. We may now, however, readily imagine a great Sloth-like quadruped, daily exercising its tongue in rending off the twigs and smaller branches of trees, to have required an organ as large and strong as the anterior condyloid foramina prove it to have been. If the foregoing evidence had been absent, the great breadth of the smooth concave surface of the symphysis of the lower jaw in the Mylodon would have indicated the bulk of the prehensile tongue which, in the living animal, glided to and fro upon it: no incisor teeth inter-

* See the description of the Glossotherium in the 'Fossil Mammalia of the Voyage of the Beagle,' p. 57, pl. xvi. The reference of the cranial fragment of the extinct animal so-named to the Edentate order, and the inference from the indications of the temporal muscle that it possessed teeth (p. 59), are confirmed by the subsequent discovery of the entire cranium of the *Mylodon robustus*; the question (p. 63) whether the fragment might not belong to one or other of the extinct Edentata, the lower jaws of which are described in the same work, is affirmed in favour of the Mylodon. Specific differences may be detected between the fossil in question and the corresponding part of the skull of the *Mylodon robustus*, and it is, therefore, highly probable that it belongs to the *Mylodon Darwinii*, with which the term Glossotherium may now be regarded as synonymous. The error in my conjecture as to the nature of the food of the Glossotherium, into which I was led by the analogy of the Myrmecophaga, is corrected by the discovery of the remains of Edentata in which the predominant use of the tongue in obtaining food from the vegetable kingdom appears to have been second only to that in the Ant-eaters.

fered with its rapid and frequent movements; and the same dimensions of the jaw which provided space for the ever-active matrix of the deeply implanted teeth, gave the required capacity to the cavity of the mouth when the tongue was retracted and at rest.

The Megatherium whose teeth and jaws were adapted to the comminution of coarser parts of the foliage of trees, appears to have had the advantage of a short proboscis, as an adjunct to the tongue, in the work of stripping off the smaller branches of the prostrate tree; and since, in proportion as the lips and nose were modified to gain prehensile power, an inordinate development of tongue would be less needed, the evidence of the proboscis in the Megatherium harmonizes with the smaller size of its hypoglossal nerves, and with the diminution of the capacity of its mouth, occasioned by the narrowing of the palate and the mutual approximation of the lateral series of grinders. The Elephant, the hugest of existing phyllophagous quadrupeds, is characterized by a maximized proboscis; the Giraffe by a long and muscular tongue. Both these characteristics coexisted in the Megatherium, the size of the proboscis being diminished. In the Mylodon, which had no proboscis, the compensation was the more largely developed tongue, and it thus offers, in respect of the mechanism for stripping off foliage, a striking contrast with the almost tongueless Elephant.

The analogy of existing animals thus teaches us that the modifications of such soft and perishable parts as the tongue and nose, of which we obtain evidence from the enduring remains of the extinct Megatherioids, are in strict accordance with the theory of their subsisting on foliage, and of their uprending trees to obtain it; but it does not explain the utility of a prehensile tongue or proboscis to such animals, on the supposition that they subsisted on roots.

There is yet another peculiarity in the cranial organization of the Megatherian animals that harmonizes with habits of life which rendered them unusually obnoxious to blows from falling bodies, and may even be conceived to have been a designed modification in relation to those habits: I allude to the extensive air-cells introduced between the external and vitreous tables of the skull; and I propose in this place to inquire into the probable cause of the fractures, from the immediately fatal effects of which the subject of the present Memoir appears to have been saved by virtue of this remarkable structure.

The Sloths, though specially and admirably organized for clinging to the boughs of trees, yet in the course of an existence exclusively spent therein are liable, through unforeseen contingencies of rotten branches or sound ones yielding to the force of winds, to be occasionally thrown to the ground; without attaching undeserved credit to the story of these excellent climbers choosing that abrupt and hazardous mode of descent by preference *. The coarse matted hair with which their light body is densely covered is well suited to break the force of such falls, whilst any injury to the brain seems to have been provided against by the strong double bony wall of the cranial cavity which results from the extension of the air-cells from the frontal along the upper part of the head to the occipital region. But the same structure exists to an equal or greater extent in the Mylodon, which according to my interpretation of its organization was not a climber; not subject therefore to a fall. Yet the liability of the Mylodon, in the habitual practice of uprending and prostrating large trees, to be struck by the trunk or some of the large branches, must have been greater than that of the Sloth to a fall from its tree; and therefore the advantage to the Mylodon of having a double brain-case would not be less.

Certain it is, that the habits of life, or the conditions under which the Mylodon existed, did render it obnoxious to violent blows on the head †, and that it was owing to the extensive and deep cellular diploë of the skull, that they were not, in the present instance, death-blows.

It is at least not probable that any large mammiferous animal could have survived so extensive and complicated a fracture and depression of the vitreous table at the back part of the skull, as that which in the Mylodon is here confined to the outer table. Either of the blows, however, to the force of which that strong plate of bone has yielded, must have stunned, and, at least, have temporarily disabled the animal; and, if inflicted by the paw of some sufficiently powerful Carnivore, would have left the Mylodon its easy and unresisting prey. If the skull of an animal so destroyed had been preserved and afterwards discovered in a fossil state, the broken bones would not have presented any of those effects of the reparative processes which are so extensively manifested in the very remarkable specimen under consideration.

* Buffon, Histoire Naturelle, tom. xiii. p. 3.

† See Plate III.

It is not very probable that the Mylodon, if disabled and its skull fractured by a blow received in conflict with another of its kind, would have been suffered to escape: the victorious assailant would in all likelihood have followed up his advantage by a mortal wound, such as an irate Megatherium might easily have inflicted with its sharp and ponderous claw, if excited by combative or destructive instincts. Nothing, however, that has yet reached us of the habits of existing Edentata would lead to the supposition that the extinct ones were actuated by these instincts, or were characterized by less peaceful habits than those of the Sloths, the Ant-eaters, and Armadillos of the present day. Only in self-defence against the carnivorous Jaguar or Puma is the strong-clawed Ant-eater (*Myrmecophaga jubata*) reported to use successfully its powerful weapons, with the analogues of which a Mylodon or Megatherium might be conjectured to have produced the injuries in our present fossil, on the combative hypothesis of their origin. But in the conflict of the Great Ant-eater with the Jaguar, the predatory assailant is overcome by the pertinacity of the grasp, not by the force of the blow. The only analogies, therefore, by which we can test the conjecture that the injuries in question were inflicted by another Megatherioid animal, diminish its probability.

There is no certain or conclusive evidence that Human Beings coexisted with the Megatherian animals: but assuming a primæval race of Indians to have disputed the lordship of the American forests with the Edentate giants, and to have waged against them, as against all other inferior animals, a war of extermination; the same difficulty presents itself to the supposition of the recovery and escape of a stunned Mylodon from their deadly assaults with clubs and other weapons, as from the claws and teeth of the beast of prey: for the flesh of the leaf-eating Megatherian would doubtless be as much prized for food by a Human destroyer as that of the Sloth is by the Indians of the present day.

With these difficulties, therefore, opposing themselves to the conjectures which naturally rise in the mind at the first view of the injuries on the skull of the extinct Mylodon, and which suggest the hostile attacks of some other animal as their cause, we are compelled to refer those injuries to the effects of some inanimate force, which, having felled the Mylodon and temporarily disabled it, was spent, and could not follow up the blow. To a huge denizen of the woods what accident more likely to produce such injuries than the fall of a tree; and what inhabitant of the forest more obnoxious to such an accident than one destined by its organization to be habitually engaged in uprooting, and therefore in danger from the descent of heavy trees? The form of the healed, as well as of the partly-healed fracture, in both of which the fissures diverge from a longitudinal, instead of radiating from a central depression, accords better with a blow from a branch or trunk of a tree than with one inflicted by the point of a large claw. It must, therefore, be conceded, that both the injuries, and the structure of the skull by which their immediate fatal effects have been obviated, accord with the habits assigned to the Megatherian animals in the present Memoir; while they can receive no elucidation from, nor appear in any way connected with, the acts of digging the earth for roots, or ants, or for concealment, which have been severally conjectured to be the habitual labour of the Megatherioids by Cuvier, D'Alton, and De Blainville.

It has been justly asked by Dr. Lund* in reference to the fossorial hypothesis of the Megatherioid quadrupeds, "For what purpose should these monsters have burrowed? To protect themselves from their enemies? Without alluding to the length of time so bulky and helpless a creature must have required to excavate a hole sufficient for its huge carcass, of what use could such a den be for a refuge to an animal, whose food would, of necessity, often call it away?"

The extreme form of the fossorial hypothesis proposed by MM. Pander and D'Alton†, against which Dr. Lund's remarks are levelled, and which I have shown that the organization of the Megatherioids confutes, can only find favour with the naturalist who, conceiving the Megatherium to have been organized like the Armadillos, concludes that it had the same habits and mode of life. The modified form of the same hypothesis, viz. that which interprets the organization of the Megatherioids as being adapted to digging up the soil for roots, the supposed food of these gigantic quadrupeds, has most prevailed with Palæontologists since Cuvier first propounded it; and both from the eminence and scientific caution of its author and from the arguments by which this opinion has been supported, it cannot lightly or without due consideration be set aside.

In the first place it is to be observed that the only subterranean parts of

* *Loc. cit.* p. 19.

† See Note *, p. 10.

vegetables which could be masticated by teeth wholly destitute of enamel, and chiefly composed of cæmentum or bony crust, and of a substance softer than bone, viz. coarse dentine everywhere drilled by numerous and close-set vascular canals, must necessarily have been of the softer kind, as bulbs and cellular and amylaceous tubers. Such roots, as produced in a state of nature, yield sustenance at the present day to the smaller-sized quadrupeds only, and of these the purely rhizophagous species are very few in number. The history of plants reveals no natural conditions under which nutritious bulbs or tubers are developed so abundantly, diffused so extensively, or reproduced so rapidly, as to have afforded the daily food of the Megatheriums, Mylodons, Megalonyxes, Scelidotheriums, &c., which seem to have coexisted in not sparing numbers in the primæval wilds of the American continents. To support by such food the smaller domestic quadrupeds during a part of the year demands much toil and the highest art of husbandry in order to produce the requisite field-crops. The assumption of a like fertility in nature, as a peculiarity of an early and golden period of the earth's history, seems not less arbitrary than the supposition that the trees of the same period towered aloft under such gigantic proportions as to have sustained Megatheriums suspended from their boughs by prehensile tails as easily and securely as the assumed dwarfish successors to such hypothetical trees now support the puny Sloths. According to the known natural rate of growth of such tubers and bulbs as the teeth of the Megatherioids could have crushed, much ground must have been devastated and ploughed up in the quest of as many as might serve for one day's subsistence; but, according to the theory advocated in the present Memoir, the Megatherium or Mylodon would have abundance of food for several days in the branches of a tree large enough to have tasked its powers in the prostration.

I have next to remark that the observed varieties in the teeth of the Megatherioid animals are best explained, teleologically, on the theory that they fed on foliage. The close correspondence between the Megatherium and the Mylodon in the modifications of the skeleton determining the peculiar forces acting from the hind upon the fore-parts, compels us to infer that they resembled each other in the mode in which they obtained their sustenance; and, nevertheless, the difference in the form of the grinding surface of the teeth, as well as in their size and depth of insertion, obviously indicates some difference in the substances comminuted. If these substances had been roots, then a softer and more succulent kind must have been abundantly produced for the Mylodon, and another coarser kind in still greater abundance for the Megatherium—two hypotheses irreconcileable with the known history of the uncultivated growth of such roots, and of the animals they serve to sustain in a state of nature at the present day. On the theory that the Megatherioids subsisted on foliage, it is most natural to suppose that the Mylodon and Megalonyx, with teeth most closely resembling those of the Sloths, would feed, like them, on the leaves and tender buds ; while the Megatherium, whose essentially bradypodal teeth were more modified by their arrangement in a closer series, by the nearer approximation of those series towards the middle line, by their transversely ridged crowns, and by the great depth of the lower jaw, so as concurrently to offer an obvious resemblance to the Elephant's dentition, would be thereby able to bruise the smaller branches, and to masticate these together with the buds and leaves.

It is very true that the perfect skeleton of the Mylodon in the Museum of the College confirms the opinion formed by M. Laurillard from the less perfect skeleton of the Megatherium at Madrid, that the fore-foot of the Megatherium resembled that of the great Ant-eater, in so far as regards its equal adaptation for cleaving the soil. But on Baron Cuvier's hypothesis that such was the sole office to which the fore-feet were applied in quest of food, the incongruous proportions and prodigious strength of the posteriors, hind limbs and tail are inexplicable. The founder of Palæontological science has deduced no physiological consequence from the extraordinary expanse of the iliac bones, from the great breadth of the femora, from the strength of the leg or the length of the horizontal base of the above colossal parts. What other office, indeed, could be assigned to these parts of the frame of the Megatherium, on the supposition that the animal subsisted on roots, than that of supporting the body, while one or other, or perhaps both, fore-legs were occupied in digging ?

Now, if the Megatherium or Mylodon had been constrained, by the nature of their food, to the habitual posture of standing on three legs, the parts to be so supported ought to have been as light as was compatible with their essential offices. There appears no reason why the bony parietes of the abdominal and pelvic cavities should have exceeded the bulk and weight requisite for the support of the contained viscera. Yet both in the Megatherium and Mylodon, those bones, as the sacrum, ilia and ischia, which take least share in that office, assume proportions which, compared with those in the large grazing Herbivora, are gigantic and monstrous. And if these bones had not been otherwise concerned in the acquisition of food, than in being adequately propped up during the operation, their enormous development loses every other significance than as the condition of a concurrent, and otherwise unintelligible, massiveness of the hind-legs and tail.

Such colossal proportions both of the parts supporting and those supported, can only be explained teleologically, on the hypothesis which requires them as the conditions of strength adequate to the habitual acquisition of food by uprooting trees. Such actions—the same amount and combination of muscular forces—have ceased to be manifested by terrestrial quadrupeds in the existing creation, and seem impossible under any other conceivable modifications of the mammalian type than those which characterized the extinct race of Megatherians. In the task of thinning the American forests the brute force of the Mylodon has been superseded by the axe of the Backwood's-man.

Thus, then, in reference to the comparative probability of the fossorial, the climbing, and the uprooting hypotheses of the living Megatherians, it has been shown that the most characteristic modifications of the bony framework of these extinct animals are left unexplained by the first, that they directly oppose themselves to the second, and become intelligible only under the third view, which is that propounded in the present Memoir: it may also be added, that this is the only theory of the Megatherians which does not require the postulate of a different condition of the vegetable kingdom from that which now prevails.

The Cuvierian view, which assumes at the outset a kind of food not indicated by the teeth, and condemns the colossal creature to dig for each morsel, and so to the endless repetition of a task now assigned only to diminutive quadrupeds, at the same time requires for the support of the generations of the Megatherian race an abundance of esculent roots in a state of nature equal to that now raised on the best-cultivated and most fertile soils.

Dr. Lund, with a truer insight into the nature of the food of the Megatherioid animals, confesses that the scansorial hypothesis is untenable, without assuming the former existence of trees as much surpassing in size those of the present day, as the Megatherium exceeds the Sloth.

My theory of the Megatherian animals, in assigning to them the Herculean labour of uprooting and prostrating trees, for the acquisition of the food which is unequivocally indicated by their dental and maxillary organs, explains and requires all the other characteristics of their organization, and assumes no unknown condition of the vegetable world. Whoever is acquainted with the energy and rapidity of the growth of trees in the intertropical regions of the American continents, or with the enormous quantity of timber annually floated away by the great American rivers, can have little difficulty in conceiving that the interminable and by man unpenetrated forests of the primæval world would yield sustenance to many generations of huge quadrupeds, even though they might uproot the trees on the foliage of which they fed.

In fine, whatever be the value of such collateral evidence as may be deduced from the known conditions of the vegetable kingdom, a searching and impartial review of the anatomical facts and analogies detailed in the foregoing part of the present Memoir has led me to the conclusion, that :—All the characteristics which co-exist in the skeleton of the Mylodon and Megatherium conduce and concur to the production of the forces requisite for uprooting and prostrating trees ; of which characteristics, if any one were wanting, the effect could not be produced ; and that this hitherto unknown and most extraordinary mode of obtaining food, is the condition of the sum of such characteristics, and of the concourse of so great forces in one and the same animal.

Zoological Summary.

The light which is thrown on the nature of animals belonging to extinct species by the comparison of their fossil remains with recent skeletons is very often reflected back, so as to elucidate affinities of existing species which were before obscure, and which must otherwise have remained subjects of debate and doubt. Of the happy influence of Palæontology in the resolution of such problems in natural history, the present application of the osteology of the Megatherioids affords a good example.

The genera *Bradypus* and *Cholæpus* have been regarded by all zoologists as forming one of the most anomalous and isolated groups in the mammiferous class, of which no other proof is needed than the fact, that whilst Cuvier, in the 'Règne Animal,' has placed the Sloths in the lowest order of Unguiculata, his successor* in the celebrated French school of zoology has seen reason for raising them to the highest or quadrumanous order, agreeably with an old opinion of Linnæus.

Our present knowledge of the extinct Megatherian quadrupeds leads us to contemplate the natural affinities of the Sloths from a vantage-ground not attained before, yet essential to a correct and comprehensive view of them. The tardigrade and scansorial Edentata appear to the classifier conversant only with existing forms as a very restricted and aberrant group, but they may now be recognizable by the Palæontologist as the small remnant of an extensive tribe of leaf-devouring and tree-destroying animals, of which the larger extinct species were rendered equal to the Herculean labours assigned to them in the economy of an ancient world, by a gigantic development of the unguiculate type of structure, combined with such modifications as unequivocally demonstrate that they were at the lowest step of the series of Mammals furnished with claws, and that they completed the transition to the Ungulate division of the Class.

It harmonizes well with this general view of the affinities of the Megatherioid quadrupeds, that whilst they brought the unguiculate type, both by modifications of structure and predominance of size, most closely to that of the great hoofed Herbivora, they likewise were, of all the quadrupeds provided with formidable claws, the most strictly vegetable feeders.

And if we have reason to view the structural differences or superadditions which the Megatherioids present, compared with the Sloths, as being the necessary consequences of an identity of diet in quadrupeds too bulky to climb, and therefore requiring new powers for the attainment of the foliage, such an interpretation of the peculiarities of their organization, whilst it confirms the close

* M. de Blainville, *Prodrome d'une Nouvelle Zooclassie*, 1816; quoted by the author in his recent splendid *Osteographie*, in which he adduces the following osteological characters as common to the Sloths and Quadrumanes:—" Ce sont des Primates:—' Par l'état complet de l'avant-bras; la rotondité de la tête du radius; la mobilité du carpe sur l'avant-bras.—Par l'état également complet de la jambe dans ses deux os; la grand mobilité du tarse sur les os de la jambe.—Par la forme générale du tronc, presque sans queue, large et déprimé plutôt que comprimé à la poitrine:—par la largeur du bassin." —*Osteographie de Paresseux*, 4to, 1840, p. 58.

mutual affinities between the great extinct and small existing phyllophagous Unguiculata, at the same time indicates unerringly the true natural affinities of the whole of this great tribe to the other groups of Mammalia.

It would border upon the ridiculous to advocate the claims of the Mylodon to the Quadrumanous order, because its thorax was wide rather than deep, its muzzle broad and truncated, its pelvis expanded, the head of the radius round and apt for rotation, the inflection of the carpus and tarsus free, the long claws prehensile, and the diet exclusively vegetable. Yet the claims of the Megatherians to be associated with the Apes and Lemurs, are, on these grounds, equal with those of the Sloths.

The only modifications in the small Tardigrades which might mislead a naturalist into exaggerating the importance of the characters just cited, are due, in fact, to the absence of characters of the phyllophagous Edentata, by which the Sloths are made inferior to the Megatherioids, without being thereby especially approximated towards the Quadrumana: such, for example, as the removal of the ungulate digits, the loss of the mobility of certain joints in the hands and feet, the diminution of the bulk of the body, and the incomplete clavicles in one of the species.

It is most probable that the Megatherioids, like the Sloths, gave birth to a single and unusually large fœtus; but in that case, they would coincide in their uniparous generation with the Elephant and Whale, as much as with the Ape. If their uterus was undivided, as in the Sloths, they would agree with the Armadillos, as well as with the Quadrumanes. The pectoral mammæ of the Dugong and Elephant show the insufficiency of this character in determining the natural affinities of a Mammal, if we assume that the Megatherioids, like the Sloths, resembled the Primates in the position of the lactiferous organs.

In the lowest of the Quadrumana, as the Mydas Monkey*, the brain, though smooth and almost as devoid of convolutions as in the bird, is yet characterized by the large proportional size of the cerebral hemispheres, which extend a considerable way over the cerebellum. In the Sloths the cerebellum is almost left exposed, and in the Megatherioids must have been quite uncovered by the cerebrum, which was of as small proportional size as in the Ant-eaters and other

* See my paper On the Brains of the Marsupial Animals, Phil. Trans., 1837, pl. v. fig. 2. p. 93.

Edentata. The forward inclination of the occipital plane which the Sloths and Megatherioids present, in common with most other Edentata, is a character manifested by no true quadrumanous animal.

The dental system has evidently reached its lowest condition, amongst Mammalia, in the order Edentata. As respects the proportion of the order, comprising the true Ant-eaters and Pangolins, to which the term 'Edentulata' was originally and restrictively applied by Brisson, that term is quite appropriate, and it would have been well if its signification had not been extended to so many species to which it is inapplicable. The Orycterope, or Cape Ant-eater, for example, has molar teeth: some of the Armadillos possess, in addition to their molars, one or two teeth, which may, from their position, be termed incisors; and the two-toed Sloth has teeth which by their size and shape merit the name of canines; but whatever be the position, shape, or use of the teeth, in no Edentate species of the Cuvierian system does enamel enter into their composition.

The modifications in the intimate structure of the teeth, which are extreme, and peculiar to the quadrupeds of this order, may be regarded as another indication of the low ebb to which the development of the dental character has sunk; now variable, and, as it were, flickering before its final disappearance.

In the Orycterope we find, strangely repeated, a microscopic structure characteristic of the teeth of the Ray and the Saw-fish *, very different from any modification in the teeth of other Edentata or of other Mammalia. The intimate structure of the teeth of the Megatherioids and Sloths is quite as peculiar to them among Mammalia, but this modification has not been observed in any other class of vertebrate animals.

This structural peculiarity of the teeth, and their continual growth in the Sloths, are characters which, independently of the total absence of incisors, and diminished number of molars, form an essential objection against their approximation to the Quadrumanous order†: and the value of these differential characters is greatly increased by their close repetition in the teeth of all the large

* Report of the British Association, 1838, p. 145.

† M. de Blainville admits that the character of the dental system—" le système dentaire plus ou moins incomplet," *loc. cit.* p. 58.—is an indication of their affinity to the Edentata.

extinct Megatherioid animals, which, whilst essentially related to the existing Sloths in other parts of their organization, approximate in those modifications by which they differ from the Sloths, not to the Quadrumana, but to the Ant-eaters, and in a minor degree to the Orycterope and Armadillos; thus demonstrating by their differences, as by their resemblances, the essential relations of the Sloths to the Edentate order of Mammalia.

The degradation of the armature of the jaws in this order produces, especially in the truly edentulous Ant-eaters, a resemblance to the class of birds in one of their best-marked characters; and amongst the implacental Edentata we find the jaws themselves assuming the form of a duck's bill in the Ornithorhynchus.

It may be observed of the Sloths that they illustrate this affinity or tendency to the oviparous type by the supernumerary cervical vertebræ supporting false ribs, and by the convolution of the windpipe in the thorax, in the three-toed species; by the lacertine character of three and twenty pairs of ribs in the Unau; and by the single excrementory or cloacal outlet, by the low cerebral development, by the great tenacity of life and long-enduring irritability of the muscular fibre, in both species*. Most interesting, therefore, becomes the discovery, that in one of the huge extinct Sloths another character, heretofore deemed peculiar to the class of birds, should have been repeated, viz. the bony confluence of the last dorsal and the lumbar vertebræ with the sacrum. All these indications of a transition to a lower class harmonize with the Cuvierian view of the zoological position of the Sloths, as members of one of the lowest and most aberrant orders of Mammalia; and all oppose themselves to the promotion of the Sloths to the Primates, and to their separation from the terrestrial Edentata, which afford in the Ant-eaters and Pangolins, the Echidna and Ornithorhynchus so many additional retrograde steps towards the Oviparous classes.

It would be tedious to reiterate the special and gradational affinities of the

* "Cor motum suum validissime retinebat, postquam exemptum erat è corpore, per semihorium;—Exempto corde cæterisque visceribus, multo post se movebat et pedes lente contrahebat sicut dormituriens solet." Pison, *Hist. Bras.* p. 322, quoted by Buffon, who well observes, "par ces rapports, ce quadrupède se rapproche non-seulement de la tortue, dont il a déjà la lenteur, mais encore des autres reptiles et de tous ceux qui n'ont pas un centre du sentiment unique et bien distinct."—*loc. cit.* p. 45. The endowment of a persistent formative organ of the teeth indicates another property in the Megatherioid animals, by which they would resemble the cold-blooded Reptiles, viz. longevity.

Mylodon and its congeners to the different families of the Edentate order, since these have been so fully elucidated in the comparisons of the several parts of their skeletons. They establish the general conclusion that the existing arboreal and extinct terrestrial Sloths constitute a primary division or tribe of the order Bruta or Edentata, equivalent to the tribe Loricata, or Armadillos, and to the true Edentata, or the Ant-eaters and Pangolins.

The teeth and jaws give the essential character, and govern the aliment of the new primary group, of which the name *Phyllophaga*, here proposed, indicates the characteristic and peculiar diet.

The characters of the tribe, of its families and genera, and of the extinct species especially noticed in the present Memoir, are given in the subjoined Synoptical Table.

CONSPECTUS

FAMILIARUM, GENERUM, ET SPECIERUM,

Brutorum frondes carpentium.

Ordo. BRUTA, Linnæus, Fischer (*Edentata*, Cuvier).

Dentes nulli ; aut radices, cervicem et adamantum carentes.

Ungues, falculæ magnæ, plerumque vaginatæ, deflectentes.

Tribus. PHYLLOPHAGA.

Dentes pauci, e dentino vasculoso, dentino duro et cæmento compositi, dentino vasculoso axem magnum formante.

Apophysis descendens in osse jugali. Acromion cum processu coracoideo concretum.

Familia I. *TARDIGRADA*. (Syn. *Scansoria*, *Bradypodidæ*.)

Pedes longi, graciles ; antici plus minusve longiores : manibus di- vel tridactylis, podariis tridactylis ; digitis obvolutis, falculatis.

Arcus zygomaticus apertus. Cauda brevissima.

Genus 1. *Bradypus*, Linn., Illig. (Syn. *Acheus*, F. Cuv.)

Genus 2. *Cholœpus*, Illig. (Syn. *Bradypus*, F. Cuv.)

Familia II. *GRAVIGRADA*. (Syn. *Eradicatoria*, *Megatheriidæ*.)

Pedes breves, fortissimi, æquales aut subæquales : manibus penta- vel tetradactylis, podariis tetra- vel tridactylis ; digitis externis 1 aut 2, muticis, ad suffultionem gressumque idoneis, reliquis falculatis.

Arcus zygomaticus clausus. Claviculæ perfectæ. Cauda mediocris, crassa, fulciens.

Genus 1. *MEGALONYX*, Jefferson, Cuv. (Syn. *Megatherium*, Desm., Fischer.)

Dentes $\frac{5-5?}{4-4}$ subelliptici, coronide mediâ excavati, marginibus prominulis. Pedes antici longiores. Tibia et fibula discretæ. Calcaneum longum, compressum, altum. Falculæ magnæ, compressæ.

Species. MEG^x. JEFFERSONI, Cuv. (Syn. *Megatherium Jeffersoni*, Desm., Fischer. *Megalonyx laqueatus*, Harlan *.)

Genus 2. *MEGATHERIUM*, Cuv. (Syn. *Bradypus*, Pander et D'Alton.)

Dentes $\frac{5-5}{4-4?}$ contigui, tetragoni, coronide transversim sulcatâ. Manus tetradactyli; podarii tridactyli, digitis duobus externis muticis. Falculæ magnæ, diversiformes; medii digiti maximæ, compressæ. Femur capite integro; tibia cum fibulâ utrâque extremitate concreta. Astragalus paginâ anticâ supra excavatâ. Calcaneum longum, crassum.

Species. MEG. CUVIERI, Desm. (Syn. *Bradypus giganteus*, Pander et D'Alton.)

Genus 3. *MYLODON*, Owen. (*Megalonyx*, Harlan†, *Orycterotherium*, Harlan‡.)

Dentes $\frac{5-5}{4-4}$ discreti, superiorum anticus subellipticus, e reliquis modice remotus; secundus ellipticus; reliqui trigoni paginâ internâ sulcatâ: inferiorum anticus ellipticus; penultimus tetragonus; ultimus maximus, bilobatus. Pedes æquales; manus pentadactyli; podarii tetradactyli; utrisque digitis duobus externis muticis, reliquis falculatis: falculæ magnæ, semiconicæ, inæquales.

Caput femoris ligamento rotundo impressum: tibia et fibula discretæ: astragalus paginâ anticâ supra complanatâ: calcaneum longum, crassum.

Species 1. MYL. DARWINII, O. Maxilla inferior symphyse longiore angustiore; molaris secundus subellipticus; ultimus bisulcatus, sulco interno angulari.

* The species is founded on fossils from Big-bone Cave, Tenessee, described in the Medical and Physical Researches, p. 319–331. The author does not prove the specific distinction of these remains from the *Megalonyx Jeffersoni* of Cuvier.

† The lower jaw described by Dr. Harlan, *loc. cit.* p. 334–335. It is erroneously ascribed to the *Megalonyx laqueatus*.

‡ Proceedings of the American Philosophical Society, vol. ii. No. 20. p. 109.

Species 2. Myl. Harlani, O. (*Megalonyx laqueatus*, Harlan, *Orycterotherium Missouriense*, Harlan.) Maxilla inferior symphyse breviore, latiore; molaris secundus subquadratus; ultimus trisulcatus, sulco interno bi-angulari.

Species 3. Myl. robustus, O. Maxilla inferior symphyse breviore, latiore; molaris secundus subtrigonus; ultimus trisulcatus, sulco interno rotundato.

Genus 4. *Scelidotherium*, Owen. (Syn. *Megalonyx*, Lund*.)

Dentes $\frac{5-5}{4-4}$ aut contigui aut intervallis æqualibus discreti; superiores trigoni; anticus inferiorum trigonus, secundus et tertius subcompressus, paginâ externâ sulcatâ; ultimus maximus, bilobatus.

Caput femoris ligamento tereti impressum; tibia et fibula discretæ. Astragalus antice duabus excavationibus. Calcaneum longum, crassum. Falculæ magnæ, semiconicæ.

Species. Scel. leptocephalum, O.
Scel. Cuvieri, O. (Syn. *Meg. Cuvieri*, Lund.)
Scel. Bucklandi, O. (Syn. *Meg. Bucklandi*, Lund.)
Scel. minutum, O. (Syn. *Meg. minutus*, Lund.)

Genus 5. *Cœlodon*, Lund.

Dentes $\frac{4-4}{3-3}$.

Genus 6. *Sphenodon*, Lund †.

* I am in doubt whether the term *Platyonyx*, subsequently proposed by Dr. Lund, be really intended to apply to the animals of the genus *Scelidotherium*, seeing that the breadth of their claw-bones is equalled by the height and vastly exceeded by the length of the same: it would be very descriptive of the broad ungual bones of the *Glyptodon* and its congeners.

† Both this genus, and *Cœlodon*, Lund, are indicated rather than satisfactorily established. The teeth of the Sloth are first developed in the form of hollow obtuse cones, and do not assume the cylindrical form until worn down to the part which has acquired, in the progress of growth, the normal thickness; and this is afterwards maintained, without appreciable alteration, during the subsequent uninterrupted growth of the tooth. The compressed molars of the *Scelidotherium*, which doubtless follow the same law of development, would present in the young animal the form of hollow wedges, and such I suspect to be the nature of those teeth, which are figured by Dr. Lund in the above-cited Danish memoir, plate xvii. figs. 5–10, and on which he has founded his genus *Sphenodon*.

Comparative Table of Dimensions of the Skeleton of the Mylodon robustus *and other Megatherioids.*

	M. robustus.			Megatherium*		
	ft.	in.	lines.	ft.	in.	lines.
From the fore-part of the skull to the end of the tail, following the upper curves of the vertebral column	11	0	0	18	0	0
Circumference of the trunk, outside the tenth pair of ribs	8	2	0			
... ... pelvis	9	9	0	14	4	0†
Length of the cervical region	1	1	0	2	1	0
... dorsal region	3	5	6	5	10	0
... lumbar region (anchylosed in the Mylodon)	0	8	0	1	3	0
... sacrum (proper)	1	2	0	1	4	0†
... tail	3	0	0	4	6	0
Cranium.						
Length from the occipital condyles to the anterior border of the upper maxillary bones	1	6	6	2	9	0
Length from the occipital condyles to the anterior border of the base of the descending process of the malar bone	1	0	6	1	10	6
Length from the anterior border of same process to that of the upper maxillary bone	0	6	0	0	11	6
Breadth across the widest part of the zygomatic arches	0	10	9	1	6	0
Least breadth of cranium at the interspace of the arches	0	5	4	1	6	0
Breadth of the nasal bones	0	3	3	0	5	7†

	M. robustus.			M. Darwinii.			Megatherium.		
Lower-jaw.	ft.	in.	lin.	ft.	in.	lines.	ft.	in.	lines.
Length.	1	3	6	1	6	0	2	1	6
Breadth between the posterior extremities	0	6	3	0	0	8	1	1	6
... ... condyles	0	4	2						
... ... posterior sockets	0	2	10	0	2	9			
... ... anterior sockets	0	4	0	0	3	6			

* Calculated from the figure of the skeleton of the Megatherium by Drs. Pander and D'Alton, completed by Mr. Clift from the additional parts brought to England by Sir Woodbine Parish. See Geological Transactions, Second Series, vol. iii. pl. xliv.

† Taken from the actual specimen in the Museum of the Royal College of Surgeons.

	M. robustus.			M. Darwinii.			Mega-therium.		
	ft.	in.	lines.	ft.	in.	lines.	ft.	in.	lines.
Breadth across the anterior part of symphysis	0	5	4	0	3	8	0	5	8
Depth of ascending ramus from the upper part of the condyle	0	5	7				1	0	0
Depth of ramus at the anterior part of the base of coronoid process	0	3	7	0	2	9	0	9	0
Depth of ramus at the first socket	0	3	0				0	5	0
... the symphysis following the outer curve	0	4	3	0	2	6			
Antero-posterior extent of base of coronoid process	0	3	8	0	4	4	0	7	6
From the back part of the condyle to the end of the angular process	0	3	2				0	5	10
From the end of the angular process to the last socket	0	6	6						
From the first socket to the anterior margin of the jaw	0	3	6	0	6	0	0	8	9
Extent of the alveolar series	0	5	4	0	4	6			
Breadth of the condyle	0	2	6						
From the largest anterior outlet of the dental canal to the anterior margin of the jaw	0	3	2	0	4	0			
Vertical diameter of the entrance of the dental canal	0	0	6	0	0	5			

Anterior Extremity.

	Mylodon.			Mega-therium*.			Megalonyx.		
	ft.	in.	lines.	ft.	in.	lines.	ft.	in.	lines.
Length of the anterior extremity	4	6	0	10	0	0			
Scapula.									
The greatest extent of the right scapula from the inferior angle to the end of the coracoid arch	1	7	3	2	6	6			
Greatest breadth from the inferior border of the glenoid cavity to the posterior superior angle	1	1	2	1	5	6			
Greatest height of spine	0	3	5	0	5	0			
Longest diameter of glenoid cavity	0	5	0	0	6	6			
Shortest diameter of ditto	0	3	0	0	4	6			
Length of the base	1	2	0	2	3	6			

* The dimensions of the scapula, clavicle, radius, and bones of the hand are taken from the actual specimens in the Museum of the Royal College of Surgeons.

	Mylodon.			Megatherium.			Megalonyx.		
	ft.	in.	lines.	ft.	in.	lines.	ft.	in.	lines.
Longest diameter of supra-spinal aperture formed by the junction of the acromion and coracoid processes	0	5	0	0	6	6			
Shortest diameter of ditto	0	3	0	0	4	6			
Length of superior costa	1	2	0	2	5	0			
... inferior costa	1	0	0	1	6	0			
Breadth of supra-spinal fossa	0	7	0	1	0	6			
... infra-spinal fossa	0	6	0	0	5	0			
Clavicle.									
Length	0	8	2	1	3	0			
Smallest circumference	0	3	0	0	7	6			
Humerus.									
Length	1	3	6	2	3	0	1	6	0
Circumference at the centre of shaft	0	11	2				0	8	0
... ... upper end	1	1	7				1	3	0
Transverse diameter of the distal end	0	7	4	1	3	0	0	5	6
Ulna.									
Length	1	2	6	2	1	6	1	8	0
Length of olecranon	0	4	6				0	5	8
Circumference of upper end	0	11	0				0	10	0
... lower end	0	8	0				0	7	0
Radius.									
Length	0	11	0	2	2	0	1	5	0
Smallest circumference	0	7	6	0	9	0	0	5	8
Greatest circumference at lower end	0	12	0	1	8	0	0	11	0
Least diameter of upper articular surface	0	1	10	0	3	3	0	2	0
Circumference of the upper end	0	6	0	1	0	0	0	7	6
Manus.									
Length of the fore-foot	1	2	0	2	7	3			
Breadth of ditto	0	8	4	1	2	6			
Length of the middle metacarpal bone	0	3	9	0	7	6	0	3	10
Circumference of ditto at its proximal extremity	0	8	3	0	12	7	0	7	1
... ... distal extremity	0	6	9	0	11	0	0	7	0
Length of the fourth metacarpal bone	0	4	3	0	10	6			
Circumference of ditto at its proximal extremity	0	6	1	0	10	4			
... ... distal extremity	0	6	0	0	12	10			
Length of ungual phalanx of middle digit	0	5	3	0	10	6	0	7	3
Vertical diameter of ditto near the middle	0	2	0	0	6	0	0	2	8
Transverse diameter of ditto at the same part	0	1	10	0	3	0	0	1	6
Length of the bony core of the claw	0	4	10	0	10	0	0	6	6

Posterior Extremity.

	Mylodon.			Megatherium*.		
	ft.	in.	lines.	ft.	in.	lines.
Pelvis.						
From the spinous process of the sacrum to the anterior superior spine of the ilium	2	0	0	3	0	0
From the anterior superior spine of the ilium to the acetabulum	0	9	0	1	6	6
... ... anterior part of the symphysis pubis	2	2	0	3	4	0
Antero-posterior extent of the ilium	1	5	0	1	10	6
Lateral extent of the ilium	1	4	0	2	3	8
Longest diameter of the acetabulum	0	5	3	0	7	6
Vertical diameter of the ischiadic foramen	0	4	5	0	7	0
Transverse diameter of ditto	0	5	2	0	4	5
Length of the dorsal surface of the anchylosed sacrum	2	1	0	1	6	0
From the superior edge of the acetabulum to the symphysis pubis	1	6	6	2	3	0
Depth of the symphysis pubis	0	3	6	0	10	0
Breadth of the pubis from its anterior edge or brim to the obturator foramen	0	7	0	0	10	2
Shortest diameter of obturator foramen	0	3	7	0	5	2
From the outer or extreme point of the ilium to the tuberosity of the ischium	1	8	0	3	3	0
Breadth of the ischium where it joins the sacrum	0	5	6	1	0	6
From the extreme point of the ilium to the anterior edge of the symphysis pubis	2	1	3	2	8	0
The antero-posterior diameter of the pelvic aperture	1	8	6	2	0	0
Transverse diameter of ditto at the brim of the pelvis	1	1	0	1	2	0
Transverse diameter of the pelvic aperture at the outlet	1	3	9	1	6	0
Femur.						
Greatest length from the extremity of the head of the femur to the lower surface of the inner condyle	1	7	0	2	4	6
From the top of the great trochanter to the lower surface of the outer condyle	0	18	7	2	3	0
Greatest circumference of the head of the femur	0	15	0	2	0	0
Circumference of the neck of the femur	0	15	6	1	10	0
Circumference of the upper part of the femur over the great trochanter	2	2	0	3	2	0

* The remaining dimensions of the Megatherium, with the exception of those of the entire foot, are taken from the specimens in the Museum of the Royal College of Surgeons.

	Mylodon.			Megatherium.			Megalonyx.		
	ft.	in.	lines.	ft.	in.	lines.	ft.	in.	lines.
Circumference of the middle of the femur	1	3	6	2	1	10			
... above the condyles	1	1	10	3	2	0			
... around the condyles	1	8	0	2	10	6			
Breadth of the femur at the great trochanter	0	9	0	1	4	0			
... across the middle of the femur	0	6	1	0	11	0			
... above the condyles	0	7	2	1	4	6			
Transverse breadth below the condyles	0	6	6	1	0	0			
Inter-condyloid space at the middle of the bone	0	2	1	0	3	8			
Tibia.									
The greatest length along the middle line	0	8	6	1	10	0			
Circumference of the proximal ends of the tibia and fibula (anchylosed in the Megatherium)	1	6	10	2	11	0			
Smallest circumference of the tibia at its middle	0	8	6	1	2	2			
Circumference of the distal ends of the bones of the leg over the malleoli	1	4	2	2	6	3			
Length of the interosseous space	0	5	6	0	7	1			
Greatest breadth of ditto	0	2	6	0	3	6			
Breadth of the proximal articular surface of the tibia	0	6	6	0	11	9			
... distal articular surface of ditto	0	4	6	0	8	3			
... tibia and fibula at the lower end	0	6	6	1	0	6			
Length of hind-foot	1	7	0	2	10	6			
Breadth of ditto	0	6	9	1	0	0			
Astragalus.									
Its greatest breadth	0	4	0	0	9	0			
... height	0	3	6	0	9	0			
Os calcis.									
Greatest length on its inferior surface	0	7	6	1	5	0	0	8	0
Greatest circumference (behind its middle part)	1	0	0	1	7	3			
Vertical diameter of posterior part	0	3	6	0	6	0	0	7	4
Transverse diameter of ditto	0	4	6	0	7	0	0	1	0
Os naviculare.									
Greatest breadth	0	2	0	0	6	6			
Greatest length	0	3	2	0	4	6			
Os cuboides.									
Greatest diameter	0	2	10	0	5	0			
Ungual Phalanx.									
Length of ungual phalanx of middle digit, hind-foot	0	5	4	0	9	6			
Greatest height near the middle	0	1	10	0	5	6			
Circumference at the same part	0	6	3	1	2	6			
Breadth at the same part	0	1	9	0	3	4			

The colossal proportions of certain bones of the Megatherioid quadrupeds are strikingly shown by being contrasted with the same parts in a full-sized male Indian Elephant, as, for example :—

	Mylodon.			Mega-therium.			Elephant.		
	ft.	in.	lines.	ft.	in.	lines.	ft.	in.	lines.
The breadth of the entire pelvis	3	5	0	5	1	0	3	8	0
Breadth of the largest caudal vertebra	0	10	5	1	9	0	0	7	0
Breadth of the distal end of the humerus	0	7	4	1	3	0	0	10	6
Circumference of the middle of the fore-arm	1	1	0				1	3	0
Circumference of middle of femur	1	3	9	2	2	0	1	0	0
Circumference of the middle of the bones of the leg	1	2	0	2	0	0	1	1	0
Length of os calcis	0	7	5	1	5	0	0	7	6

EXPLANATION OF THE PLATES.

PLATE I.

Side-view of the skeleton of the *Mylodon robustus*, one-sixth of the natural size, or on a scale of 2 inches to a foot: an outline of the skeleton of the Ai (*Bradypus tridactylus*) reduced to the same scale, is given at fig. 2, whereby the gigantic proportions of the Mylodon, as compared with a species of its most nearly allied existing genus, may be readily and accurately appreciated.

Plate I.

G. Scharf del. et lithog.

Printed by C. Hullmandel

Skeleton of Mylodon robustus

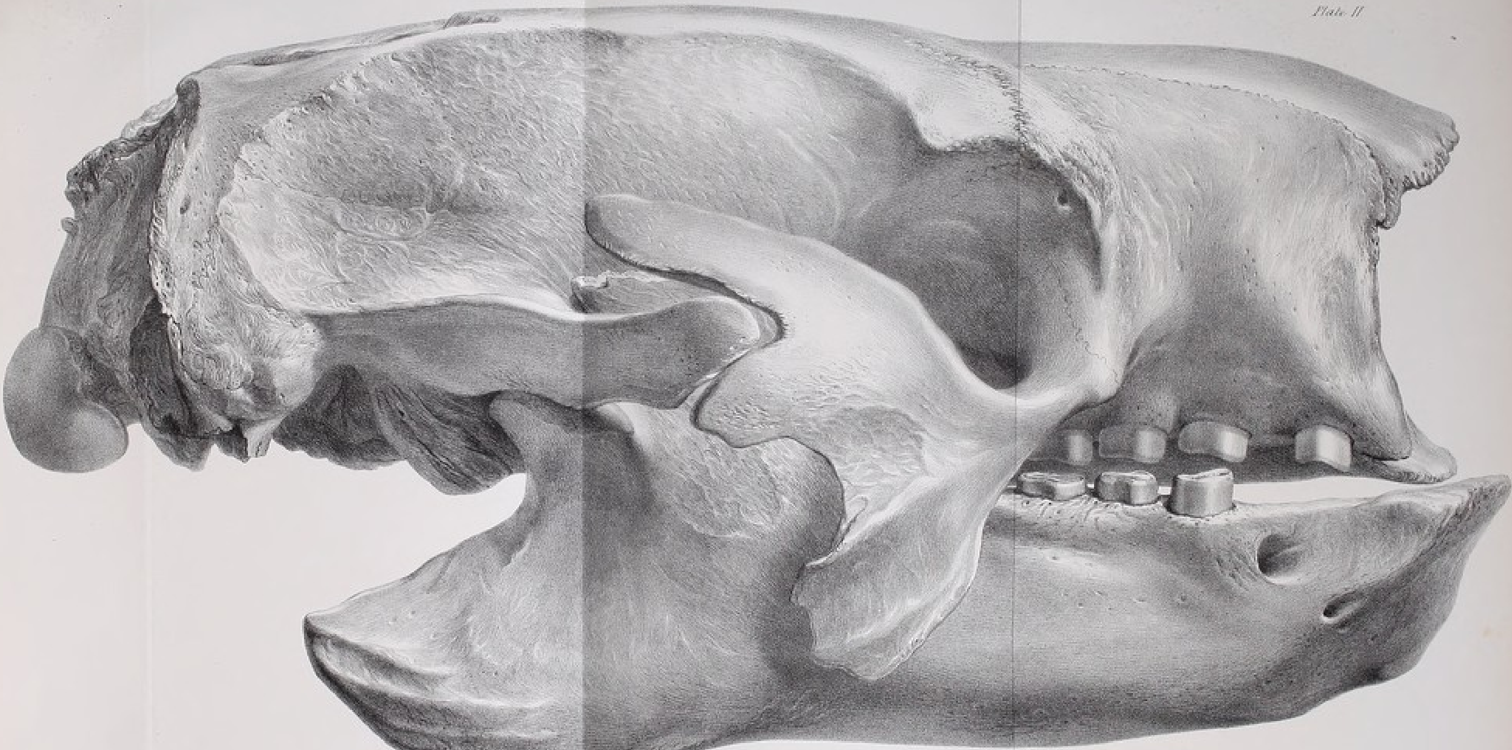
Fig. 2 Bradypus tridactylus

On a Scale of 2 inches to a foot.

PLATE II.

Side-view of the skull of the *Mylodon robustus*, natural size.

Plate II



Lithog. from Nature by G. Scharf

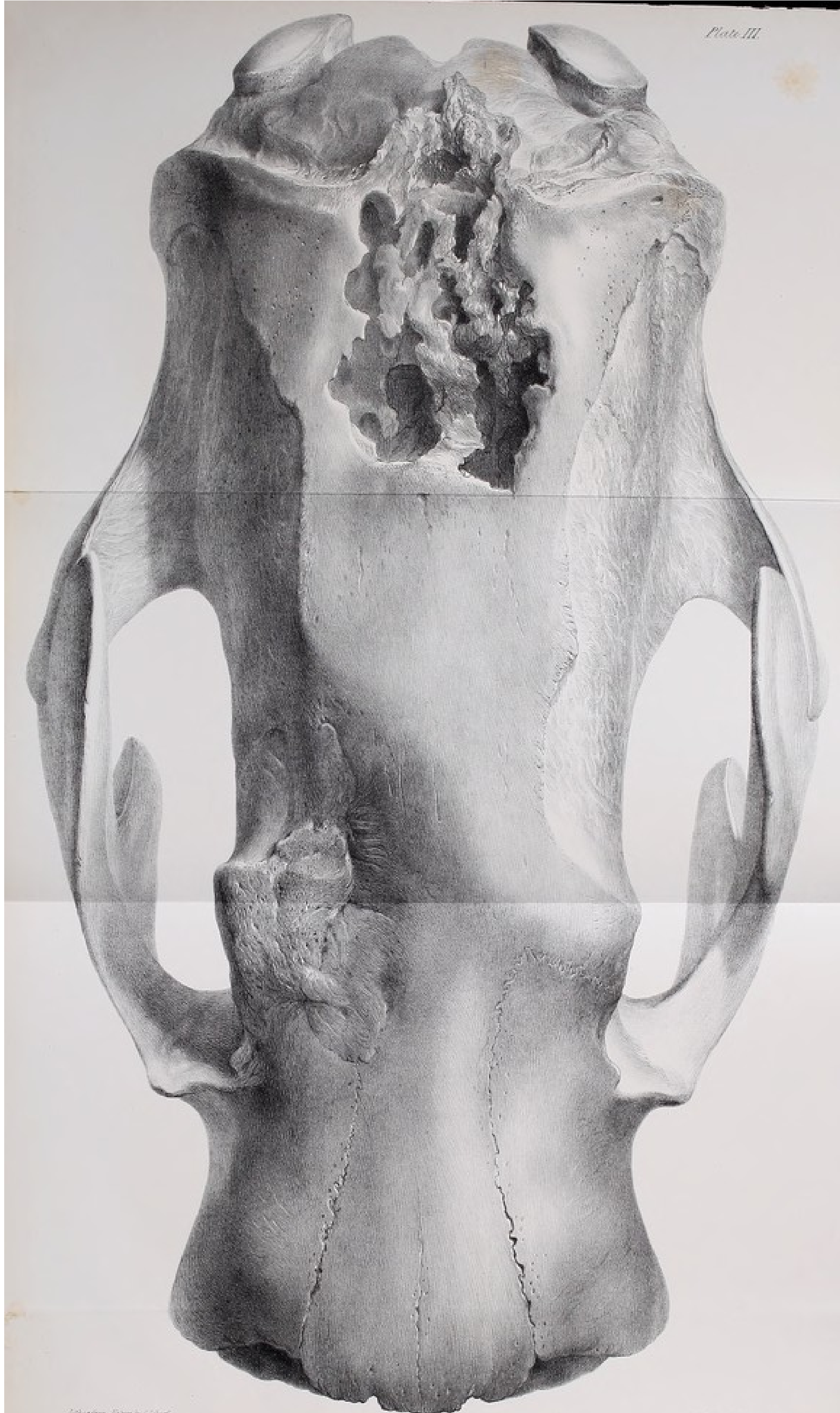
Printed by C. Hullmandel

Mylodon robustus

PLATE III.

Upper view of the skull of the *Mylodon robustus*, showing the two fractures of the outer table of the skull, one partially, the other entirely healed.

Plate III.



Lithog. from Nature by G. Scharf

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Mylodon robustus

Cranium, Nat. size

PLATE IV.

Base-view of the skull of the *Mylodon robustus*, natural size.

Lithog. from Nature by G. Scharf.
Printed by C. Hullmandel.

Mylodon robustus.
Base of Cranium. Nat. Size.

PLATE V.

End-views and section of the skull of the *Mylodon robustus*, half the naatual size.

Fig. 1. Posterior or occipital termination of the skull.

a. Inner orifice of the anterior condyloid canal.

b. Stylo-hyal articular cavity.

c. Digastric fossa.

d. Part of the additamentum suturæ lambdoidalis.

e. Inferior transverse occipital crest.

f. Situation where the superior transverse occipital crest has been depressed by the larger fracture.

Fig. 2. Vertical transverse section of the skull through the smaller fracture.

f. Situation of that fracture, showing the thickening of the outer table of the skull, and of the septa of the contiguous air-cells.

d. The vomer, which has been bent to the left side, probably by accumulation of pus in the inflamed sinuses adjoining the fracture.

Fig. 3. Anterior extremity of the cranium, forming the frame of the vertical aperture of the great nasal aperture.

a. Expanded terminal fossa of the anchylosed nasal bones, for the attachment of the cartilage of the nose.

b, *b*. Superior turbinated bones.

c. Middle meatus of the nose, above the ridge for the attachment of the inferior turbinated bone.

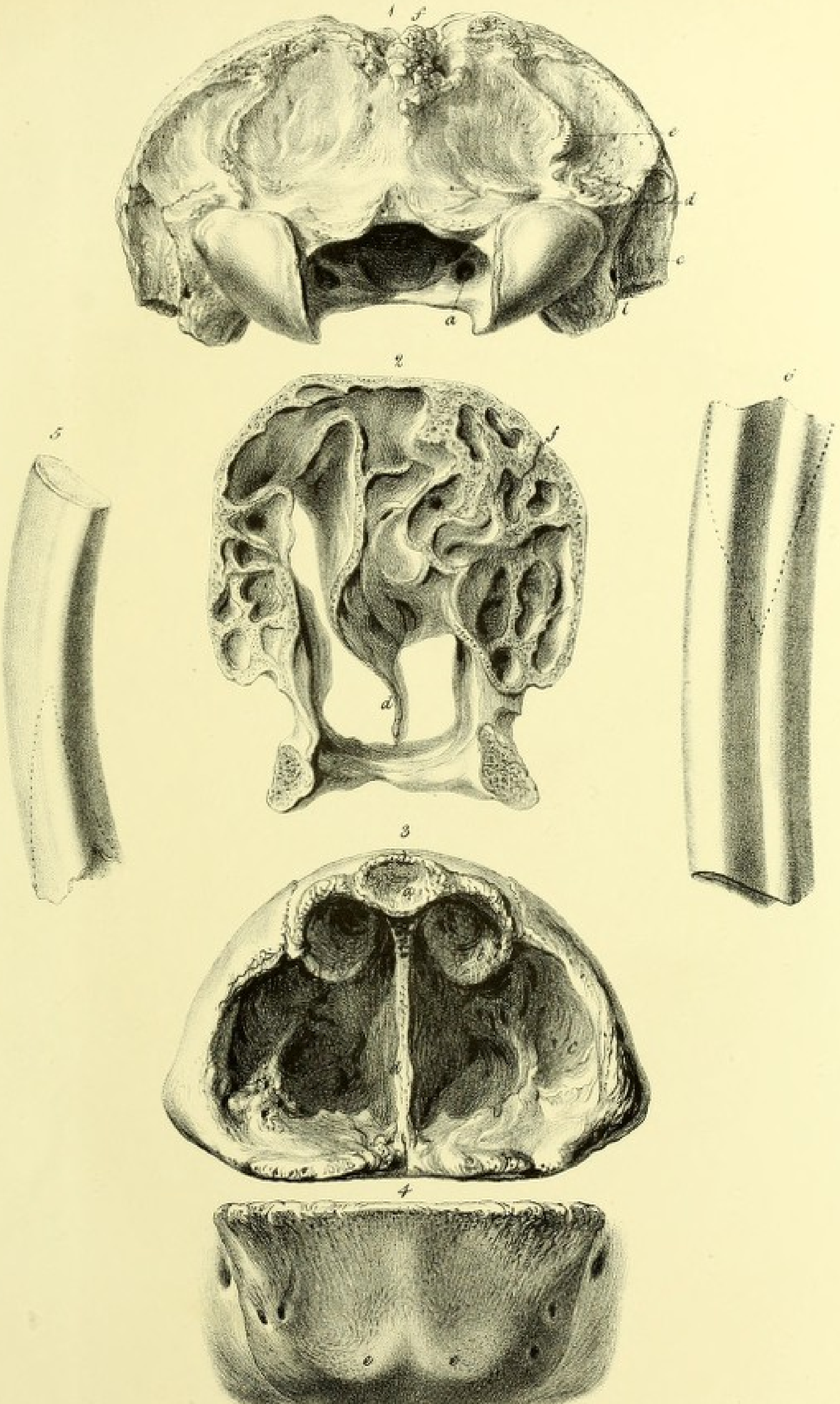
d. The thick vertical anterior margin of the vomer.

Fig. 4. Anterior extremity of the lower jaw.

e, *e*. Tuberosities for the attachment of the retractor labii inferioris.

Fig. 5. Anterior molar of the lower jaw: the dotted line shows the shape and size of the persistent pulp-cavity.

Fig. 6. Third molar of the upper jaw, viewed from the inner side: the dotted line shows the size and shape of the pulp-cavity. [The preceding figures having been added after an impression of the four preceding figures had been taken, have not printed out sufficiently strongly.]



Lithog. from Nature by G. Scharf.

Printed by C. Hullmandel.

Terminal Views and Section of the Cranium. 6 Inches to a Foot.

PLATE VI.

Three views of the lower jaw, half the natural size.

Fig. 1. Inner side of the right ramus.

Fig. 2. Upper surface of the lower jaw, showing the shape of the grinding surface of the teeth.

a. The condyle.

b. Base of the coronoid process.

c. Angular process.

d. Section of the symphysis.

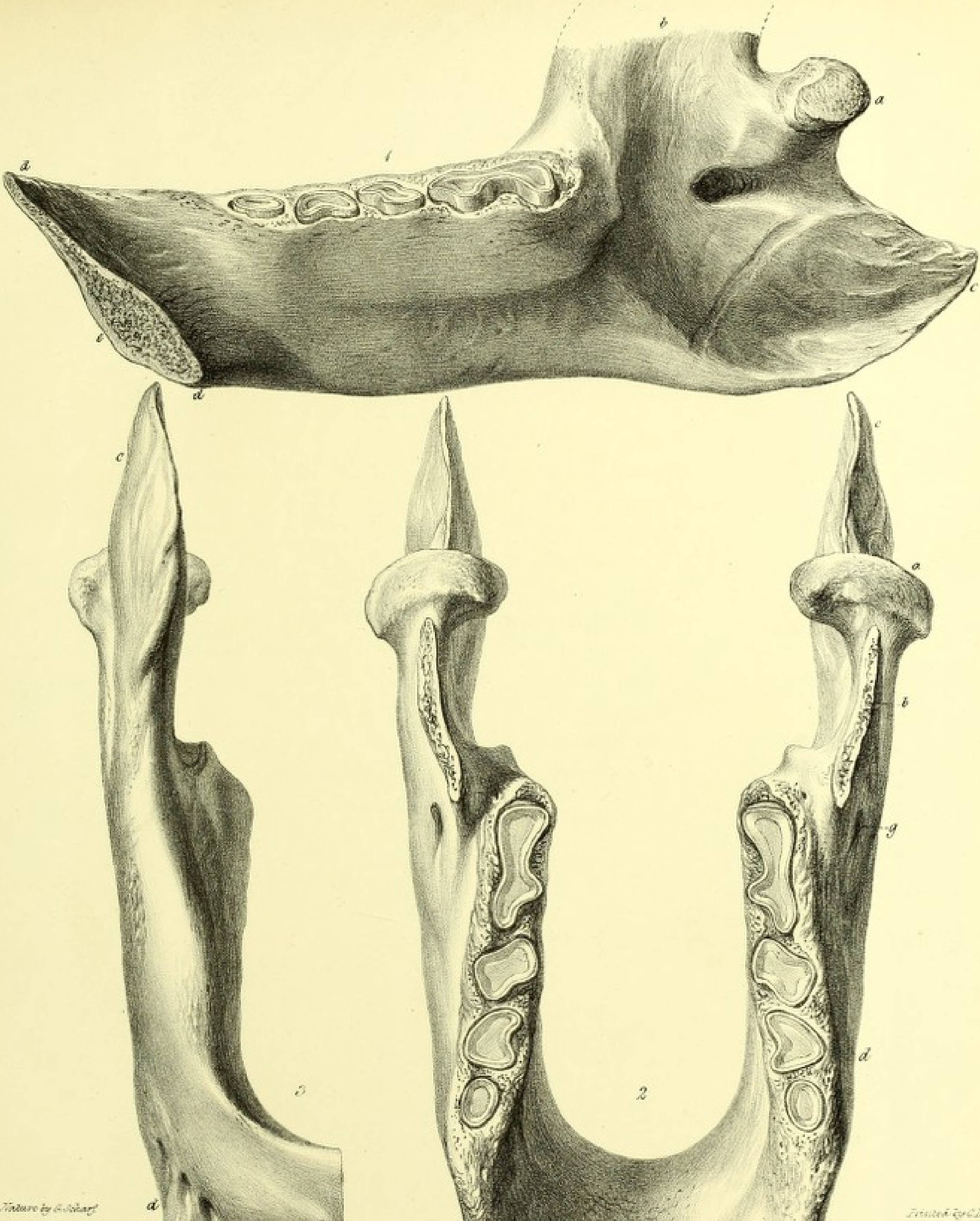
e. Prominence for the attachment of the retractores labii inferioris

f. Posterior orifice, or entry of the dental canal.

g. External and posterior outlet of the dental canal.

Fig. 3. Under surface of the left ramus of the lower jaw.

d. External and anterior outlets of the dental canal.



Lithog. from Nature by G. Scharf

Printed by C. Hullman

Lower Jaw. 6 Inches to a Foot.

PLATE VII.

Atlas and axis, half the natural size.

Fig. 1. Upper surface of the atlas.

Fig. 2. Under surface of the atlas.

Fig. 3. Hinder surface of the atlas.

Fig. 4. Side view of the atlas.

a. Body.

b. Summit of neural arch.

c. Transverse process.

d. Anterior articular or condyloid cavities.

e. Posterior articular processes.

f. Odontoid articular surface.

g. Entry to the vertebrarterial canal.

h. Anterior superior orifice of canal.

i. Inferior orifice of canal.

k. Posterior superior orifice of canal.

Fig. 5. Side-view of the axis, or vertebra dentata.

a'. Posterior surface of the body.

b'. Spinous plate or process.

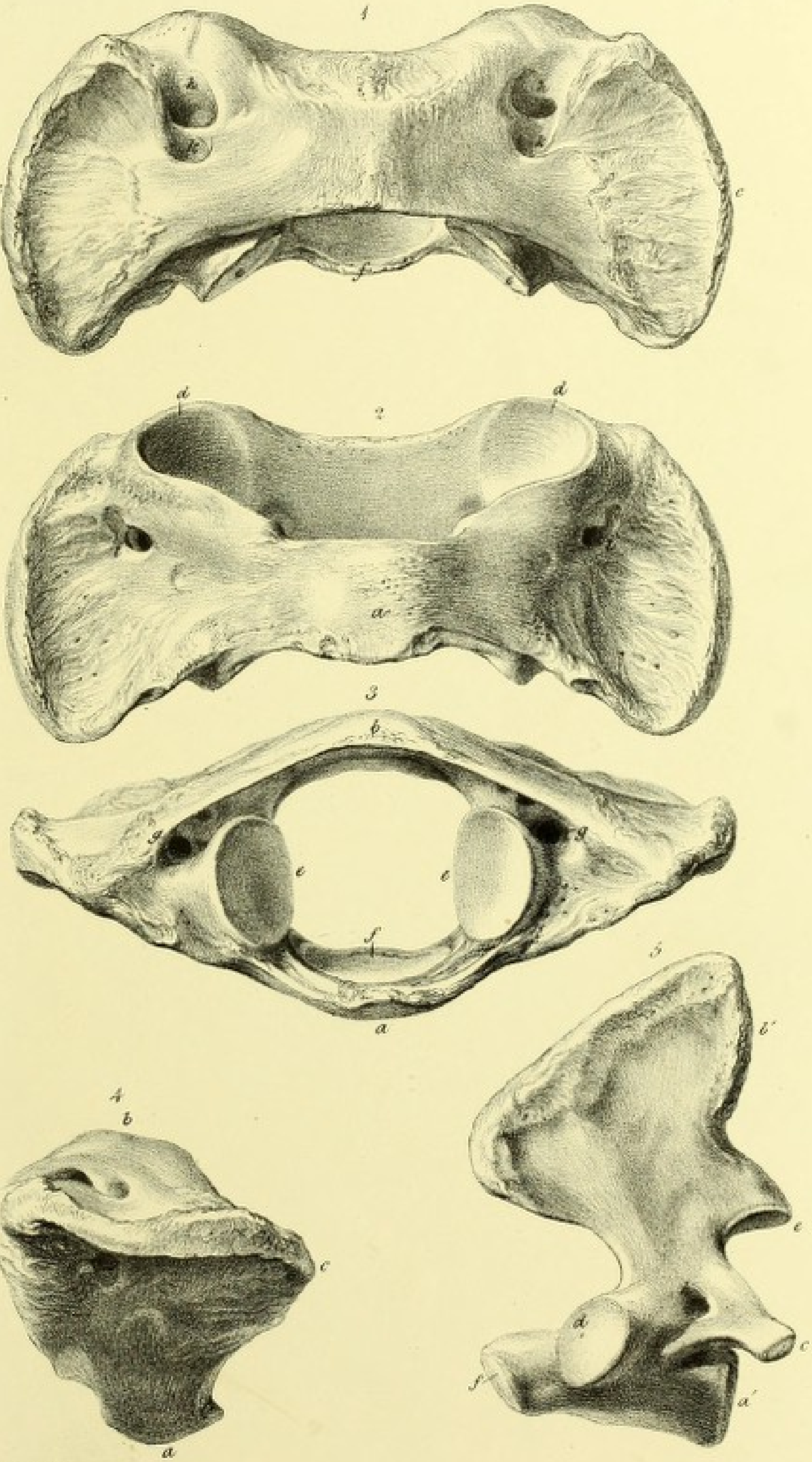
c. Transverse process.

d. Anterior articular process.

e. Posterior articular process.

f. Odontoid process.

Plate VII.



Lithog. from Nature by G. Scharf.

Printed by C. Hullmandel.

1. 4. Atlas. 5. Axis. 6 In. to a Foot.

PLATE VIII.

Dorsal and caudal vertebræ of *Mylodon robustus*, half the natural size.

Fig. 1. Front view of the eighth dorsal vertebra.

Fig. 2. Side view of the eighth dorsal vertebra.

Fig. 3. Upper view of the eighth dorsal vertebra.

Fig. 4. Under view of the eighth dorsal vertebra.

a. Anterior costal articular surface.

b. Posterior costal articular surface.

c. Superior costal articular surface on the transverse process.

d. Anterior articular processes.

e. Posterior articular processes.

Fig. 5. Hinder surface of the first caudal vertebra.

a. Hæmapophysial articular surfaces.

b. These letters are placed on the posterior articular surfaces of the hæmapophyses, or inferior vertebral plates, which remain ununited in the first caudal vertebra.

e. Posterior articular processes of the neurapophyses, here united as in ordinary cases to form the superior or neural arch.

Fig. 6. Front view of the neural arch of the first caudal vertebra.

d. Anterior articular processes.

Fig. 7. Upper surface of the first caudal vertebra.

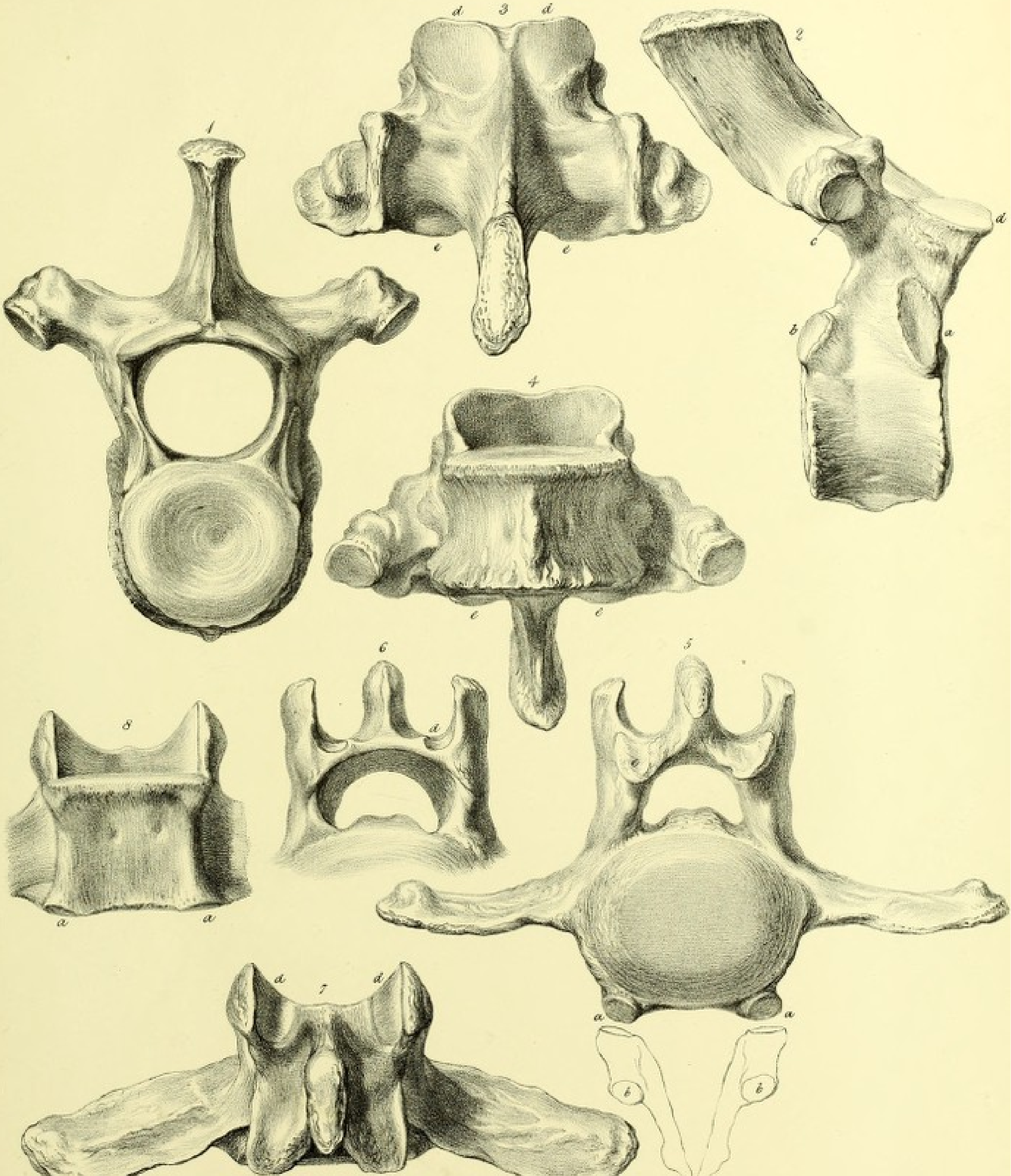
d. Anterior articular processes of the neural arch.

e. Posterior articular processes of the neural arch.

Fig. 8. Under surface of the second caudal vertebræ.

a, *a*. Posterior hæmapophysial articulations: the anterior articulations are on the opposite angles of the square surface of the body, which likewise shows the two vascular foramina.

Plate VIII.



Lithog. from Nature by G. Scharf.

Printed by C. Hullmandel.

1_4. Dorsal Vertebra. 5_8. Caudal Vertebra. 6 In. to a Foot.

PLATE IX.

Parts of the sternum and sternal ribs, half the natural size.

Fig. 1. The successive sternal bones are indicated by roman numerals, I. to VI., about two-thirds of the sternum being probably here exhibited from the internal or posterior aspect.

a. Anterior costal articular surface of the manubrium.

b. Contracted part supporting the posterior costal surfaces.

Fig. 2. External or anterior surface of the manubrium sterni.

c. Posterior costal surfaces.

Fig. 3. External or anterior view of the fourth and fifth sternal bones, showing the complex articulations of the extremities of the ossified sternal ribs therewith : one of these ribs is dislocated on the left side to show the four distinct surfaces, two separate and two approximate, on the contiguous angles of the anterior and posterior divisions of the conjoined sternal bones.

Fig. 4. A side-view of the fourth and fifth sternal bones.

a. Anterior costal surface of the outer tubercle or division.

a'. Posterior costal surface of the outer tubercle or division.

b. Anterior costal surface of the inner plate or division.

b'. Posterior costal surface of the inner plate or division.

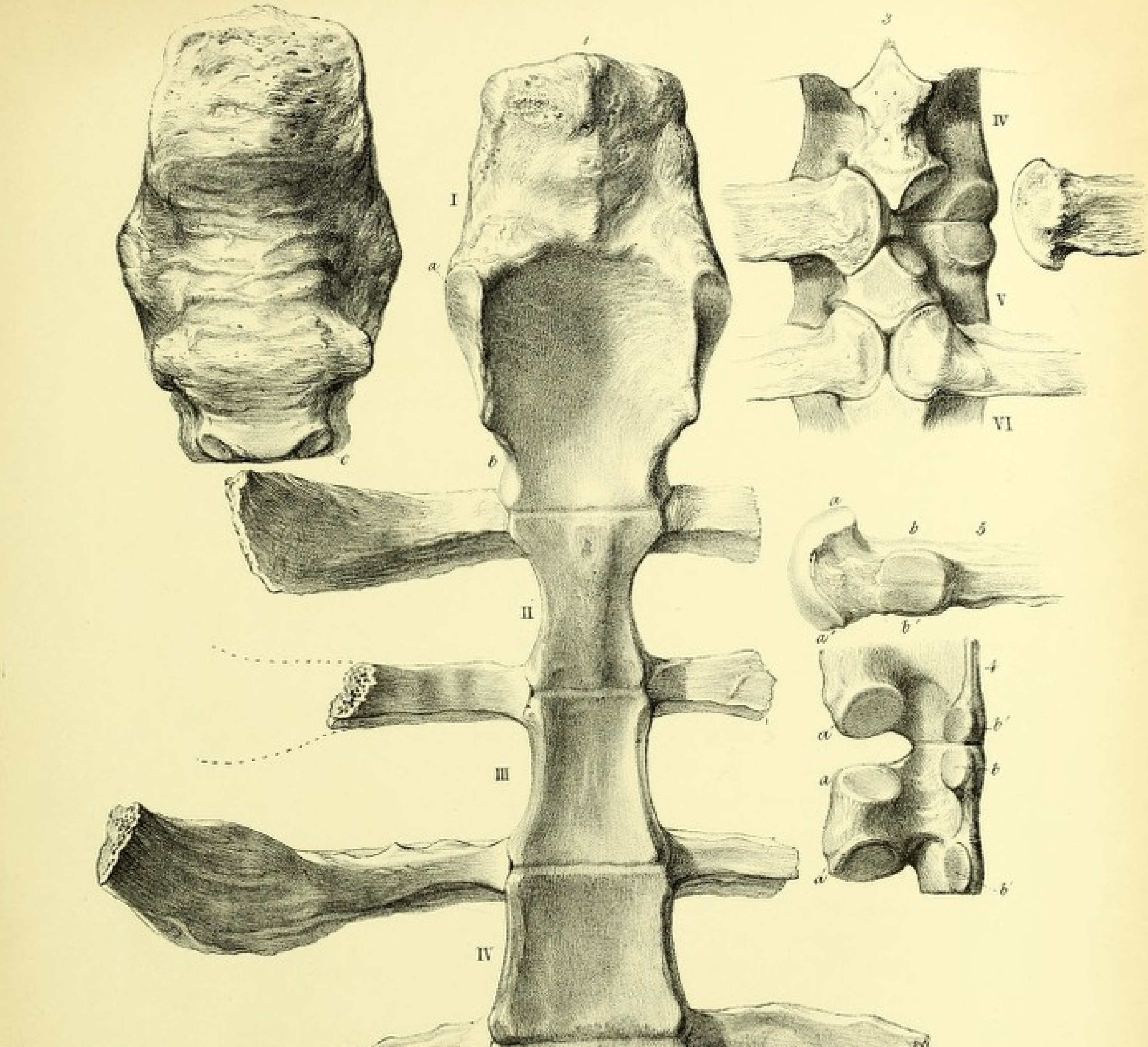
Fig. 5. Sternal end of the ossified sternal rib detached from its articulation with the preceding sternal bones.

a. Lower division of terminal articular surface, which joins with the surface *a* in fig. 4.

a'. Upper division of terminal articular surface, which joins with the surface *a'* in fig. 4.

b. Lower division of subterminal articular surface, which joins with *b* in fig. 4.

b'. Upper division of subterminal articular surface, which joins with *b'* in fig. 4.



Lithog. from Nature by G. Scharf. Printed by C. Hullmandel.

Sternum 6 Inches to a Foot

PLATE X.

Two views of the pelvis of the *Mylodon robustus*, rather more than one-sixth the natural size, or on the scale of two and a quarter inches to a foot.

Fig. 1. Upper surface of the pelvis with the anchylosed lumbar vertebræ and last dorsal vertebra.

The proper sacral vertebræ are numbered 1 to 7; the three lumbar vertebræ are numbered 8, 9, 10; the last or sixteenth dorsal is numbered 11 and *d* 16.

Fig. 2. Hinder surface of the pelvis, showing the form of the outlet.

a. Anchylosed rib of the sixteenth pair: a style is represented as passing through the interspace between its neck and tubercle, here converted into a foramen.

b. Superior anterior articular or oblique process of the last dorsal vertebra.

c. Transverse process of the first lumbar vertebra.

d. Transverse process of the second lumbar vertebra. These, with the corresponding process of the third lumbar, are developed into a broad thin bony plate confluent with each other, and with the iliac labrum.

e. Sacro-ischiadic foramina.

f. Ischiadic tuberosities confluent with the sacrum.

g. Bony crest formed by the confluent spines of the lumbar and sacral vertebræ.

h. Canal intercepted by the spinous crest and the oblique or articular processes of the sacrum.

i. Confluent extremities of the transverse or costal processes of the sacrum, forming the outer boundary of the wider canal between them and the oblique processes.

k, k. Foramina for the posterior divisions of the sacral nerves opening into the foregoing canal.

l, l. Labrum of the ilium bent forwards.

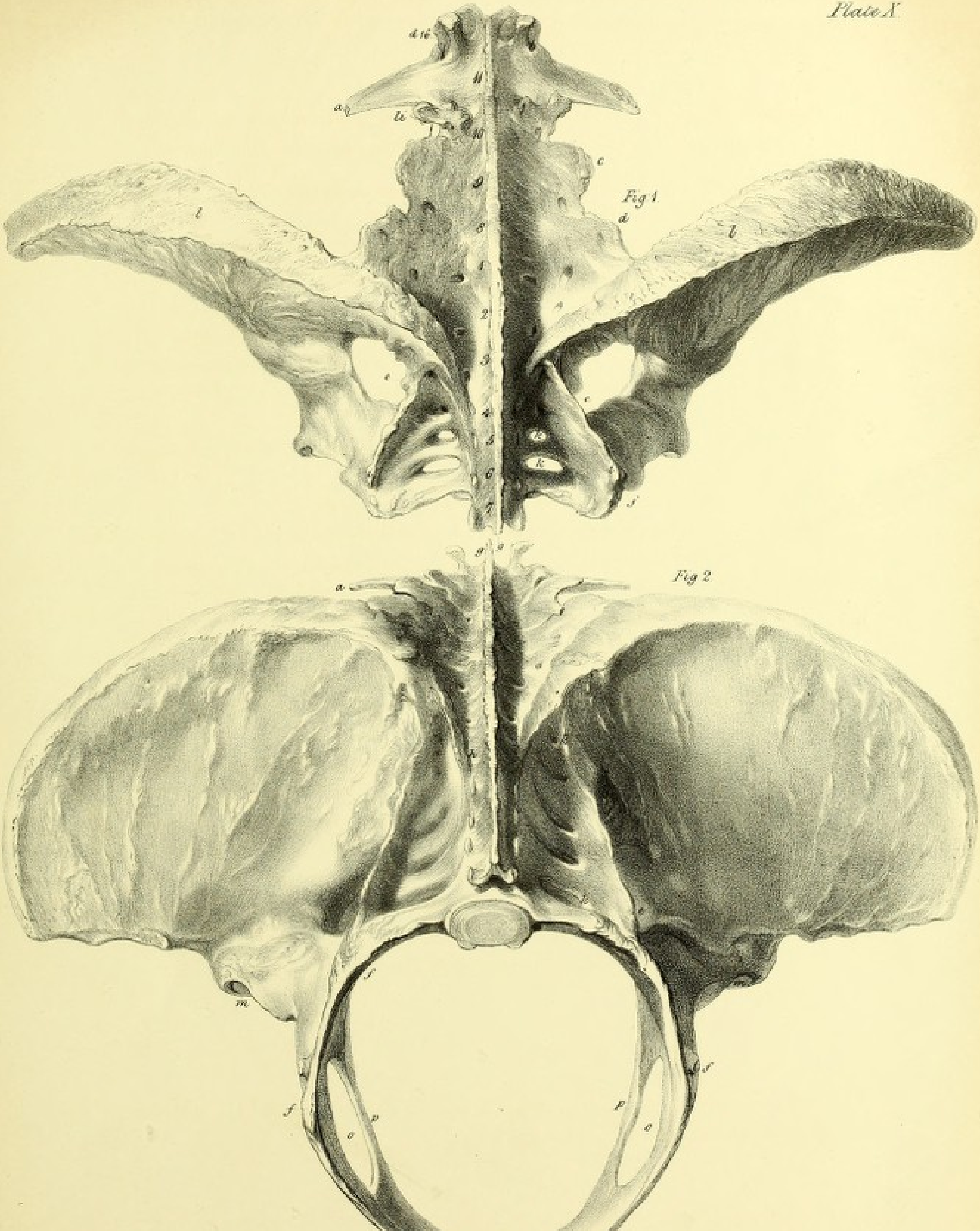
m, m. Acetabula.

n. Symphysis pubis.

o. Obturator foramina.

p. Pubic bones.

The bones of the *Mylodon robustus*, figured in Plates XI. to XXII. inclusive, are reduced one-half the natural size.



Lithog from Nature & on stone by G. Scharf.

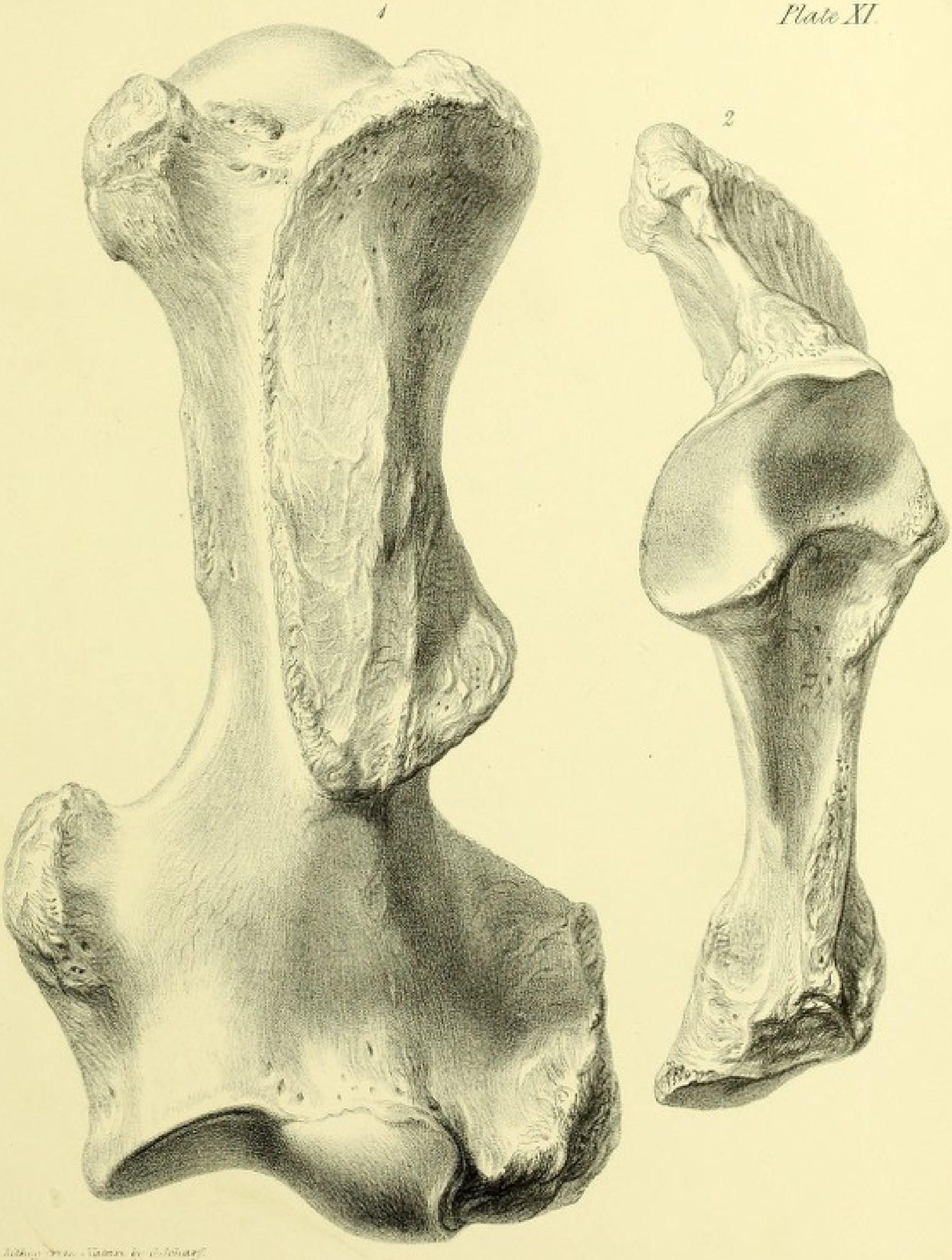
Printed by C. Hullmandel.

Upper and back Views of the Pelvis.
2 and 1/4 Inches to a Foot.

PLATE XI.

Fig. 1. Front view of the humerus.

Fig. 2. Front view of the ulna.



Lithog. from Nature by [illegible] Sharp.

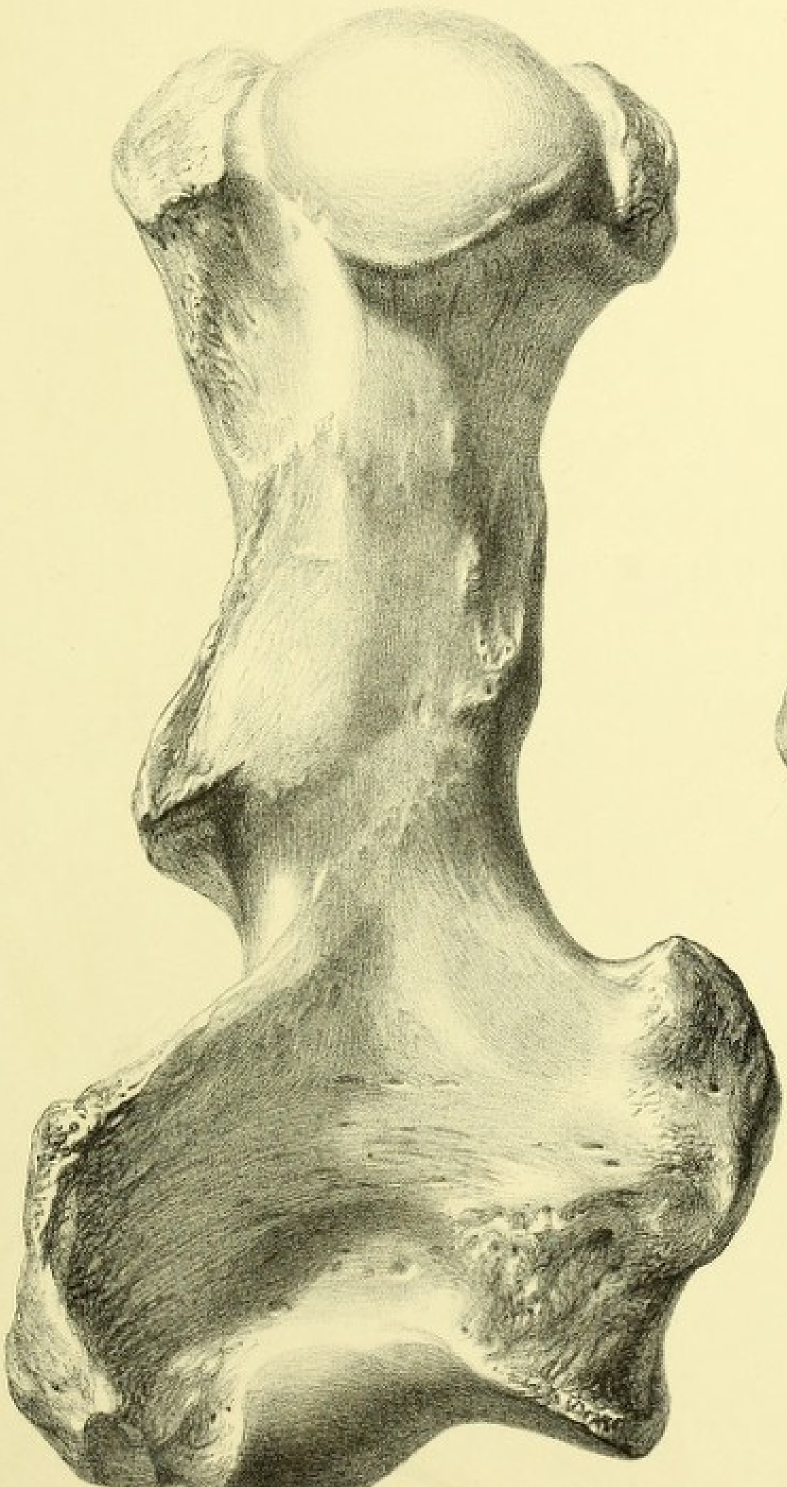
Humerus and Ulna. 6 Inches to a foot.

PLATE XII.

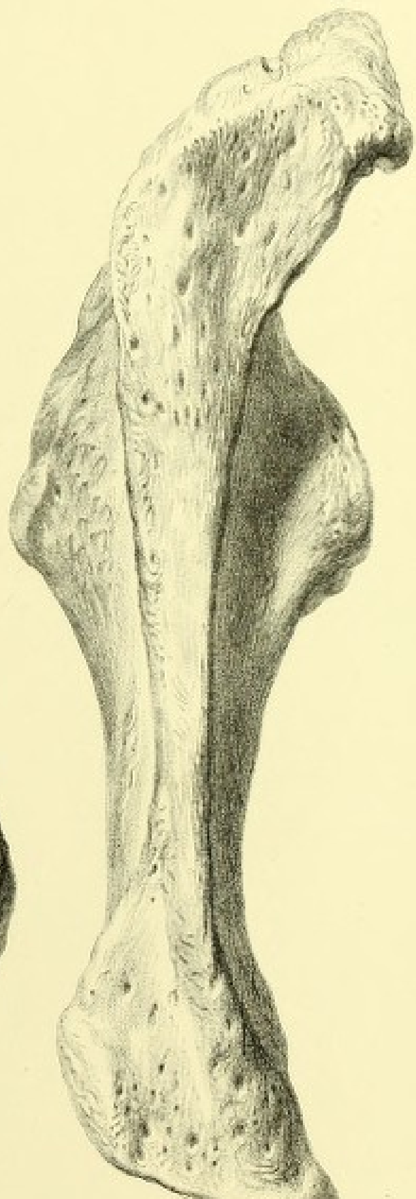
Fig. 1. Back view of the humerus.

Fig. 2. Back view of the ulna.

1



2



Lithog from Nature by G. Scharf

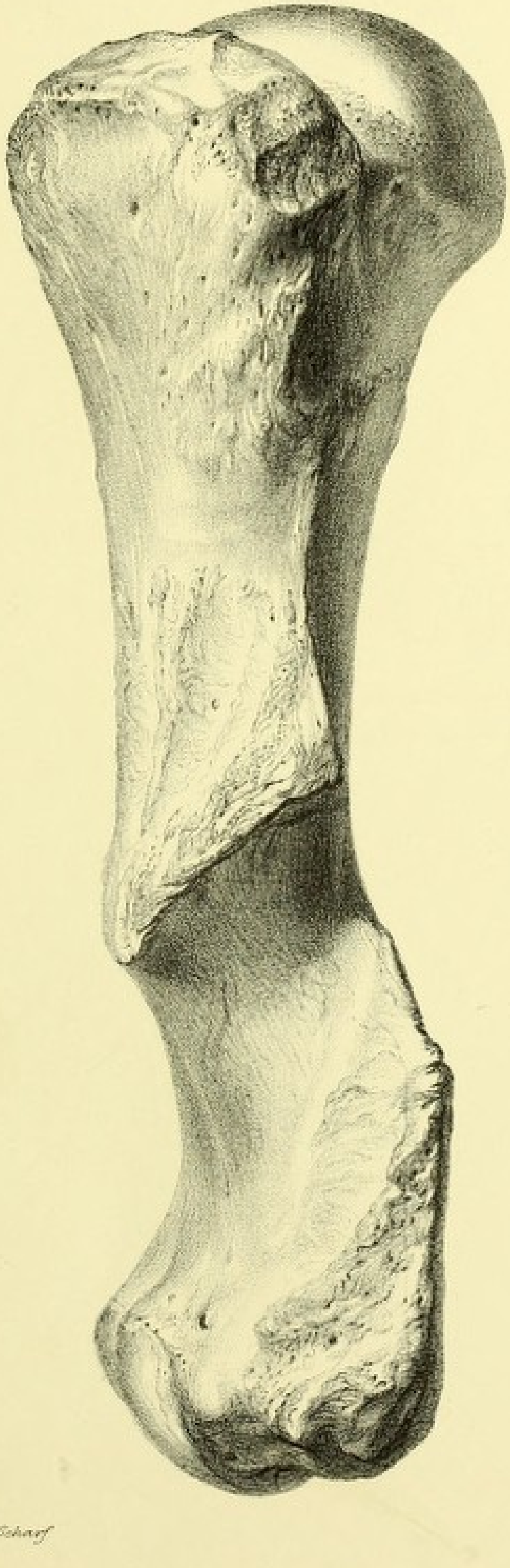
Printed by C. Hullmandel

Humerus and Ulna 6 Inch to a Foot

PLATE XIII.

Fig. 1. Outer or radial view of the humerus.
Fig. 2. Outer or radial view of the ulna.

1



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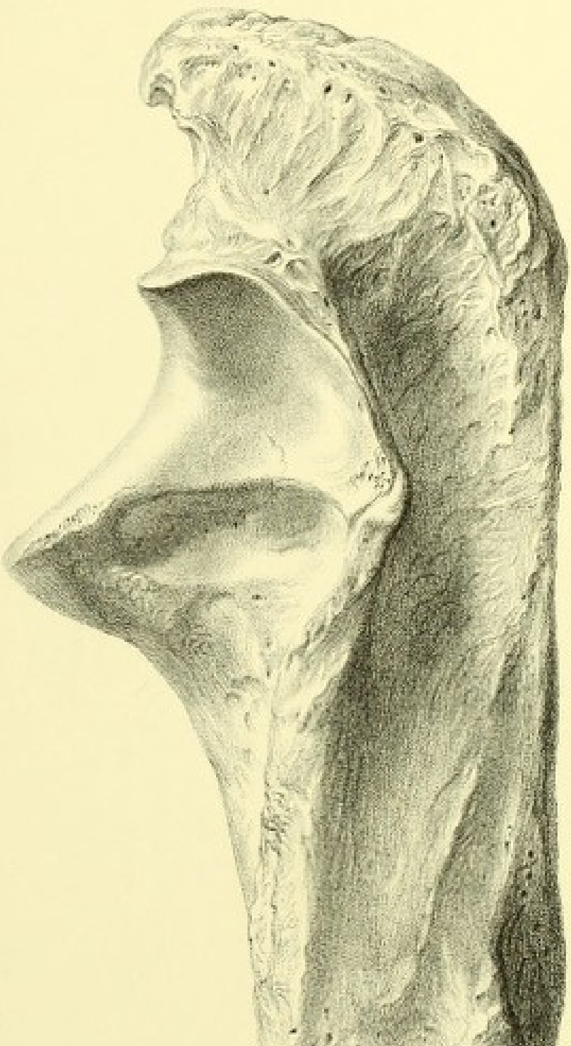


Lithog. from Nature by G. Scharf

Printed by C. Hullmandel

Humerus and Ulna 6 Inches to a Foot

PLATE XIV.

Fig. 1. Proximal articular extremity, or head of the humerus.

Fig. 2. Distal articular extremity, or condyles of the humerus.
- *a*. Flat ulnar condyle.
- *b*. Convex radial condyle.

Fig. 3. Ulna, with fig. 5, radius, articulated therewith, and rotated so as to present its outer margin to view.

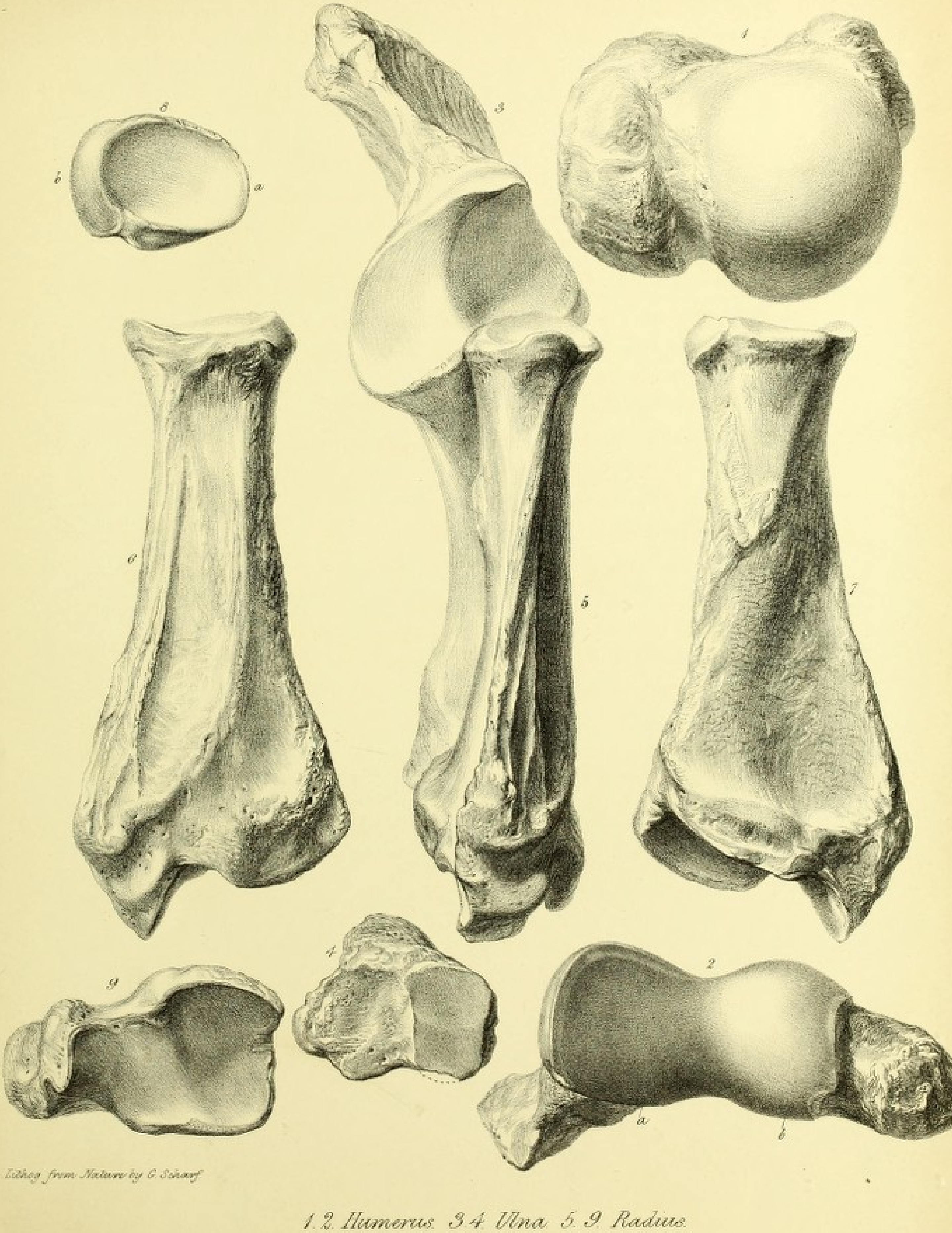
Fig. 4. Distal articular extremity of the ulna.

Fig. 6. Back view of the radius.

Fig. 7. Front view of the radius.

Fig. 8. Proximal articular extremity of the radius.
- *a*. Concavity applied to the condyle of the humerus.
- *b*. Convexity lodged in the small sigmoid cavity of the ulna.

Fig. 9. Distal articular surface of the radius.



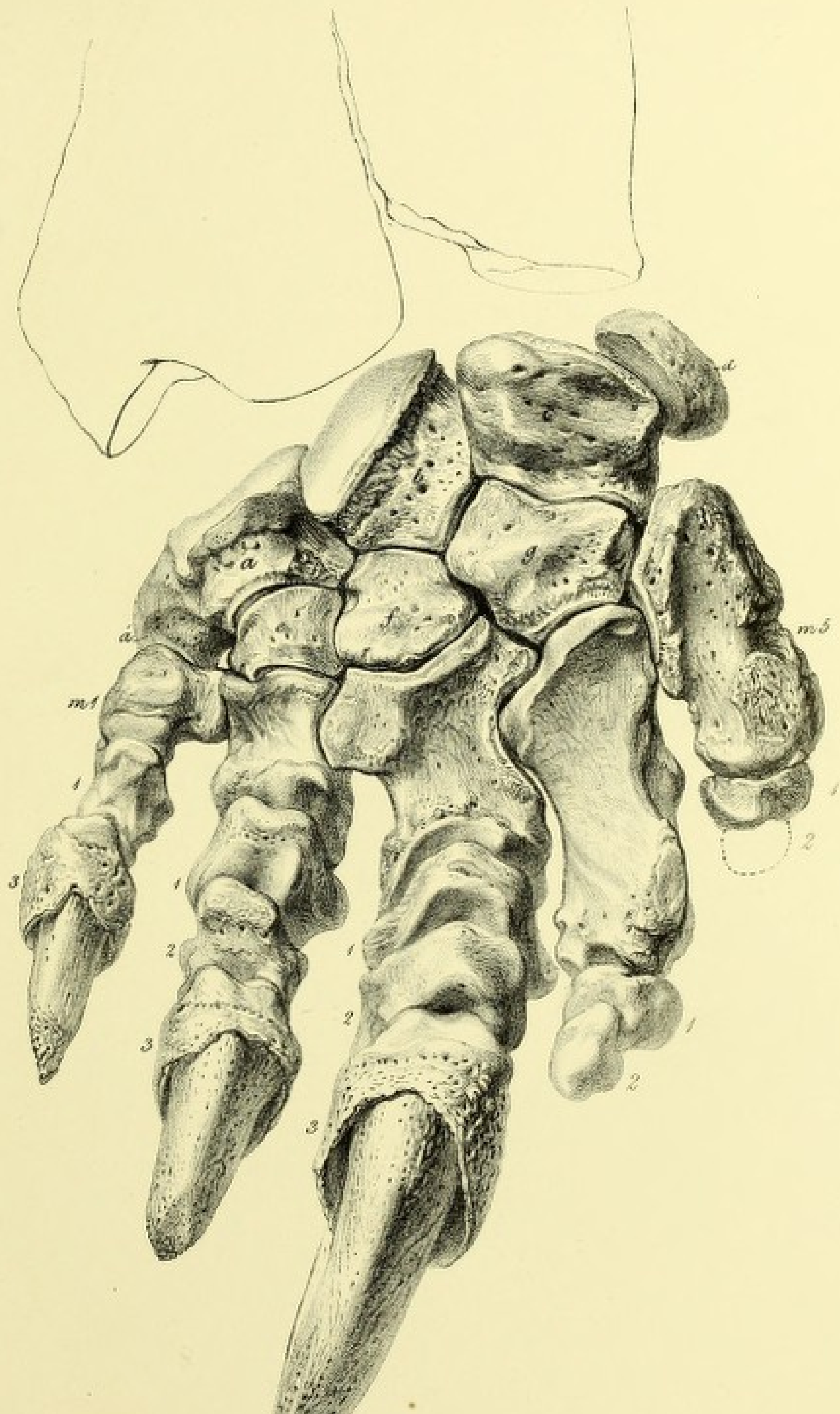
Lithog. from Nature by G. Scharf.

1. 2. Humerus. 3. 4. Ulna. 5. 9. Radius.

6 Inches to a Foot.

PLATE XV.

Upper, or anconal surface of the bones of the left fore-foot.



Lithog. from Nature by G. Scharf

Left Fore-foot, prone.

6 Inches to a foot.

PLATE XVI.

Under, or palmar surface of the bones of the left fore-foot.

a. Scaphoidal, *a′* trapezial portion of the scapho-trapezial bone.

b. Lunare.

c. Cuneiforme, or os triquetrum.

d. Pisiforme.

e. Trapezoides.

f. Os magnum.

g. Unciforme.

m 1. First metacarpal, or of the pollex.

m 5. Fifth metacarpal, or of the minimus: those of the index, medius and annularis are recognizable by their position.

1. Proximal phalanx.

2. Middle phalanx.

3. Distal or ungual phalanx.

Lithog. from Nature by G. Scharf.

Left Fore-foot, supine.
6 Inches to a Foot.

PLATE XVII.

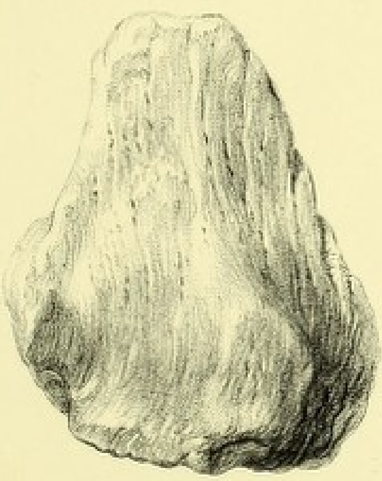
Fig. 1. Front view of the left femur.

Fig. 2. Front view of the left patella*.

* The upper end of the patella has inadvertently been figured downwards.

1

2



Lithog. from Nature by G. Scharf.

Femur and Patella.
6 Inches to a Foot.

PLATE XVIII.

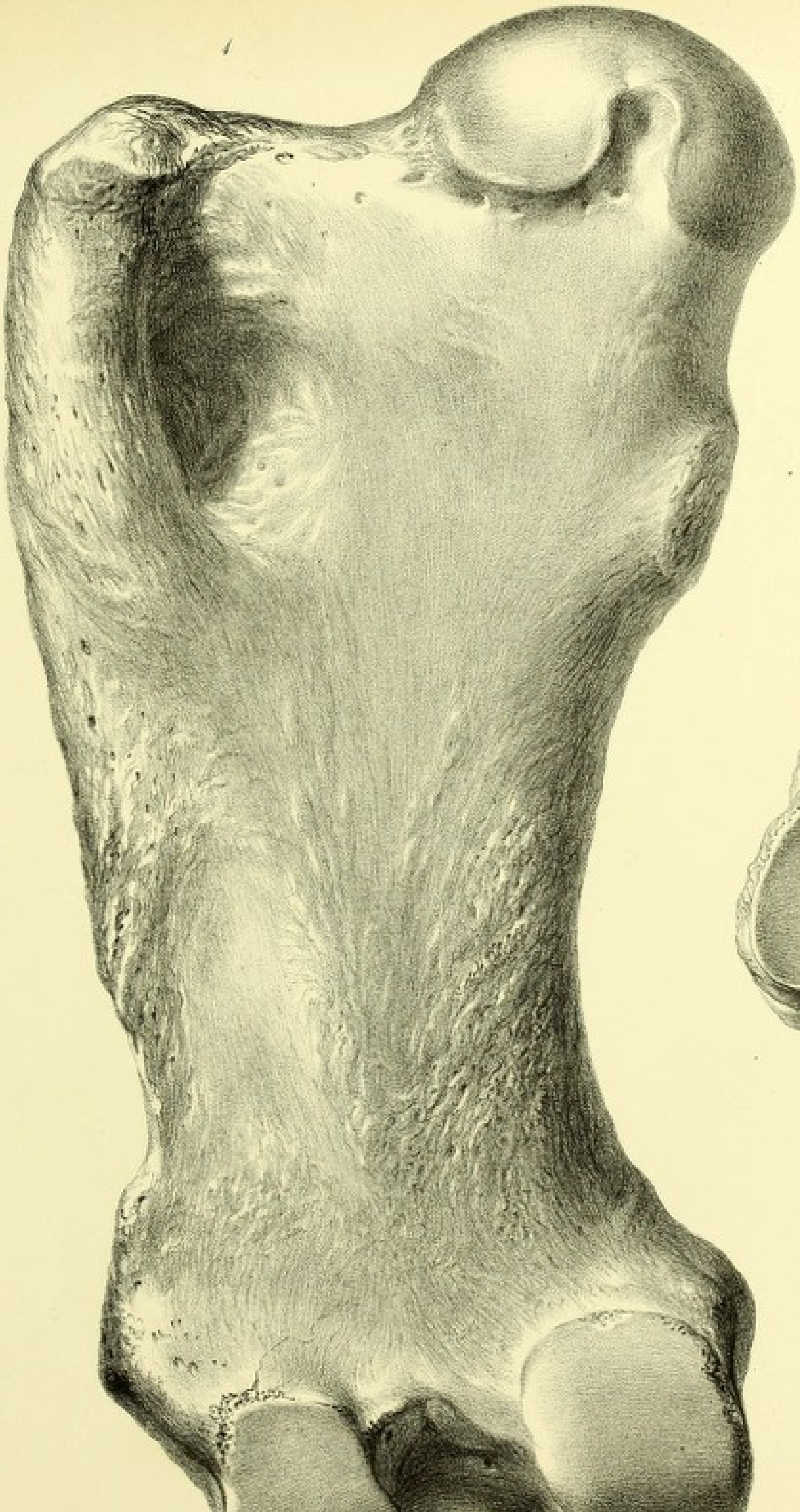
Fig. 1. Back view of the left femur.

Fig. 2. Back view of the left patella*.

* The upper end of the patella has inadvertently been figured downwards.

Plate XVIII.

1



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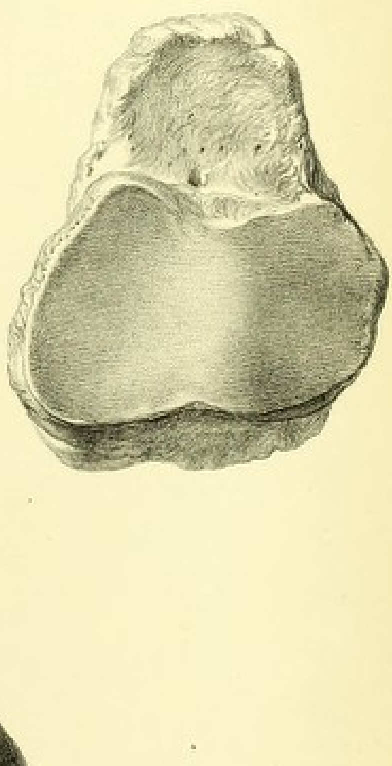


Lithog from Nature by G. Scharf

Femur and Patella.

6 Inches to a Foot.

PLATE XIX.

Fig. 1. Outer or fibular view of the left femur.

Fig. 2. Proximal end of the left femur.

a. Depression for the ligamentum teres.

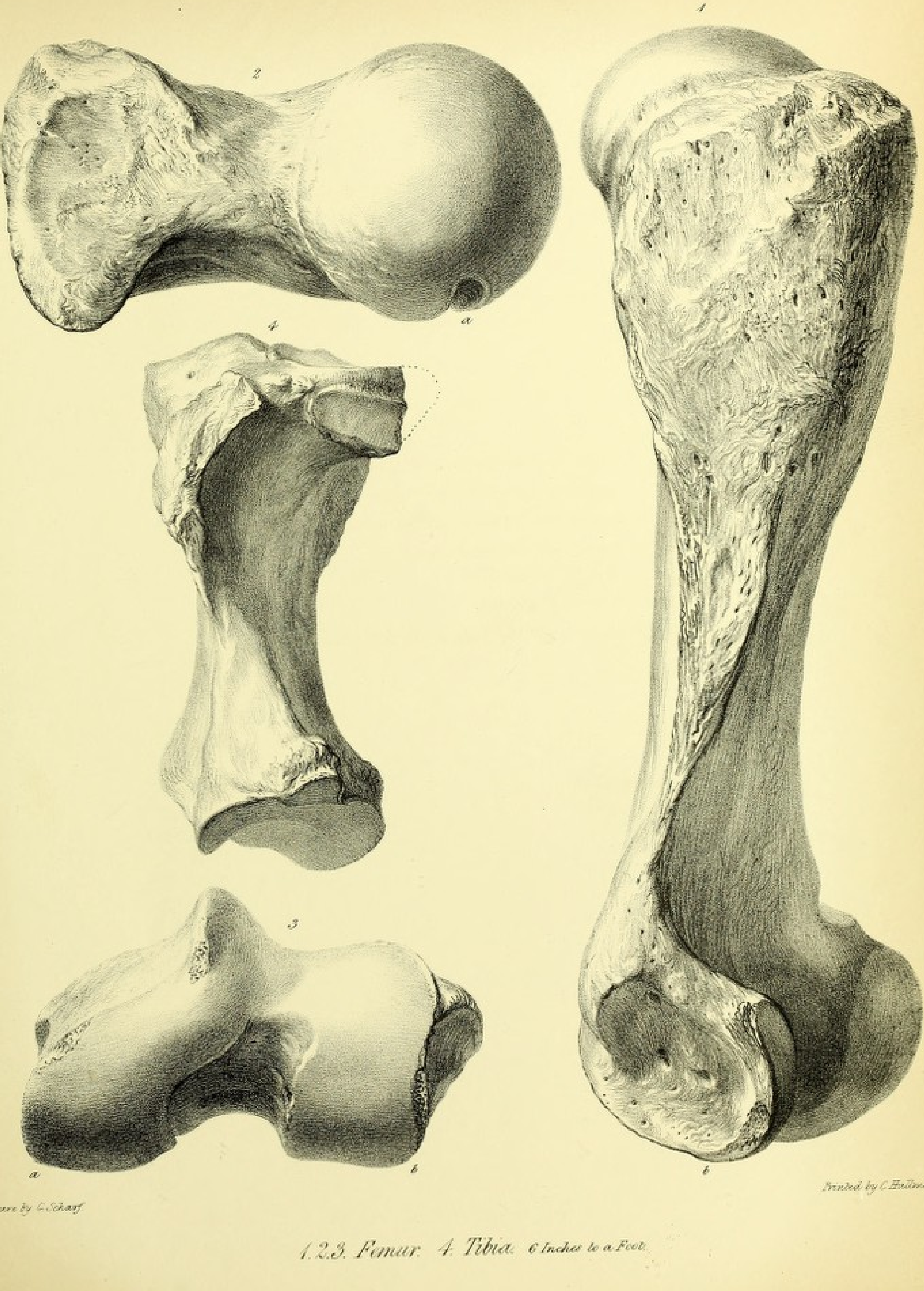
Fig. 3. Distal end of the left femur.

a. The inner condyle.

b. The outer condyle.

Fig. 4. Outer or fibular view of the left tibia.

Plate XIX.



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1. 2. 3. Femur. 4. Tibia. 6 Inches to a Foot.

PLATE XX.

Fig. 1. Front view of the bones of the left leg.

Fig. 2. Back view of the left tibia.

Fig. 3. Proximal end of the left tibia.

Fig. 4. Distal end of the left tibia.

Fig. 5. Inner or tibial view of the left fibula.

a. Articular surface for the inner condyle of the femur.

b. Articular surface for the outer condyle of the femur.

b'. Articular surface for the popliteal patella or sesamoid bone.

c. Articular surface for the head of the fibula.

d. Articular surface for the articular surface *g*, near the distal end of the fibula.

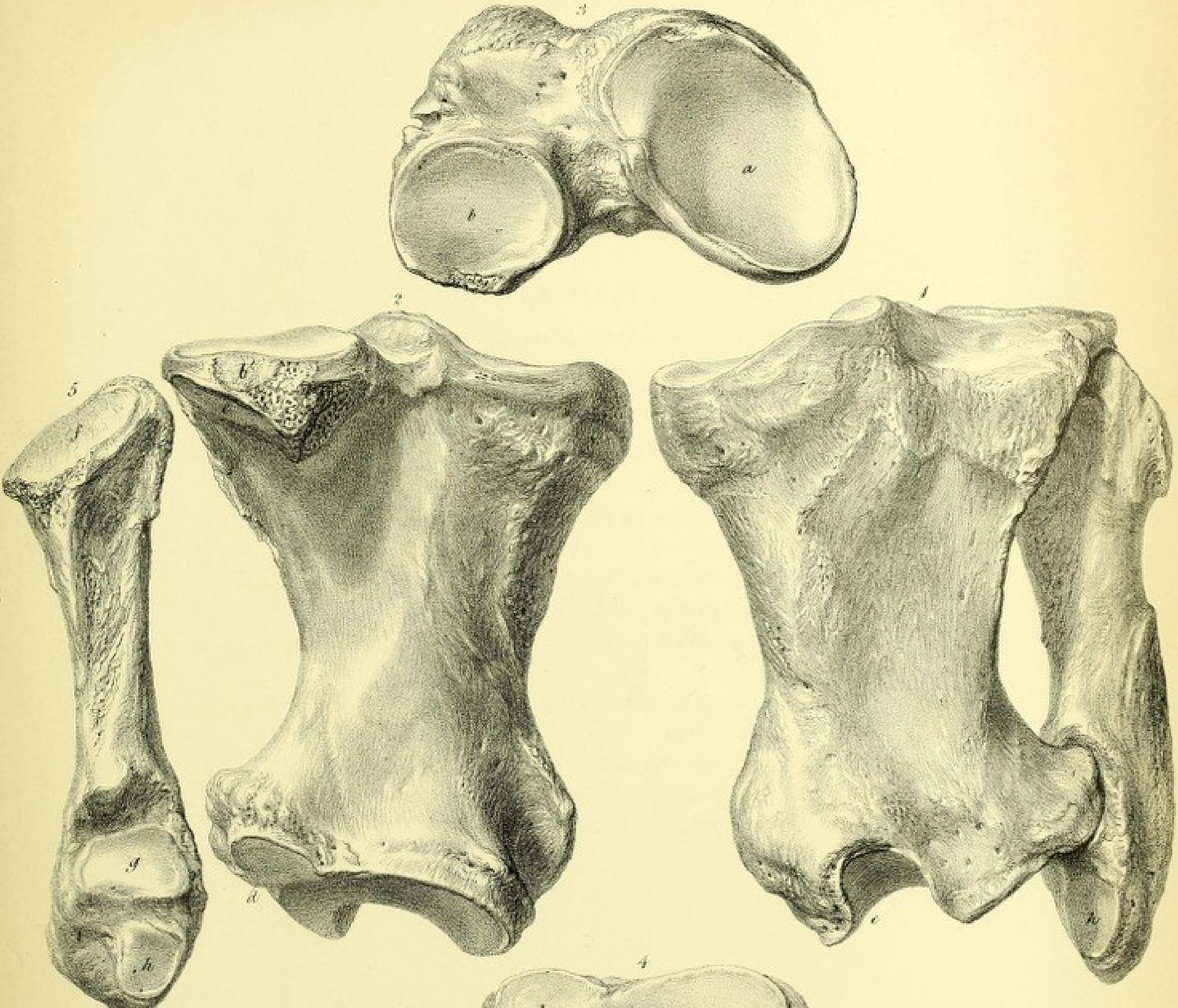
e. Deep astragalar excavation at the fore and inner part of the distal joint of the tibia.

f. Proximal articular surface of the fibula.

g. Distal articular surface for the tibia.

h. Malleolar articular surface for the astragalus.

Plate XX

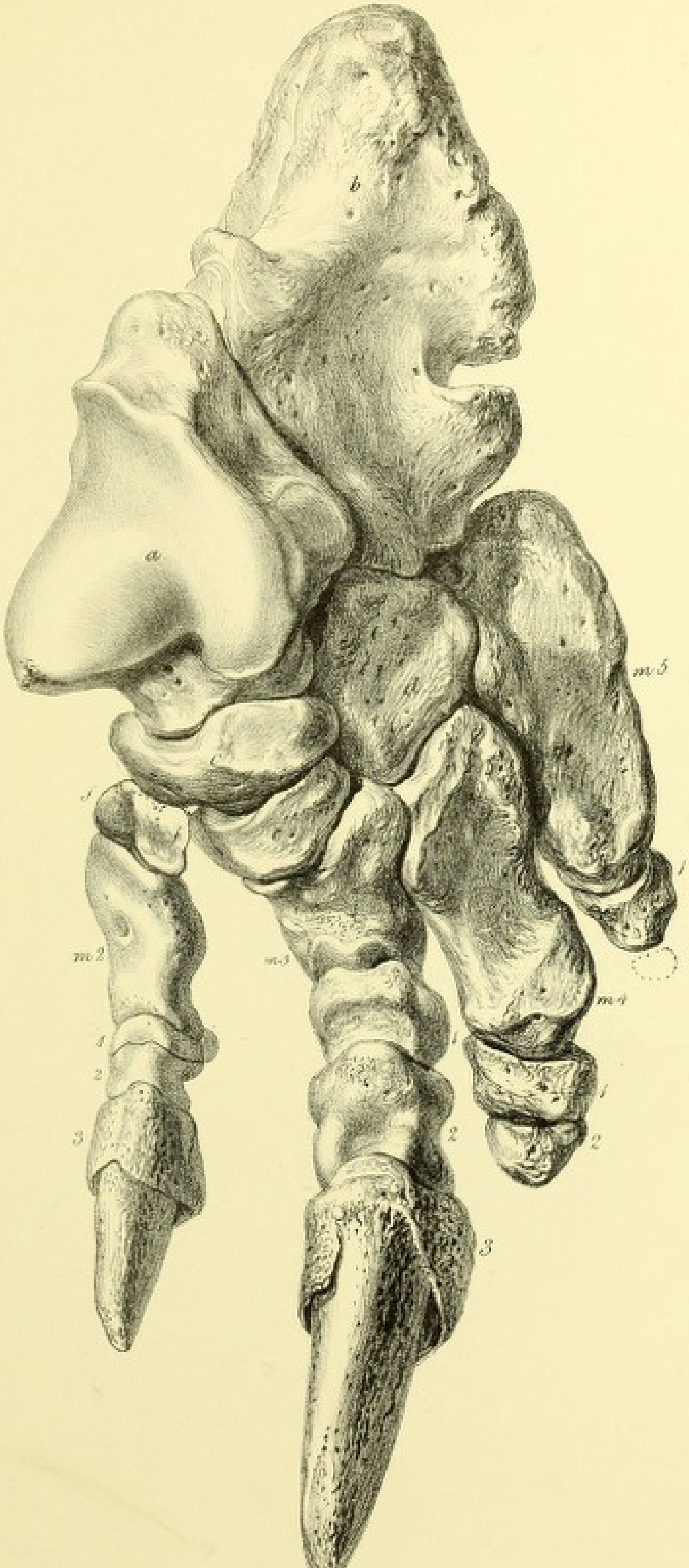


Lithog from Nature by G. Scharf

Tibia & Fibula 6 In to a Foot

PLATE XXI.

Upper surface of the bones of the left hind-foot.



Lithog. from Nature by G. Scharf. Printed by C. Hullmandel.

Left Hind Foot. Upper Side.

6 Inches to a Foot.

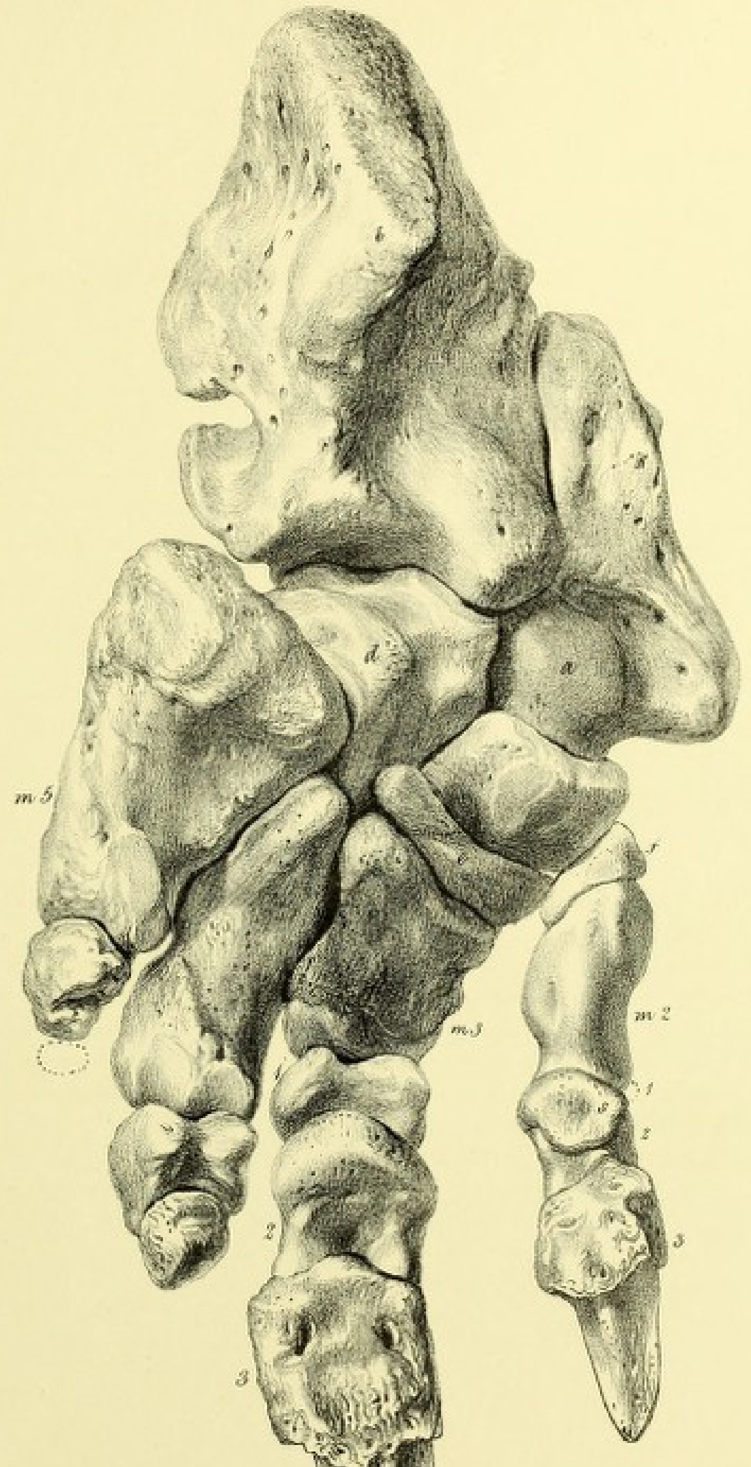
PLATE XXII.

Under surface of the bones of the left hind-foot.

a. Astragalus.
b. Calcaneum*.
c. Naviculare.
d. Cuboides.
e. External cuneiforme.
f. Second, here the internal, cuneiforme.
m 2. Second, here the internal, metatarsal†.
m 3. Third or middle metatarsal.
m 4. Fourth metatarsal.
m 5. Fifth or external metatarsal.
1. Proximal phalanx.
2. Middle or second phalanx.
3. Distal or ungual phalanx.

* In the comparison of the os calcis of the Mylodon, p. 132, the following characters of that of the Megalonyx have been omitted: it differs from the scaolcis of the Mylodon and agrees with that of the Megatherium in having the surface for the astragalus separated into two by an intervening rough tract; it differs from both in having the cuboidal surface separated from the astragalar surface by a deep groove; but the calcaneum of the Megalonyx is most remarkable for the form of the great posterior projection, which is much compressed, and expands into a broad vertical plate of bone; thus resembling the os calcis of the Sloths more than that of the Megatherium or Mylodon, but differing from that of the Sloths in its greater depth and less length.

† The first metatarsal, or that of the hallux, is not developed.



Lithog. from Nature by G. Scharf.

Printed by C. Hullmandel.

Left Hind Foot. Under Side.

6 Inches to a Foot.

PLATE XXIII.

Astragalus in different genera of Megatherioids, one-third the natural size.

Fig. 1. Upper surface of the astragalus of the *Mylodon robustus*.

Fig. 2. Under surface of the astragalus of the *Mylodon robustus*.

Fig. 3. Upper surface of the astragalus of a Megalonyx?

Fig. 4. Under surface of the astragalus of a Megalonyx?

Fig. 5. Upper surface of the astragalus of the Megatherium.

Fig. 6. Under surface of the astragalus of the Megatherium.

Fig. 7. Upper surface of the astragalus of the *Scelidotherium leptocephalum*.

Fig. 8. Under surface of the astragalus of the *Scelidotherium leptocephalum*.

a. External trochlear convex ridge of the tibial articular surface.

b. Internal tuberosity of the tibial articular surface.

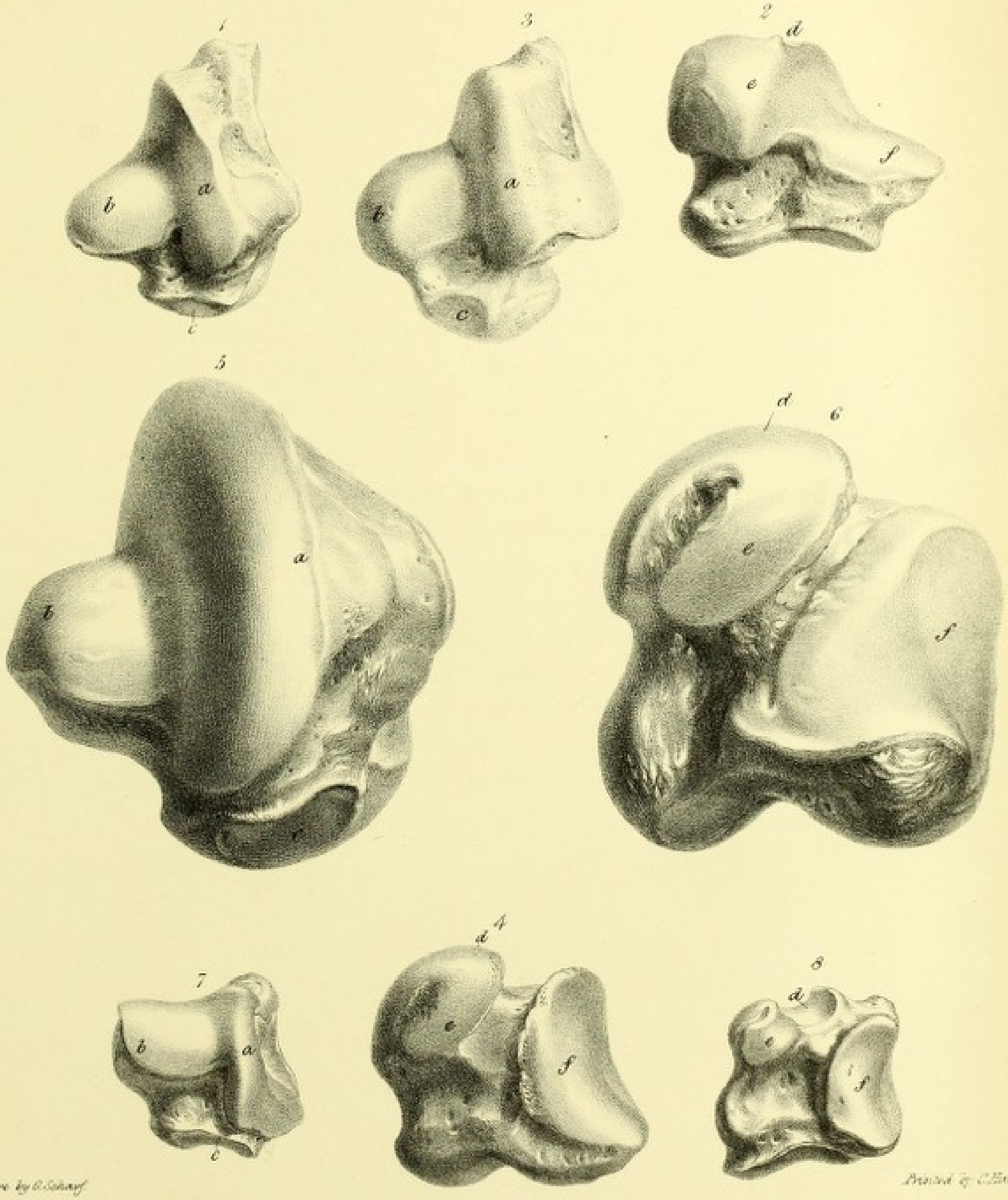
c. Upper portion of the navicular articulation.

d. Cuboidal articulation.

e. Anterior part of calcaneal articulation.

f. Posterior part of calcaneal articulation.

Plate XXIII.



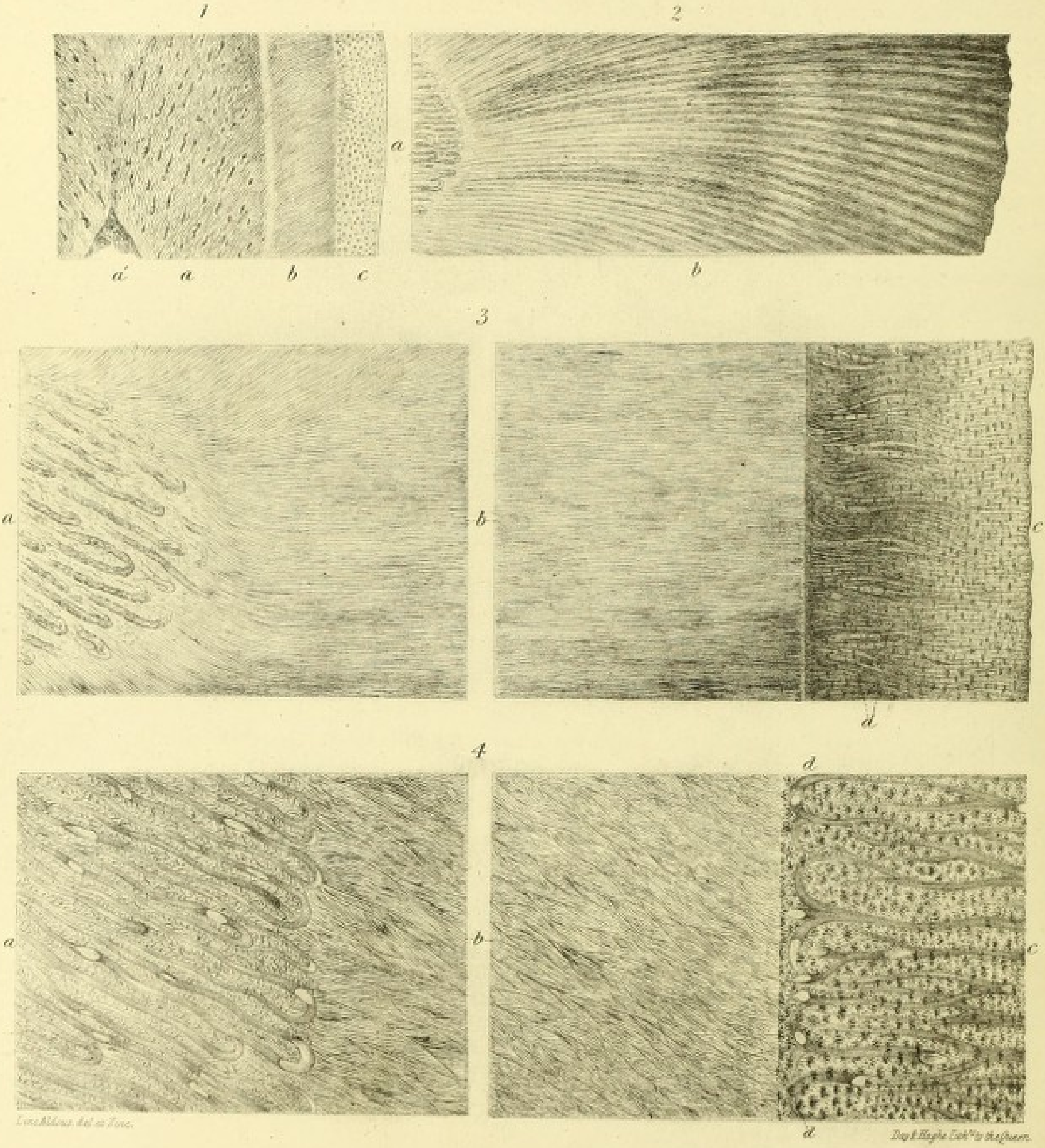
Lithog. from Nature by G. Scharf.

Printed by C. Hullmandel.

Astragalus. 4 In. to a Foot.

1 & 2. Mylodon. 3 & 4. Megalonyx. 5 & 6. Megatherium. 7 & 8. Scelidotherium.

Plate XXIV.



Structure of the Teeth.
1. Bradypus. 2.3. Mylodon. 4. Megatherium.

PLATE XXIV.

Reduced views of highly magnified sections of the teeth, showing their characteristic structure in existing and extinct Phyllophagous Bruta.

Fig. 1. A portion of a longitudinal section, including rather more than one-half of the breadth of the tooth of the three-toed Sloth (*Bradypus tridactylus*), seen with a magnifying power of 250 linear dimensions.

a'. The apex of the persistent pulp-cavity.

a. The central constituent of the tooth called vascular dentine. The dark oblong spots represent oblique sections of the vascular or medullary canals, which are between $\frac{1}{600}$th and $\frac{1}{800}$th of an inch in diameter, with intervals of twice or thrice that breadth: these canals proceed in a slightly undulating and subparallel course from the internal to the external surface of the vascular dentine, and contain processes of the pulp. Those which proceed from the summit of the pulp are parallel or nearly so with the long axis of the pulp, whilst those from the base of the pulp are transverse to that axis: the intermediate canals have an intermediate course. They everywhere send off minute calcigerous tubes, and terminate for the most part by splitting up into a pencil of smaller wavy branches, close to the hard dentine, the calcigerous tubes of which are formed by the ultimate subdivision of those branches.

b. The hard or unvascular dentine: it has the same general structure as the ordinary dentine or tooth-bone of the human teeth, consisting of a clear substance permeated by fine calcigerous tubes.

c. The cæmentum. The thickness of this layer does not quite equal that of the hard dentine. It is principally characterized by the numerous minute calcigerous cells which are represented by the dots in the figure. These cells present a more or less oblong form, with the long axis parallel with that of the tooth: their average diameter is $\frac{1}{3000}$th of an inch in the long diameter by $\frac{1}{1000}$th of an inch in the short diameter. The cement is traversed by numerous fine calcigerous tubes continued in many parts from those of the hard dentine, but having a less regular course, which is however generally at right angles to the surface: they terminate principally in minute branches, which form a rich plexus around the calcigerous cells with which they communicate.

Fig. 2. A portion of the hard dentine of a tooth of the *Mylodon robustus*, as viewed with a power of 250 linear dimensions, showing the terminal loops of the medullary canals of the soft dentine at *a*, and the fasciculate appearance which the minute calcigerous tubes present when decomposition and carbonization have proceeded to a certain extent.

Fig. 3. A thin transverse slice of a tooth of the *Mylodon robustus*, as viewed with a power of 400 linear dimensions, including the hard dentine *b*, with a portion of the vascular dentine *a*, and a portion of the cement *c*. These three substances enter into the composition of the teeth of the Mylodon in the same relative position, and nearly in the same proportions as in the Sloth: the layer of hard dentine is rather thicker relatively to the other constituents. The central axis of vascular dentine differs from that in the Sloth by the anastomoses of the medullary canals by loops, near the hard dentine, towards which their convexities are directed, as in the figure. The cement differs from that in the Sloth by being traversed by vascular canals (*d*), which are directed towards the outer surface of the hard dentine, near which they are most conspicuous: they are fewer in number than the corresponding canals of the vascular dentine, and do not form loops. The radiated calcigerous cells are as numerous as in the cement of the Sloth, but have a rather more elongated form, with the long axis parallel with that of the tooth. The cement in the Mylodon is likewise traversed by numerous and close-set calcigerous tubes continued from those of the dentine, with a general direction transversely to the surface of the cement, but with a more wavy and less parallel course, with more frequent bifurcations and more numerous branches, the tortuous subdivisions of which open in great numbers into the calcigerous cells.

Fig. 4. A slice of a tooth of a Megatherium, as viewed with a power of 500 linear dimensions. The teeth in this animal are composed, as in the Sloth and Mylodon, of a central axis of vascular dentine *a*, surrounded by a layer of unvascular dentine *b*, and a coating of cement *c*; and differ principally in the great relative thickness of that outer covering, which equals half the thickness of the vascular dentine, and is six times thicker on the anterior and posterior sides of the tooth than the layer of unvascular dentine. The vascular canals which traverse the cement are more numerous than in the Mylodon, and after branching dichotomously in their course from the outer to the inner surface of the cement, terminate at the inner surface by anastomosing in loops the convexity of which is turned towards the hard dentine. The vascular system of the cement is thus very similar to that of the vascular dentine, but the cement is distinguished by the presence of the radiated calcigerous cells, which in number and arrangement resemble those of the cement in the Mylodon and Sloth, but have a less elongated elliptic figure. The vascular dentine in the Megatherium closely corresponds in intimate structure with that of the Mylodon. The fine calcigerous tubes of the unvascular dentine more frequently bifurcate in their course towards the cement, but the artist has rather exaggerated this character in the figure. The teeth of the Scelidotherium and Megalonyx, which I have examined microscopically, agree in all their essential characters with those of the Sloth, Megatherium and Mylodon, and most nearly resemble in their minor modifications those of the latter genus, but have a greater proportion of hard dentine. The large central axis of vascular dentine, and the thick peripheral layer of cement, with the thin intervening layer of hard or ordinary dentine, are peculiar to the phyllophagous family of the order Bruta.

The modifications of this characteristic dental structure which the extinct members of the family have brought to light, give the plainest and most striking demonstration of the vital activity which once pervaded every part of their teeth. Red blood freely circulated through the vascular dentine and the cement, and the vessels of both substances communicated with each other by a few similar canals, which traversed the hard dentine. With respect to those minute and more important tubes which are the chief constituent of the unvascular dentine, and which pervade the interspaces of the vascular canals in the vascular dentine and cement, they form one continuous and inter-communicating system of vessels, by which the colourless plasma of the blood was distributed throughout the tooth for its nutrition and maintenance in a healthy state.

THE END.

PRINTED BY RICHARD AND JOHN E. TAYLOR,
RED LION COURT, FLEET STREET.

ERRATA.

P. 155. *For* " Both these characteristics coexisted in the Megatherium, the size of the proboscis being diminished," *read* " Both a prehensile tongue and proboscis, but of moderate size, coexisted in the Megatherium."

In note to Description of Pl. XXII. *for* " caolcis " *read* " os calcis."