# A MANUAL

OF THE

# ANATOMY OF VERTEBRATED ANIMALS.

BY

THOMAS H. HUXLEY, LL.D., F.R.S.,

AUTHOR OF "LAY SERMONS," "MAN'S PLACE IN NATURE," "ORIGIN OF SPECIES," ETC.

LONDON:
J. & A. CHURCHILL.
11 NEW BURLINGTON STREET.
1871.

somewhat like that which lodges the "larmier" of a stag (traces of which are observable in some of the older species of *Equus*); otherwise the cranium is altogether like that of a Horse. Again, the shaft of the ulna is very slender, but it is larger than in the Horse, and is distinctly traceable throughout its whole length although firmly anchylosed with the radius. The distal end of the fibula is so completely anchylosed with the tibia, that, as in the Horse, it is difficult to discern any trace of the primitive separation of the bones. But, as has been already mentioned, each limb possesses three complete toes—one strong, median, and provided with a large hoof, while the two lateral toes are so small that they do not extend beyond the fetlock-joint. In the fore-limb, rudiments of the first and fifth toes have been found.

The teeth are exceedingly like those of the Horse, but the crowns of the molars are shorter; and, in the upper jaw, that which, in the true Horses, is a large fold of the inner face of the tooth becomes a detached pillar. The smaller plications of the enamel are also more numerous, close-set, and complicated. On the outer face of the lower milk-molars there is a column such as exists in the Stags. Of this a rudiment exists, as a fold, in the corresponding teeth of the existing Horse.

In the genus *Anchitherium*, all the known remains of which are of older miocene (and, perhaps, newer eocene) age, the skeleton in general is still extraordinarily like that of a Horse. The skull, however, is smaller in proportion than in the Horse, and the jaws are more slender. The hindermost molar tooth is situated farther back under the orbit, and the orbit itself is not completely encircled by bone, as it is in the Horses and Hipparions.

The shaft of the ulna is stouter than in *Hipparion*, and is less closely united with the radius. The fibula appears, at any rate in some cases, to have been a complete though slender bone, the distal end of which is still closely united with the tibia, though much more distinct than in the Hipparions and the Horses. In some specimens, however, the middle of the shaft seems to have been incompletely ossified. Not only are there three toes in each foot, as in *Hipparion*, but the inner and the outer toes are so large that they must have rested upon the ground. Thus, so far as the limbs are concerned, the *Anchitherium* is just such a step beyond the *Hipparion*, as the *Hipparion* is beyond the Horse, in the direction of a less specialized quadruped. The teeth are still more divergent from the Equine type. The incisors are smaller in proportion,



and their crowns lack the peculiar pit which characterizes those of *Equus* and *Hipparion*. The first grinder is proportionately much larger, especially in the upper jaw, and like the other six has a short crown and no thick coat of cement. The pattern of their crowns is wonderfully simplified. The fore and hind ridges run with but a slight obliquity across the crown, and the pillars are little more than enlargements of the ridges, while in the lower jaw these pillars have almost disappeared. But the foremost of the six principal grinders is still somewhat larger than the rest, and the posterior lobe of the last lower molar is small, as in the other *Equidæ*.

In all those respects in which *Anchitherium* daparts from the modern Equine type, it approaches that of the extinct *Palæotheria;* and this is so much the case that Cuvier considered the remains of the *Anchitherium* with which he was acquainted to be those of a species of *Palæotherium*.

*b.* In the *Rhinocerotidæ* the second, third, and fourth toes are nearly equally developed in both the fore- and the hind-feet.

The dental formula is $i.\ \frac{1\cdot1}{1\cdot1}$ or $i.\ \frac{0\cdot0}{0\cdot0}$ $c.\ \frac{0\cdot0}{0\cdot0}$ $p.m.\ \frac{4\cdot4}{4\cdot4}$ $m.\ \frac{3\cdot3}{3\cdot3}$. But the teeth differ from those of the Horse in many other respects besides the number of the incisors and the absence of canines. Thus, the upper incisors differ greatly in form from those which are situated in the lower jaw; and, in some species, incisors are absent. Their crowns are not folded as in the Horse. The peculiarities of the grinding teeth will be mentioned below.

The skin is very thick and may be converted into a jointed armor; the hair is scanty. The upper lip is much produced and is very flexible. In some species one, or sometimes two, horns are attached in the middle line to the nasal or frontal bones. But these horns are formed, as it were, by agglomeration of a great number of hair-like shafts.

The distal phalanges of the tridactyle feet of the Rhinoceros are invested by small hoofs; but these do not entirely support the weight of the body, which rests, in great measure, upon a large callous pad developed from the under face of the metacarpal and metatarsal regions; these are much shorter than in the Horse.

The dorso-lumbar vertebræ are twenty-two or twenty-three, of which twenty are dorsal. There are four sacral and twenty-two caudal. The cervical vertebræ, as in the Horse, are strongly opisthocœlous, and the transverse processes of the

last lumbar articulate with those of the penultimate lumbar and with the sacrum.

The skull differs from that of the Horse in the absence of any frontal or zygomatic processes in consequence of which the orbit and temporal fossa form one cavity. The nasals are immense, and are separated from the premaxillæ by a wide extent of the maxilla on each side. The premaxillæ are relatively small and reduced to little more than their palatine portions. The glenoidal surface of the mandible is transverse and convex. The squamosal sends down an immense post-glenoidal process, which is longer than either the post-tympanic or the paramastoid. It unites with the post-tympanic to form a kind of false auditory meatus, in the absence of any proper ossified canal of that kind. The periotic and the tympanic bones are anchylosed, the tympanic being a mere irregular hoop of bone. The *pars mastoidea* is completely hidden by the junction of the short post-tympanic with the long paramastoid. The hinder margin of the bony palate is opposite the middle of the antepenultimate molar.

The mandibular condyle is transverse and convex. The perpendicular portion of the ramus is large, and the coronoid process ascends slightly above the condyle. In a vertical and longitudinal section of the skull, the form of the cerebral cavity is seen to be similar to that of the Horse. The inner and outer tables of the bony roof of the skull are separated by great air-cavities.

The spine of the scapula has no acromion, but gives off a strong recurved process from the middle of its length.

The radius and ulna are complete, but are anchylosed.

The carpus has the eight ordinary bones. In the manus the digits ii., iii., iv., are complete, and a bony tubercle articulated with the outer facet of the *cuneiforme* represents digit v. The digit iii. is largest and longest, and its phalanges are symmetrical in themselves; those of the digits ii. and iv. are not symmetrical in themselves. The terminal phalanges have somewhat the form of the coffin-bone of the Horse.

The ilia have wide, transversely-directed crests, as in the Horse. The femur is provided with a very strong third trochanter. The tibia and the fibula are complete, and the tarsus has the ordinary seven bones. The pulley of the astragalus is not very deeply grooved, and is hardly at all oblique. The facet for the cuboid is very small. The metatarsals resemble the metacarpals in their number and symmetry, but there is no rudiment of the fifth.



In some species of *Rhinoceros* there are $\frac{3 \cdot 3}{2 \cdot 2}$ incisors in the milk detention, and $\frac{1 \cdot 1}{2 \cdot 2}$ or $\frac{1 \cdot 1}{1 \cdot 1}$ incisors in the permanent dentition. In the latter the upper incisors are large, long-crowned teeth, very unlike the lower ones, of which it seems probable that only one pair, in any case, are permanent teeth. In some Rhinoceroses, as has been already stated, the adult is devoid of incisor teeth.

There are no canines in either dentition. Of the four milk-molars, the first, as in the Horse, is smaller than the others, and is not replaced. The structure of both the upper and the lower molars is substantially the same as in the Horse, but the roots are developed much sooner; the laminæ of the upper molars take a much more transverse direction; the laminæ of the upper molars do not develop pillars, though accessory crests may be developed from the two faces of the posterior lamina; the lower molars have no pillars; and the cement does not fill up the valleys between the wall and the laminæ.

The cardiac division of the simple, though large stomach, is lined by a white callous epithelium, as in the Horse. The small intestine presents large processes or tags, half an inch long or more, upon which the true villi are borne. The cæcum is very large, and the colon enormous. There is no gall-bladder. The heart and brain are very similar to those of the Horse.

The male can hardly be said to have a scrotum, as the testes lie close to the abdominal ring. A prostate, vesiculæ seminales, and Cowper's glands, are present. The long penis has a mushroom-shaped glans, and the animal is retromingent. The cornua uteri are proportionately longer than in the mare. The teats are two and inguinal in position. The characters of the fœtal membranes and the nature of the placentation are unknown.

At the present day the genus *Rhinoceros* is confined to Africa and Asia. The African species all have two horns, a nearly smooth skin, and the adult has no incisors. The Asiatic species have one horn only (except that of Sumatra, which has two). The skin is marked out by deep folds into shields, and the adults have well-developed incisors.

Rhinoceroses are known in the fossil state as far back as the miocene epoch. *R. tichorhinus*, with the nasal septum ossified, and a covering of long woolly hair, inhabited Europe and Asia during the cold of the glacial epoch. *R. incisivus* had four digits in the manus, and larger incisor teeth than any

existing species. *R. hexaprotodon* had more numerous incisors than any other species.

*c.* In the *Tapiridæ* there are four toes on the front-foot, though the ulnar digit does not reach the ground. The hind-foot has three toes.

The dental formula is $i.\frac{3\cdot3}{3\cdot3}$ $c.\frac{1\cdot1}{1\cdot1}$ $p.m.\frac{4\cdot4}{3\cdot3}$ $m.\frac{3\cdot3}{3\cdot3}$.

The molar teeth each present two transverse, or slightly-oblique ridges, connected by a low wall externally.

The skin is soft and hairy, and the muzzle and snout are prolonged into a short proboscis.

The Tapirs have twenty-three or twenty-four dorso-lumbar vertebræ, of which nineteen or twenty are usually dorsal. The centra of these vertebræ, and the transverse processes of the last lumbars, have the same peculiarities as those of the Horse and Rhinoceros. There are seven sacral and about twelve caudal vertebræ. The skull is partly Rhinocerotic, partly Equine, in its characters. Thus there is a sagittal crest —the post-tympanic processes are large, but they are not so long as the paramastoids, and they do not unite with the post-glenoidal processes beneath the meatus. In these respects the Tapir is Horse-like, but in the following it is more Rhinocerotic.

Thus the tympanic is quite rudimentary; the post-glenoidal process is larger than in the Horse; the orbit is not separated from the temporal fossa; the nasals are widely separated from the premaxillæ; the premaxillæ are very small, and are early anchylosed.

The hinder margin of the osseous palate is opposite the anterior edge of the penultimate molar. The mandibular rami unite in a very long symphysis; the ascending portion of the ramus is large, and projects backward with a convex edge in a remarkable manner. There is a high coronoid process.

In the fore-limb, the scapula has no acromion, and the coracoid is a mere tubercle. The supraspinous fossa is very much larger than in the Horse or Rhinoceros. The radius and the ulna are complete, but not movable upon one another. Although, by the completion of the fifth digit, in addition to the second, third, and fourth, there are four digits in the manus, the Perissodactyle character is manifested by the fact that the third is longest, and symmetrical in itself, while the others are asymmetrical. The femur has a strong third trochanter; the fibula is complete; the astragalus more Rhinocerotic than Equine. There is no trace of a hallux, but the



fifth digit of the pes appears to be represented by an osseous rudiment.

In the presence of the full complement of incisors and canines the Tapir is more Horse-like than Rhinocerotic, but is still very peculiar; for the outer upper incisors are larger than the canines, while the outer lower incisors are much smaller than the canines, and are apt to fall out at a certain age. The canines, are still more closely approximated to the incisors than in the Horse, especially in the lower jaw, and, consequently, the diastema is very large. The six posterior molars in the upper jaw, and the five posterior molars in the lower, present nearly the same structure. There is a low outer wall with two slightly-marked concavities (in the maxillary teeth) or convexities (in the mandibular teeth) on its outer face. From this two ridge-like laminæ run inward and a little backward across the crown of the tooth. The valleys are broad and shallow, and the coat of cement very thin. The molar tooth of the Tapir thus represents the plan of structure common to the *Perissodactyle* in its simplest form. Deepen the valleys, increase the curvature of the wall and laminæ, give the latter a more directly backward slope; cause them to develop accessory ridges and pillars, and increase the quantity of cement; and the upper molar of the Tapir will gradually pass through the structure of that of the Rhinoceros to that of the Horse.

In the anterior upper premolar (or milk-molar?) the anterior moiety of the crown is incompletely developed. In the anterior lower premolar the anterior basal process, which exists in all the molars, is excessively developed, so that the crown of the tooth assumes the bicrescentic pattern of the Rhinoceros's lower grinder. This probably indicates the manner in which the Tapiroid form of inferior molar is converted into the Rhinocerotic, or Equine, form.

The stomach is simple and oval, the cardiac and pyloric orifices being closely approximated. The cæcum is proportionally smaller than in the Horse or Rhinoceros. There is no gall-bladder. The heart is devoid of a septal bone and of a Eustachian valve. There is only a *single vena cava anterior*, and the aorta divides into an anterior and a posterior trunk. There is no third bronchus. No distinct scrotum is present. There are vesiculæ seminales and prostatic glands, but no Cowper's glands. The placentation is diffuse. The teats are two, and inguinal.

There are two or three species of Tapir at present living