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THE

VERTEBRATE SKELETON

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Section (*d*). RUMINANTIA or PECORA.

Family **Cervidae.** Moschus—musk deer.
Cervus—deer.
Cervulus—muntjac.
Hydropotes—Chinese water deer.

Family **Giraffidae.** Giraffa—giraffe.
Sivatherium.

Family **Antilocapridae.** Antilocapra—prongbuck.

Family **Bovidae.** Tetraceros—four-horned antelope.
Gazella—gazelle.
Bos—ox.
Bison.
Bubalus—buffalo.

Suborder (2). PERISSODACTYLA.

Family **Tapiridae.** Tapirus—tapir.

Family **Lophiodontidae.** *Lophiodon.*
Hyracotherium.

Family **Palaeotheriidae.** *Palaeotherium.*

Family **Equidae.** *Hipparion.*
Equus—horse.

Family **Rhinocerotidae.** Rhinoceros.
Elasmotherium.

Family **Titanotheriidae.** *Titanotherium* (*Brontops*).
Palaeosyops.

Family **Chalicotheriidae.** *Chalicotherium.*

Family **Macraucheniidae.** *Macrauchenia.*

Division B. SUBUNGULATA.

Suborder (1). TOXODONTIA.

Family **Astrapotheriidae.** *Astrapotherium.*

Family **Nesodontidae.** *Nesodon.*

Family **Toxodontidae.** *Toxodon.*

Family **Typotheriidae.** *Typotherium.*

Suborder (2). CONDYLARTHRA.

Family **Phenacodontidae.** *Phenacodus.*

Suborder (3). HYRACOIDEA.

Family **Hyracidae.** Procavia (Hyrax).

Suborder (4). AMBLYPODA.

Family **Coryphodontidae.** *Coryphodon.*

Family **Uintatheriidae.** *Uintatherium* (*Dinoceras*).

Suborder (5). PROBOSCIDEA.

Family **Dinotheriidae.** *Dinotherium.*

Family **Elephantidae.** *Mastodon.*
Elephas—elephant.

Group TILLODONTIA.

Order 5. RODENTIA.

Suborder (1). SIMPLICIDENTATA.

Section SCIUROMORPHA.

Family **Castoridae.** Castor—beaver.

Section MYOMORPHA.

Family **Lophiomyidae.** Lophiomys.

Family **Muridae.** Hydromys.
Acanthomys—spiny mouse.
Mus—mouse.

Family **Spalacidae.** Bathyergus.

Family **Dipodidae.** Dipus—jerboa.
Pedetes—Cape jumping-hare.

Section HYSTRICOMORPHA.

Family **Hystricidae.** Hystrix—porcupine.

Family **Chinchillidae.** Chinchilla.
Lagostomus—viscacha.

CHAPTER XXII.

GENERAL ACCOUNT OF THE SKELETON IN MAMMALIA.

THE EXOSKELETON AND VERTEBRAL COLUMN.

Epidermal Exoskeleton.

Hair, which forms the characteristic Mammalian exoskeleton varies much in different animals, and in different parts of the same animal. A large proportion of mammals have the surface fairly uniformly covered with hair of one kind only. In some forms however there are two kinds of hair, a longer and stiffer kind alone appearing on the surface, and a shorter and softer kind forming the under fur. In most mammals hairs of a special character occur in certain regions, such as above the eyes, on the margins of the eyelids, and on the lips and cheeks, here forming the vibrissae or whiskers.

Sometimes as in *Hippopotamus*, *Orycteropus* and the Sirenia, the hair, though scattered over the whole surface, is extremely scanty, while in the Cetacea it is limited to a few bristles in the neighbourhood of the mouth, or may even be absent altogether in the adult. In most mammals the hairs are shed and renewed at intervals, sometimes twice a year, before and after the winter. The vibrissae or large hairs which occur in many animals upon the upper lip, and the mane and tail of Equidae are probably persistent.

In the hedgehogs, porcupines and *Echidna* certain of the hairs are modified and greatly enlarged, forming stiff spines. Similar spines occur in the young of *Centetes*, and in *Acanthomys* among the Muridae.

Several other forms of epidermal exoskeleton are met with in mammals, including:—

(*a*) **Scales.** These overlie the bony scutes of armadillos and occur covering the tail in several groups of mammals, such as beavers and rats. In the Manidae the body is covered by flat scales which overlap.

(*b*) The **horns** of Bovine Ruminants. These, which must on no account be confused with antlers, are hollow cases of hardened epidermis fitting on to bony outgrowths of the frontals. In almost every case they are unbranched structures growing continuously throughout life, and are very rarely shed entire. In the Prongbuck *Antilocapra* however they are bifurcated and are periodically shed. Horns are nearly always limited to a single pair, but the four-horned antelope *Tetraceros* has two pairs, the anterior pair being the smaller.

(*c*) The **horns of Rhinoceroses.** These are conical structures composed of a solid mass of hardened epidermal cells growing from a cluster of long dermal papillae. From each papilla there grows a fibre which resembles a thick hair, and cementing the whole together are cells which grow from the interspaces between the papillae. These fibres differ from true hairs in not being developed in pits in the dermis. Rhinoceros horns may be either one or two in number, and are borne on the fronto nasal region of the skull. They vary much in length, the longest recorded having the enormous length of fifty-seven inches.

(*d*) **Nails, hoofs** and **claws.** In almost all mammals except the Cetacea, these are found terminating the digits of both limbs. **Nails** are more or less flattened structures, **claws** are pointed and somewhat curved. In most mammals

the nails tend to surround the ends of the digits much more than they do in man. Sometimes the nail of one digit differs from that of all the others; thus the second digit of the pes in the Hyracoidea and Lemuroidea is terminated by a long claw, the other digits having flat nails. In the Felidae the claws are retractile, the ungual phalanx with claw attached folding back when the animal is at rest into a sheath, above, or by the side of the middle phalanx. In the Sloths and Bats enormously developed claws occur, forming hooks by which the animals suspend themselves. In *Notoryctes* the third and fourth digits of the manus bear claws of great size; similar claws occur in *Chrysochloris*, being correlated in each case with fossorial habits. The nail at its maximum development entirely surrounds the terminal phalanx of the digit to which it is attached, and is then called a **hoof**. Hoofs are specially characteristic of the Ungulata.

(*e*) **Spurs and beaks** are structures which are hardly represented among mammals, while so characteristic of birds. They are however both found in the Monotremata. In both *Echidna* and *Ornithorhynchus* the male has a peculiar hollow horny spur borne on a sesamoid bone articulated to the tibia. The jaws in *Ornithorhynchus* are cased in horny beaks similar to those of birds, and are provided with horny pads which act as teeth.

(*f*) **Horny plates** of a ridged or roughened character occur upon the anterior portion of the palate, and of the mandibular symphysis in all three genera of recent Sirenia; also upon the toothless anterior portion of the palate in Ruminants.

(*g*) The **baleen of whales** also belongs to the epidermal exoskeleton. It consists of a number of flattened horny plates arranged in a double series along the palate. The plates are somewhat triangular in form and have their bases attached to the palate at right angles to its long axis, while their apices hang downwards into the mouth cavity. The outer edge of each plate is hard and smooth, while the inner edge and

apex fray out into long fibres which look like hair. At the inner edge of each principal plate are subsidiary smaller plates. The plates are formed of a number of fibres each developed round a dermal papilla in the same way as are the fibres forming the horns of *Rhinoceros*. Baleen and Rhinoceros horn likewise agree in that the fibres are bound together by less hardened epithelial cells, which readily wear away and allow the harder fibres to fray out. The greatest development of baleen occurs in the Northern Right whale, *Balaena mysticetus*, in which the plates number three hundred and eighty or more on each side, and reach a length of ten or twelve feet near the middle of the series.

Dermal Exoskeleton.

Mammals show two principal kinds of exoskeletal structures which are entirely or partially dermal in origin, viz. the bony scutes of armadillos, and teeth.

The **bony scutes of armadillos** are quadrate or polygonal in shape and are in general aggregated together, forming several shields protecting various regions of the body. The head is generally protected by a *cephalic* shield, the anterior part of the body by a *scapular*, and the posterior by a *pelvic* shield. The tail is also generally encased in bony rings, and scutes are irregularly scattered over the surface of the limbs. The mid-body region is protected by a varying number of bands of scutes united by soft skin, so as to allow of movement. Corresponding to each dermal scute is an epidermal plate. In *Chlamydophorus* the scutes are mainly confined to the posterior region where they form a strong vertically-placed shield which coalesces with the pelvis. The anterior part of the body is mainly covered by horny epidermal plates with very little ossification beneath. In the gigantic extinct Glyptodonts the body is covered with a solid carapace formed by the union of an immense number of plates, and there are no movable rings. The top of the head is defended

by a similar plate, the tail is generally encased in an unjointed bony tube, and there is commonly a ventral plastron.

In *Phocaena phocaenoides* the occurrence of vestigial dermal ossicles has been described, and in *Zeuglodon* the back was probably protected by dermal plates.

Teeth[1].

Teeth are well developed in the vast majority of mammalia, and are of the greatest morphological and systematic importance, many extinct forms being known only by their teeth. Mammalian teeth differ from those of lower animals in various well marked respects. (1) They are attached only to the maxillae, premaxillae and mandible, never to the palatines, pterygoids or other bones. (2) They frequently have more than one root. (3) They are always, except in some Odontoceti, placed in distinct sockets. (4) They are hardly ever ankylosed to the bone. (5) They are in most cases markedly heterodont. (6) They are commonly developed in two sets, the milk dentition and permanent dentition.

It sometimes happens that teeth after being formed are reabsorbed without ever cutting the gum. This is the case, for instance, with the upper incisors of Ruminants.

The form of mammalian teeth varies much, some are simple conical structures comparable to those of most reptiles, and these may either have persistent pulps, as in the case of the upper canines of the Walrus and the tusks of Elephants, or may be rooted as in most canine teeth. Some teeth have chisel-shaped edges, and this may be their original form, as in the

[1] See W. H. Flower, "Remarks on the homologies and notation of the teeth in Mammalia," *J. Anat. and Physiol. norm. path.*, Vol. III., p. 262; R. Owen, *Odontography*, London, 1840—45; C. S. Tomes, *Manual of Dental Anatomy*, London, 1876. See also H. F. Osborn, "Recent researches on succession of teeth in Mammals," *Amer. Natural.*, XXVII., p. 493, and "Rise of Mammalia in N. America," *Stud. Biol. Lab. Columb. Coll.*, Zool. I., no. 2.

human incisors, or may, as in those of Rodents, be brought about by the more rapid wearing away of the posterior edge, the anterior edge being hardened by a layer of enamel.

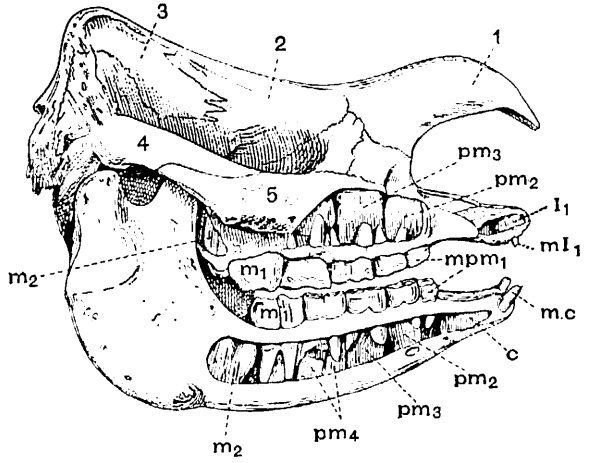

Fig. 81. Skull of a young Indian Rhinoceros (*R. unicornis*), showing the change of the dentition × ¼. (Brit. Mus.)

1. nasal.
2. frontal.
3. parietal.
4. zygomatic process of squamosal.
5. jugal.

mI$_1$. milk incisor.
mc. milk canine.
mpm$_1$. milk premolar.
I$_1$. first incisor.
c. canine.
pm$_2$, *pm*$_3$, *pm*$_4$. 2nd, 3rd and 4th premolars.
m$_1$, *m*$_2$. first and second molars.

Then, again, the crown may, as in the majority of grinding teeth, be more or less flattened. The various terms used in describing some of the forms of the surface of grinding teeth are defined on page 345.

The teeth of the Aard Varks are compound, and differ completely from those of all other mammals (see p. 425).

As a rule, the higher the general organisation of an animal

tibia and fibula are both large and are commonly ankylosed together at either end. The limb bones are very massive also in the Glyptodonts.

SIRENIA. In no living Sirenian is there any trace of a hind limb, but in *Halitherium* a vestigial femur is found, which articulates with the pelvis by a definite acetabulum.

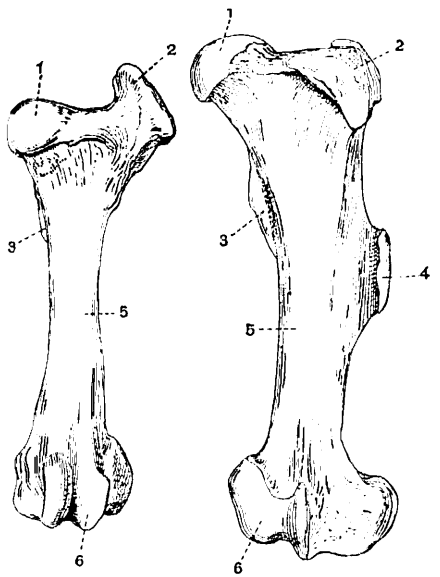

FIG. 109. LEFT FEMUR OF AN OX (*Bos taurus*) (to the left) AND OF A SUMATRAN RHINOCEROS (*R. sumatrensis*) (to the right). ×⅛. (Camb. Mus.)

1. head.
2. great trochanter.
3. lesser trochanter.
4. third trochanter.
5. shaft.
6. condyles.

In the Mystacoceti among the CETACEA small nodules of bone or cartilage occur connected with the vestigial pelvis, and may represent the femur and tibia. No trace of the skeleton of the hind limb is known in the Odontoceti.

In the UNGULATA VERA the femur is noticeable for the size of the great trochanter (fig. 109, 2); there is no definitely constricted neck separating the head from the rest of the bone, and the lesser trochanter (fig. 109, 3) is not very prominent. All Perissodactyles except the Chalicotheriidae show a strongly marked third trochanter, but this is absent in all known Artiodactyles. The development of the fibula in general corresponds to that of the ulna. In *Rhinoceros*, *Macrauchenia*, *Tapirus* and the Suina it is distinct and fairly well developed; in the Tragulina on the other hand it is vestigial, being reduced to the proximal end only. In the Ruminantia and Tylopoda also, it is much reduced forming merely a small bone attached to the distal end of the tibia, sometimes as in the Red deer a slender vestige of the proximal end also is preserved quite detached from the distal portion; in the Horse this proximal portion is all that there is found of the fibula. The progressive diminution of the fibula can be well seen in the series of forms that are regarded as the ancestors of the Horse. The patella of the Ungulata vera is well ossified, but fabellae[1] are not usually found.

SUBUNGULATA. Of the Toxodontia, *Toxodon* has no third trochanter while *Typotherium* and *Astrapotherium* have one. In the Condylarthra the femur has well-marked lesser and third trochanters, and the fibula and patella are well developed. In the Hyracoidea there is a slight ridge on the femur in the place of the third trochanter, the fibula is complete, but is generally fused to the tibia at its proximal end.

Of the Amblypoda, *Coryphodon* has a third trochanter, but *Uintatherium* has none; in this respect, in the vertical position and general appearance (fig. 108) of the limb, and in the articulation of the fibula with the calcaneum, the leg of *Uintatherium* closely approaches that of the Proboscidea.

In the Proboscidea the femur is very long and straight,

[1] See p. 412.