

in tint on the chest, breast, and under tail-coverts; bill brown, whitish on the lower margin and on the under mandible; no ring round the eye; ear-coverts and sides of the face like the head.

Length of skin 3·7 inches, wing 2·5, tail 1·9, tarsus 0·7; bill from forehead 0·5, from anterior margin of nasal groove 0·3, from gape 0·6.

The flank-plumes are rather elongated and somewhat decomposed.

Hab. Aru Islands?

April 18, 1882.

Prof. Flower, LL.D., F.R.S., President, in the Chair.

The following report on the additions to the Society's Menagerie during the month of March 1882 was read by the Secretary:—

The total number of registered additions to the Society's Menagerie during the month of March 1882 was 54, of which 26 were by presentation, 16 by purchase, 3 by birth, and 9 were received on deposit. The total number of departures during the same period, by death and removals, was 81.

The most noticeable addition during the month was:—

A Radiated Fruit-Cuckoo (*Carpococcyx radiatus*) from Sumatra, purchased March 31st.

The gait and actions of this remarkable Ground-Cuckoo remind one more of a Gallinaceous bird or a Gallinule than of any of its arboreal relatives of the same family. The form is quite new to the Society's Collection.

The following papers were read:—

1. On the Mutual Affinities of the Animals composing the Order EDENTATA. By WILLIAM HENRY FLOWER, LL.D., F.R.S., Pres. Zool. Soc., &c.

[Received April 4, 1882.]

The name assigned to this order by Cuvier is often objected to as inappropriate, as, though some of its members are edentulous, others have very numerous teeth; and the Linnean name *Bruta* is occasionally revived by modern authors. But that term is quite as objectionable, especially as the group to which Linneus applied it is by no means equivalent to the order as now understood, but contained all the animals then known which are comprised in the modern orders *Proboscidea*, *Sirenia*, and *Edentata*, together with the Walrus, one of the *Carnivora*. If retained at all, it should rather belong to the *Proboscidea*, as *Elephas* stands first in the list of genera of *Bruta* in the 'Systema Naturæ,' and was probably in the mind of Linnæus when he assigned the name to the group.

Cuvier's order included the *Ornithorhynchus* and *Echidna*, animals of which the structure was then imperfectly known, but which are now by almost universal consent removed to an altogether different section of the class. Otherwise its limits are those now adopted. The name *Edentata*, moreover, is now so generally used, and its meaning so well understood as a conventional term, that it would be very undesirable to substitute any other for it. In fact similar reasons might be given for ceasing to use nearly all the current ordinal designations of mammals. It might be equally well objected that all the *Carnivora* are not flesh-eaters, many of the *Marsupialia* have not pouches, and so forth.

The few common characters by which the Edentata are associated are too well known to need repetition. The principal one is the absence of any trace of the typical heterodont and diphyodont dentition, found in a more or less modified form in all other placental mammals¹. The one genus *Tatusia* presents a startling exception, in the presence of a set of milk-teeth, with (according to Burmeister) distinct roots implanted in separate alveoli, and (according to C. Tomes) distinct enamel-organs, if not enamel. This is one of the most important facts bearing upon the evolution of the Edentates yet discovered, though its full signification is not yet evident.

It is highly probable that most, if not all, of the existing Edentates are the very much differentiated representatives of a large group, the greater number of which are now extinct, and which have become so without ever attaining a high grade of organization. The great diversity of structure, the high degree of specialization to which many have attained, the paucity of species and even of individuals, their limited area of distribution, and their small size compared with known extinct forms, all show that they belong to an ancient and waning race, the members of which still hold their own either by the remoteness and seclusion of their dwelling-places, their remarkable adaptation of structure to special conditions of life, or by aid of the peculiar defensive armature with which they are invested. Their former history can, however, only be surmised, rather than read, at present; for though we have ample evidence of the abundance and superior magnitude of certain forms in the most recent and post-Tertiary geological age, and in one part of the world, beyond that time (*i. e.* in the true Tertiary period), and in other parts of the world than America, their fossil remains hitherto discovered are only fragmentary, giving a most imperfect idea of their actual condition, as well as affording no indications that serve to connect them with certainty to any other branch of the class.

The existing Edentates readily group themselves into five distinct families, of the limits of which there is no reasonable doubt. These are :—1. The BRADYPODIDÆ, containing two genera, *Bradypus* and *Cholæpus*. 2. The MYRMECOPHAGIDÆ, containing three distinct modifications, worthy of generic rank—*Myrmecophaga*, *Tamandua*, and

¹ The Cetacea are possible exceptions; but embryological and palæontological researches appear to show that their dentition may be derived from the ordinary mammalian type.

Cycloturus. 3. The DASYPODIDÆ, which may be divided into two sections, one containing the genus *Tatusia*, which, in the presence of milk-teeth, the structure of the fore feet, as well as in many characters of the visceral anatomy, stands apart from all the other Armadillos¹; and another, including the genera *Dasypus*, *Xenurus*, *Priodon*, *Tolypeutes*, and *Chlamyphorus*, which are clearly all modifications of a common type, although the last-named shows such a striking difference in the character of its dermal armature that it might make a section apart, if its internal structure were not so closely similar to that of *Dasypus*. 4. The MANIDÆ, containing about seven species, the slight modifications of which are scarcely worthy of being considered generic. 5. The ORYCTEROPODIDÆ, with one genus containing two closely allied local forms and species. The three first-named families are inhabitants of the New, the last two of the Old World. The families of which all the members are extinct are the MEGATHERIIDÆ and GLYPTODONTIDÆ, both American and post-Tertiary, the one related to the *Bradypodidæ*, and the other to the *Dasypodidæ*. The Tertiary forms are less known; but those of the New World may be provisionally grouped under Marsh's name of MOROPODIDÆ, and those of the Old World as MACROTHERIIDÆ.

As to the mutual relationship of these families, it has been customary with all recent zoologists to group them into two divisions, often called suborders:—the PHYLLOPHAGA, PHYTOPHAGA, or TARDIGRADA, containing the *Bradypodidæ* alone; and the ENTOMOPHAGA or VERMILINGUA, including all the others, unless, as in some systems, *Orycteropus* is placed apart as forming a distinct section.

Whether these distinct suborders are adopted, or the families merely arranged in their supposed relationship, the Old-World Ant-eaters, or *Manidæ*, are invariably closely associated with the New-World Anteaters or the *Myrmecophagidæ*, and the latter are widely separated from the Sloths.

This being (I think I am not wrong in saying) the view universally accepted at the present time, it is my purpose to investigate it a little more closely than has hitherto been done, and to see whether it is really based upon important structural relations, or only upon what may be called superficial or adaptive modifications.

The bonds which unite the *Manidæ* to the *Myrmecophagidæ* are mainly to be found in the structure of the mouth, especially the extensile character of the tongue, the great development of the sub-maxillary glands, and absence of teeth. These characters are exactly analogous to those found in the *Echidna* among Monotremes, the Woodpeckers among Birds, and the Chameleon among Reptiles. The explanation probably lies in the fact that in countries where termites and similar insects flourish, various distinct forms of vertebrates have become modified in special relation to this abundance of nutritious food, which could only be made available by a peculiar structure of the alimentary organs.

¹ See Garrod, "Notes on the Anatomy of *Tolypeutes tricinctus*, with remarks on other Armadillos," Proc. Zool. Soc. 1878, p. 222.

In tracing true affinities we must not look to these obviously adaptive characters, but to others of really deeper significance.

To commence with the skeleton, one of the most striking characters by which the *Myrmecophagidæ* differ from ordinary mammals is the presence on the posterior dorsal and the lumbar vertebræ of accessory articulating surfaces, in addition to the true zygapophyses common to all mammals, and causing a remarkable interlocking of the arches of these vertebræ. Such articulations are found equally well-developed in the *Megatheriidæ* and in the *Dasypodidæ*, and in a comparatively rudimentary state in the *Bradypodidæ*, especially in *Bradypus*¹.

The whole vertebral column of the Sloths, especially the dorsal and lumbar region, is poorly developed, evidently in relation to the subordinate function of the muscles attached to it. In the ordinary position the animal hangs below the branches of the trees in which it dwells, the trunk being merely slung between the two pairs of extremities; progression is effected chiefly by the body being dragged along by the fore limbs; the hind legs, which usually take so active a part in supporting and propelling the trunk, are small and weak, and the functions of walking, running, and jumping are alike in abeyance. Hence all the processes of the vertebral column—the spinous, transverse, and accessory—are but feebly developed. The existence then, even in a rudimentary form, of these additional articulations is extremely significant. It may almost be said that they prove that the Sloths are descended from animals in which they existed in a fully developed form. On the other hand, like as in some respects the vertebral column of *Manis* is to that of *Myrmecophaga*, not a trace of either of these articulations or of the processes on which they are situated are to be found in the former. There is a strong interlocking of the lumbar vertebræ; but it is formed by the greatly curved form of the true zygapophyses, and not by the addition of any superadded parts. In *Orycteropus* also they are entirely absent. On this ground alone we might be justified in assuming that the Old-World Edentates are not closely related to the American forms.

Nothing can be more different than the characters of the sternum of *Myrmecophaga* and of *Manis*. In the former the numerous mesosternal segments are small, laterally compressed, and articulated with each other and with the strongly ossified sternal ribs by synovial joints. In *Manis* the sternum is broad and flat, and the sternal ribs only partly ossified, and connected with it in the normal manner. In these characters, the *Bradypodidæ*, *Megatheriidæ*, and *Dasypodidæ* agree with the Anteaters, and *Orycteropus* is more nearly related to *Manis*.

The gigantic post-Tertiary Edentates of the New World, *Megatherium* and its allies, throw much light upon the close affinity of the Sloths and true Anteaters. By common consent they have been placed among the former when the order is divided into two divisions, and are spoken of as "Ground-Sloths;" yet in many important characters, perhaps in all those not relating to the functions of

¹ See 'Osteology of Mammalia,' 2nd edit., 1876, p. 55.

prehension and mastication of food, they are quite as near, if not nearer, to the Anteaters. They may truly be regarded as intercalary types, bridging over the gulf which now exists between them. The teeth are certainly those of the Sloths, even to the actual number in most genera; but the diminution of that number in *Cœlodon* leads towards their total suppression in *Myrmecophaga*. In the lengthening of the anterior part of the skull in *Megatherium*, but more strongly marked in *Scelidotherium*, the commencement of the *Myrmecophaga* type is clearly seen; and that they had tongues longer and more protractile than those of existing Sloths (perhaps even prehensile, as Professor Owen suggests) is very probable. The vertebral column, ribs, sternum, and tail were far more Myrmecophagine than Bradypodine. In the scapula they possess a character which is shared by both Sloths and Anteaters but by no other mammal. The coracoid bone and the coracoid border of the scapula join over the coraco-scapular notch, converting it into a foramen. The recent discovery of clavicles in a rudimentary state in all three species of *Myrmecophaga*¹ adds another common character to the group, though perhaps not one of first-class importance. It must, however, be noted that in no species of *Manis* has any trace of a clavicle been found. The flattening of the femur, and development of a linear ridge along its external border, is common and peculiar to the Sloths, Anteaters, and Megatheres. The special characters of the manus in these three families are all derivations from a common type; but in this portion of their organization the Megatherioids show their relationship with the Anteaters much more than with the Sloths. In the mode of setting the foot to the ground, and in the absence of claws upon one or more of the outer digits, the likeness is most surprising. The manus of the Pangolins, on the other hand, although presenting some superficial resemblances, is formed on a different type, in most respects more conformable to that which is normal among mammals; but it has the peculiarity (which it shares with all known Carnivora) of connate scaphoid and lunar bones, and in the deep median clefts of the ungual phalanges it resembles *Perameles* among the Marsupials.

Passing from this brief review of the osteological characters, we find in the arrangements of the arterial system of the limbs a close resemblance between the Sloths and Anteaters; and though the tail is so reduced in the former, its caudal artery is surrounded by a well-developed plexus, such as we could hardly account for, except upon the supposition that it were a remnant of a condition in which the tail resembles that of the Anteaters or Megatheres. In *Manis*, no *retia mirabilia* appear to be developed in connection with the arteries of the limbs—although one has been found, in at least one species, in the tail; but it is also present in animals as far removed as the Spider Monkeys.

A part of the organization to which it is natural to attach much importance in tracing affinities is that concerned in the reproductive function. The organs of both male and female Sloths and Ant-

¹ See W. A. Forbes, P. Z. S. 1882, p. 287.

eaters are closely similar in structure, while those of *Manis* are formed upon a totally different type. In the former families the testes are placed exactly in the same situation, close to each other, lying on the rectum, between it and the bladder; the penis is quite rudimentary, consisting of a pair of small corpora cavernosa, not directly attached by their crura to the rami of the ischium, and having a glans scarcely larger than that of the clitoris of most mammals, and, as in birds and reptiles, without any true corpus spongiosum. The number and development of the accessory glands vary apparently in different species of both families.

In the females of both Anteaters and Sloths the uterus is simple and globular, and the vagina, at least in the virgin state, is divided into two channels by a strong median partition. Lastly, the placentation, as far as it is known, if not identical, is similar in principle. The placenta of *Choloepus* has been fully described by Turner; it is deciduate, and composed of a number of lobes aggregated into a dome-like mass. There is nothing in the descriptions, certainly less complete, of the placenta of *Tamandua* and *Cycloturus* to show any differences except in detail of form.

In *Manis*, on the other hand, the testes are totally different in position, lying in the inguinal canal. The penis is external and well developed. The uterus is truly bicornuate, the vagina not divided, and the placenta diffused and non-deciduate. All the organs and foetal membranes are formed very much on the plan of those of the typical Ungulata, without a trace of the special peculiarities of the American Edentates.

As regards the tegumentary system *Myrmecophaga* closely resembles *Bradypus* in the character of its hairy covering; while *Manis*, in its very remarkable horny scales, shows a type entirely different from both and from every other mammal.

Many other minor considerations might be adduced; but I think I have brought forward enough to establish the fact beyond reasonable question, that *Manis*, if allied at all to *Myrmecophaga*, must have separated from the original common stock before this had given off the *Bradypodidæ*—or, in other words, that the Sloths and Anteaters, with the Megatherioids intervening, are far more nearly allied to each other than either is to the Pangolins.

It now remains to examine the position of the other families.

Dasypodidæ. In many respects this family is remarkably specialized, more particularly in the characters of the integumentary structures, in which it differs from all known mammals.

In dental characters it presents nothing fundamentally different from those of the Sloths. In lingual, salivary, and digestive organs, on the other hand, it is more nearly allied to the Anteaters, though presenting a less extreme form of modification, showing in fact one of the stages by which such modification may have been brought about. It is therefore so far a connecting link between these families.

In the extremely important character of the presence of interlocking accessory zygapophyses to the lumbar vertebræ, and in the structure of the sternum and sternal ribs, it follows the type of *Myr-*

mecophaga and *Megatherium*; but in the peculiar form and ankylosis of some of the cervical vertebræ, common to all existing members of the family, it stands apart from all other Edentates. In the presence of a clavicle it resembles the other American forms; but it differs in the shape of the scapula, and in the existence of a third trochanter to the femur. The structure of the extremities, especially the manus, presents many modifications, some of which are quite comparable to, though not identical with, those of the *Myrmecophagidæ*.

The reproductive organs differ in the presence of a largely developed copulating organ in the male, and of a simple vagina of corresponding length in the female; these, as long ago suggested by Professor Owen, appear to be correlated with the difficulties which would otherwise be interposed to sexual congress by the arrangements of the dermal armour, and which of course do not occur in the Sloths and Anteaters. The testes are still abdominal, though not in the same position; and the penis, notwithstanding its size, wants (as pointed out by Morrison Watson¹) both the glans and bulb, generally formed in mammals by the corpus spongiosum. The uterus is as simple, or nearly so, as that of the Sloths and Anteaters; and there is no reason to suppose, from what is at present known, that the placentation differs in principle from that of those families; for if deciduate, whether the whole mass assumes an oval, discoidal, or bell-shaped form is only a matter of detail.

The Armadillos, then, have undoubtedly near affinities to the other American Edentates, and are probably members of the same group, though not so nearly related to either of the other families as they are to each other, and are moreover remarkably specialized in a particular direction. The Glyptodonts form an allied group, agreeing in most essential features, but also presenting some very singular special modifications.

Lastly, *Orycteropus* is a form in most respects perfectly apart from all the others. The structure of its teeth alone would almost entitle it to be placed in an order by itself, were it not for the practical inconvenience of doing so. Its vertebral column is formed on the normal type of mammals. Its limbs also present comparatively few specializations; but it resembles the Armadillos in possessing a third trochanter to the femur. Its digestive organs are also comparable to those of the Armadillos, as its mode of feeding is similar. But its reproductive organs, both male and female, and placentation are formed upon a principle unknown in other Edentates, or, in combination, in other mammals. The testes, in a specimen I once examined, were inguinal, though they appear to descend, at all events temporarily, into a scrotum; but the penis is almost as small as in the Great Anteater. The uterus is more bicornuate than in *Manis*, the two lateral chambers opening separately into the vagina, as in some Rodents. The placenta, as described by Prof. Turner, is broadly zonular; but whether deciduate or not is at present undetermined, probably the latter. As Balfour remarks, this type of placenta is capable of being easily derived from that of *Manis*,

¹ P. Z. S. 1878, p. 677.

by the disappearance of the foetal villi at the two poles of the ovum ; while the small size of the umbilical vesicle indicates that it is not, like the zonary placenta of the Carnivora, directly derived from a type with both allantoic and umbilical vascularization of the chorion.

Although palæontology has revealed the existence of a vast number of the Edentates by which the New World was tenanted in the Pleistocene age, and has given us a more perfect idea of their characters than is known of most other extinct forms, unfortunately the history of the group throughout the period of the true Tertiaries is at present almost a blank. The presence of a large species probably allied to *Manis* in the Siwalik fauna is indicated by a single phalanx, described and figured by Lydekker under the name of *M. sindiensis*. No animals, attributed with any certainty to the Edentata, are known of Eocene age. The few scattered and imperfect remains of supposed Edentates, *Macrotherium* and *Ancylotherium*, of the European later Miocene formations, and the similarly imperfect and as yet not fully described bones of *Moropus* and *Morotherium* of corresponding ages in North America, indicate that animals existed at that time of large size, presenting characters in some respects allied to the recent members of the order, but in others so different that they cannot be placed in any of the existing families. *Macrotherium*, for instance, appears to have limb-characters which ally it to the Ungulates. As far as can be surmised at present, the affinities of these early forms were rather with the existing members which survive in their own part of the world, than with those of a different hemisphere. *Macrotherium* certainly appears to present more resemblance to *Manis* than to the American Edentates. The first fragments of it which were found were attributed by Cuvier to a "*Pangolin gigantesque*." But some evidence has since been found in favour of its having possessed teeth. So far this is quite what might be expected ; but it certainly throws very little light either upon the mutual relations of the existing forms, the steps by which the present state of things has been brought about, or, what would be still more interesting, their affinities with mammals of other groups. The tabular form (see p. 366) into which the result of these inquiries have been thrown will show what I conceive to be the relationship of the existing forms ; but it also shows the great deficiency of our knowledge of the group in past ages.

The general conclusions to which a study of this group have led me may be summed up as follows :—All the American Edentates at present known, however diversified in form and habits, belong to a common stock. The *Bradypodidæ*, *Megatheriidæ*, and *Myrmecophagidæ* are closely allied, the modifications seen in the existing families relating to food and manner of life. The ancestral forms may have been omnivorous, like the present Armadillos, and gradually separated into the purely vegetable and purely animal feeders ; from the former are developed the modern Sloths, from the latter the Anteaters. The Armadillos are another modification of the same type, retaining some more generalized characters, as those

EDENTATA.

NEW-WORLD FORMS.

Present
Period.BRADY-
PODIDÆ.MYRMECO-
PHAGIDÆ.

DASYPODIDÆ.

OLD-WORLD FORMS.

ORYCTERO-
PODIDÆ.

MANIDÆ.

Pleistocene
Period.

MEGATHERIIDÆ.

DASYPODIDÆ.

GLYPOTODONTIDÆ

Pliocene
Period.

Moroherium.

*Manis sindiensis?*Miocene
Period.

MOROPODIDÆ.

MACROTHERIIDÆ.

of the alimentary organs, but in other respects, as their defensive armature, remarkably specialized.

The two Old-World forms *Manidæ* and *Orycteropidæ* are so essentially distinct from all the American families, that it may even be considered doubtful whether they are derived from the same primary branch of mammals, or whether they may not be offsets from some other branch, the remaining members of which have been lost to knowledge.

Alphonse Milne-Edwards, in discussing the inferences to be derived from the study of the foetal membranes of the Edentates¹, has maintained that one of two views must be accepted:—either that it shows that no value can be attached to the placentation in seeking natural affinities; or that the Edentates as we know them now are not a homogeneous order, but should be separated into several distinct natural groups. It is the latter view to which he gives the preference. It need scarcely be remarked that the observations made in the present communication lead to a similar conclusion.

2. On the Modification of a Race of Syrian Street-Dogs by means of Sexual Selection. By Dr. VAN DYCK. With a Preliminary Notice by CHARLES DARWIN, F.R.S., F.Z.S.

[Received April 4, 1882.]

Most of the naturalists who admit that natural selection has been effective in the formation of species, likewise admit that the weapons of male animals are the result of sexual selection—that is, of the best-armed males obtaining most females and transmitting their masculine superiority to their male offspring. But many naturalists doubt, or deny, that female animals ever exert any choice, so as to select certain males in preference to others. It would, however, be more correct to speak of the females as being excited or attracted in an especial degree by the appearance, voice, &c. of certain males, rather than of deliberately selecting them. I may perhaps be here permitted to say that, after having carefully weighed to the best of my ability the various arguments which have been advanced against the principle of sexual selection, I remain firmly convinced of its truth. It is, however, probable that I may have extended it too far, as, for instance, in the case of the strangely formed horns and mandibles of male Lamellicorn beetles, which have recently been discussed with much knowledge by W. von Reichenau², and about which I have always felt some doubts. On the other hand, the explanation of the development of the horns offered by this entomologist does not seem to me at all satisfactory.

¹ Annales des Sciences Naturelles, Zoologie, 6me série, tome viii. p. 6 (1879).

² "Ueber den Ursprung der secundären männlichen Geschlechtscharakteren &c.," Kosmos, Jahrgang v. 1881, p. 172.



Flower, William Henry. 1882. "1. On The Mutual Affinities Of The Animals Composing The Order EDENTATA." *Proceedings of the Zoological Society of London* 1882, 358–367. <https://doi.org/10.1111/j.1469-7998.1882.tb06635.x>.

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