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AN INTRODUCTION
TO THE STUDY OF
M A M M A L S
LIVING AND EXTINCT

BY

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THE WOOLLY OPOSSUM

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Family RHINOCEROTIDÆ.

Although the existing members of this family are readily distinguished from the other living representatives of the suborder by the simple crescentoid form assumed by the ridges of the lower cheek-teeth, yet it is exceedingly difficult to give a definition by which they can be distinguished from the *Lophiodontidæ*, from some members of which they are, indeed, probably derived. The outer columns of the upper molars (Fig. 167) are, however, so excessively flattened as to produce a continuous thick and nearly straight outer wall, which is often produced in advance of the anterior transverse ridge; both transverse ridges being but little curved, and intimately connected with the outer wall. The upper premolars are in most cases nearly or quite as complex as the molars, and the ridges of the lower cheek-teeth are crescentoid. The last lower molar has no third lobe. The height of the crowns of the cheek-teeth is variable.

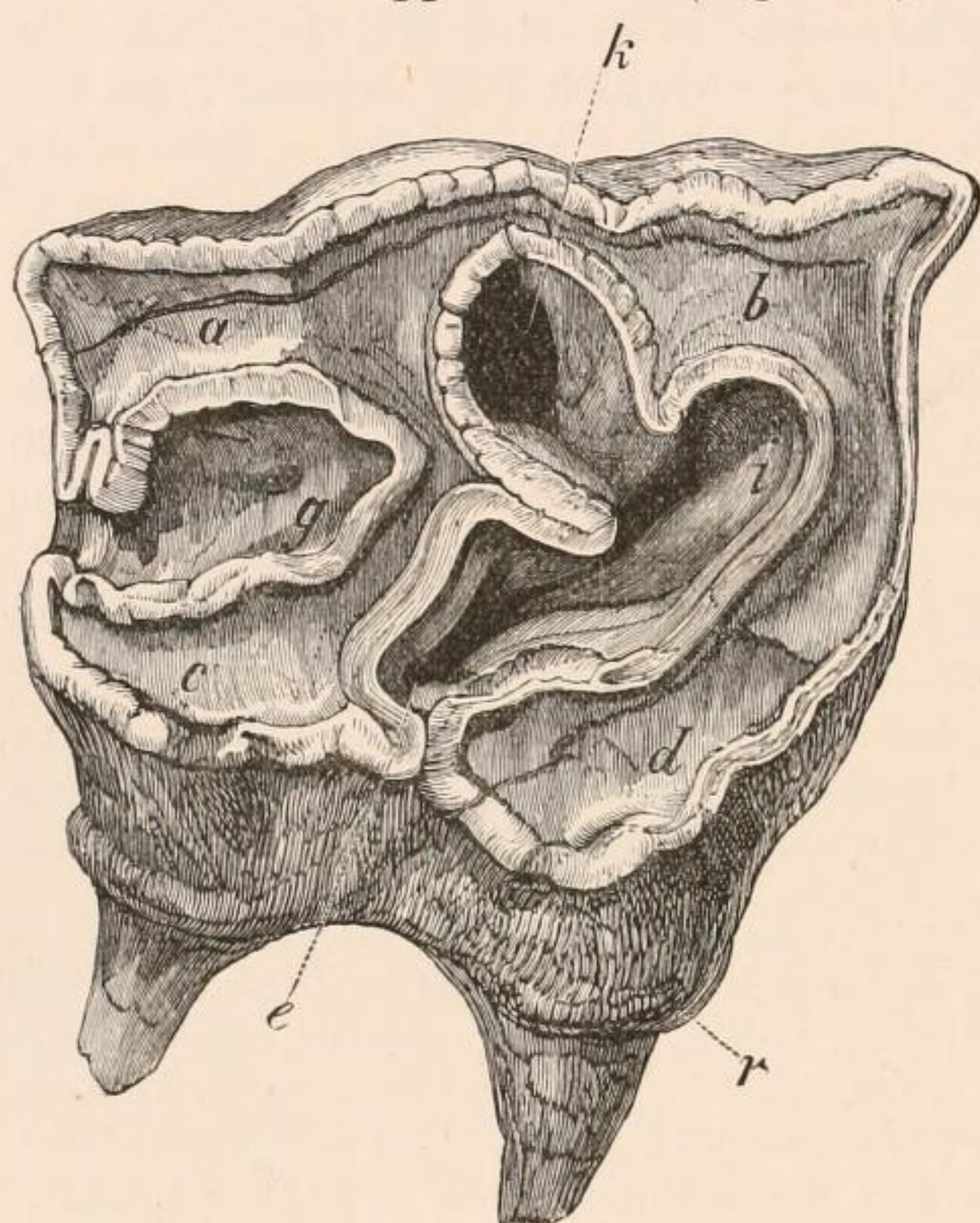


FIG. 167.—A partially worn second right upper molar of *Rhinoceros antiquitatis*. Letters as in Fig. 155 (p. 375), except *k*, which indicates a prolongation of the median valley. (After Owen.)

The skull is large, with the orbit confluent with the temporal fossa. There are either three or four digits in the manus, and three in the pes. One or more dermal horns are attached to the fronto-nasal region of the skull of existing forms, but these were wanting in some of the fossil species.

Rhinoceros.¹—Incisors variable, reduced in number, often quite rudimentary, and early deciduous. Upper canines absent. Molar series, consisting of the full number of four premolars and three molars above and below, all in contact and closely resembling each other, except the first, which is much smaller than the rest and often deciduous; and the last, in which the hinder lobe is partly

¹ Linn. *Syst. Nat.* 12th ed. vol. i. p. 104 (1766).

aborted, so that the contour of the crown is triangular. Head large, skull elongated, elevated posteriorly into a transverse occipital crest. No postorbital processes. Nasal bones large and stout, co-ossified, and standing out freely above the premaxillæ, from which they are separated by a deep and wide fissure; the latter small, generally not meeting in the middle line in front, often quite rudimentary. Tympanics small, not forming a bulla. Brain cavity very small for the size of the skull. Vertebrae: C 7, D 19-20, L 3, S 4, C about 22. Limbs stout, and of moderate length. Three completely developed toes, with distinct broad rounded hoofs on each foot (Fig. 151, p. 368), some fossil forms having a fourth in the manus. Eyes small. Ears of moderate size, oval, erect, prominent, placed near the occiput. Skin very thick, in many species thrown into massive folds. Hairy covering scanty. When one horn is present it is situated over the conjoined nasal bones; when two, the hinder one is over the frontals. These horns, which are of a more or less conical form and usually recurved, often grow to a great length (three or even four feet), and are composed of a solid mass of hardened epidermic cells growing from a cluster of long dermal papillæ. The cells formed on each papilla constitute a distinct horny fibre, like a thick hair, and the whole are cemented together by an intermediate mass of cells which grow up from the interspaces between the papillæ. It results from this that the horn has the appearance of a mass of agglutinated hairs, which, in the newly growing part at the base, readily fray out on destruction of the softer intermediate substance; but the fibres differ from true hairs in growing from a free papilla of the derm, and not within a follicular involution of the same.

The large lower cutting teeth of the typical Rhinoceroses have been very generally regarded as incisors, but comparison with fossil allied types, in which three lower incisors and canines are present, leaves little doubt but that they are really canines. The upper molar teeth present some amount of specific variation; thus while one type (Fig. 168, A) has only a simple "crotchet" projecting from the posterior transverse ridge into the median valley, in others (Fig. 168, B) this crotchet joins a "crista," or "combing-plate," projecting from the outer wall to cut off a distinct fossette from the median valley. Occasionally, however

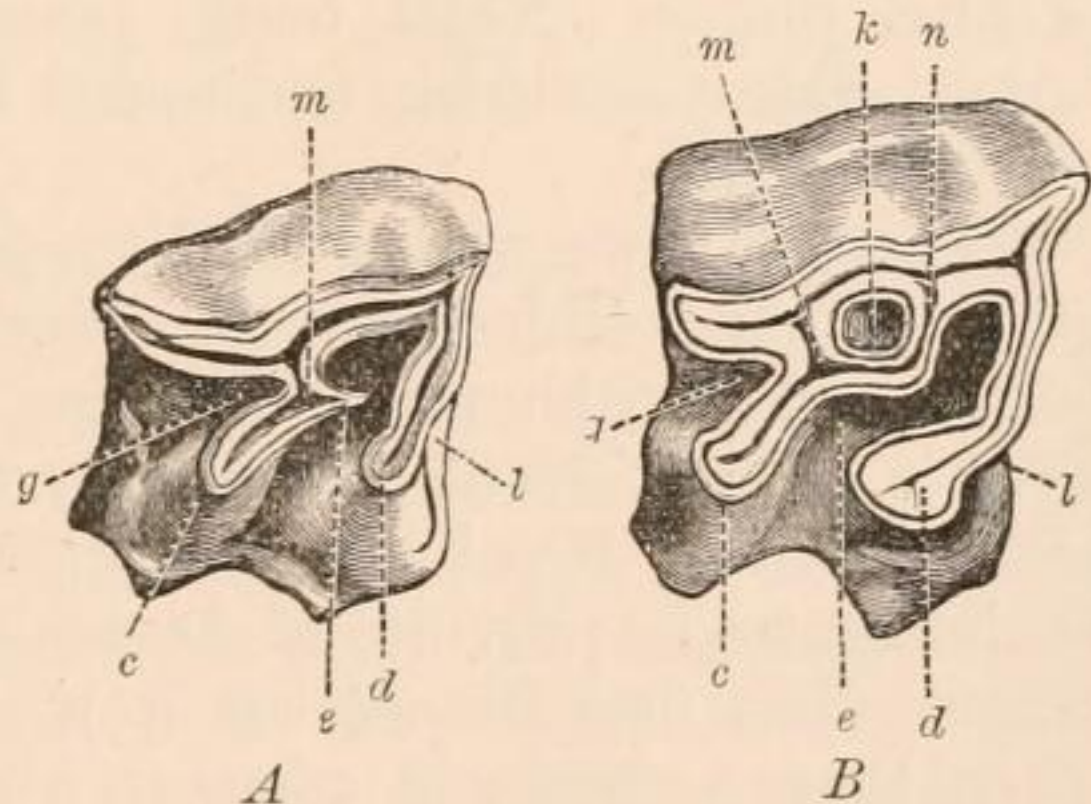


FIG. 168.—A partially worn second right upper molar of (A) *Rhinoceros sondaicus*, and (B) *R. unicornis*. *k*, Fossette cut off from median valley; *m*, crotchet; *n*, crista, or combing-plate; *e*, anterior valley; *l*, anterior intermediate column. Other letters as in Fig. 155, p. 375.

(as in Fig. 167), the crotchet and combing-plate do not completely join, although the fossette is distinctly indicated. The first upper premolar may occasionally be preceded by a milk-tooth. The Rhinoceroses differ from the Horses and agree with the Tapirs in the direction of the cæcum.

The living species of *Rhinoceros* are all animals of large size, but of little intelligence, generally timid in disposition, though ferocious when attacked and brought to bay, using the nasal horns as weapons, by which they strike and toss their assailant. Their sight is dull, but their hearing and scent are remarkably acute. They feed on herbage, shrubs, and leaves of trees, and, like so many other large animals which inhabit hot countries, sleep the greater part of the day, being most active in the cool of the evening or even during the night. They are fond of bathing and wallowing in water or mud. None of the species have been domesticated. Animals of the group have existed in both the Old and New Worlds since the latter part of the Eocene period. In America they all became extinct before the end of the Pliocene period. In the Old World their distribution has become greatly restricted, and they are no longer found in Europe and North Asia, but only in Africa and portions of the Indian and Indo-Malayan regions.

Existing Species.—The existing (as well as many of the extinct) species of Rhinoceroses naturally divide into three groups, which are regarded by some zoologists as of generic value.

Rhinocerotid, or Typical Group.—The adults with a single large compressed incisor above on each side, and occasionally a small lateral one; below, a very small incisor and a very large, procumbent, pointed canine. Nasal bones pointed in front. A single nasal horn. Skin very thick, and raised into strong, definitely arranged ridges or folds.

There are two well-marked species of one-horned Rhinoceroses. (1) The Indian Rhinoceros, *R. unicornis* (Fig. 169) of Linnæus,¹ the largest and best known, from being the most frequently exhibited alive in England, is at present only met with in a wild state in the terai region of Nipal and Bhutan, and in the upper valley of the Brahmaputra or province of Assam, though it formerly had a wider range. The first Rhinoceros seen alive in Europe since the time when these animals, in common with nearly all the large remarkable beasts of both Africa and Asia, were exhibited in the Roman

¹ Many authors use Cuvier's name, *R. indicus*, in preference to this, on the ground that there are more than one species with one horn, forgetting that the name substituted is equally inconvenient, as more than one species live in India. The fact of a specific name being applicable to several members of a genus is no objection to its restriction to the first to which it was applied; otherwise changes in old and well-received names would constantly have to be made in consequence of new discoveries.

shows, was of this species. It was sent from India to Emmanuel, King of Portugal, in 1513; and from a sketch of it, taken in Lisbon, Albert Dürer composed his celebrated but rather fanciful engraving, which was reproduced in so many old books on natural history. Both in this and the following species the post-glenoid and post-tympanic processes of the squamosal bone of the skull unite below so as to completely surround the external auditory meatus. The molar teeth are hypsodont, and have a horizontal plane of wear; those of the upper jaw (Fig. 168, *b*) being characterised by the presence of a combing-plate joining the crotchet, and

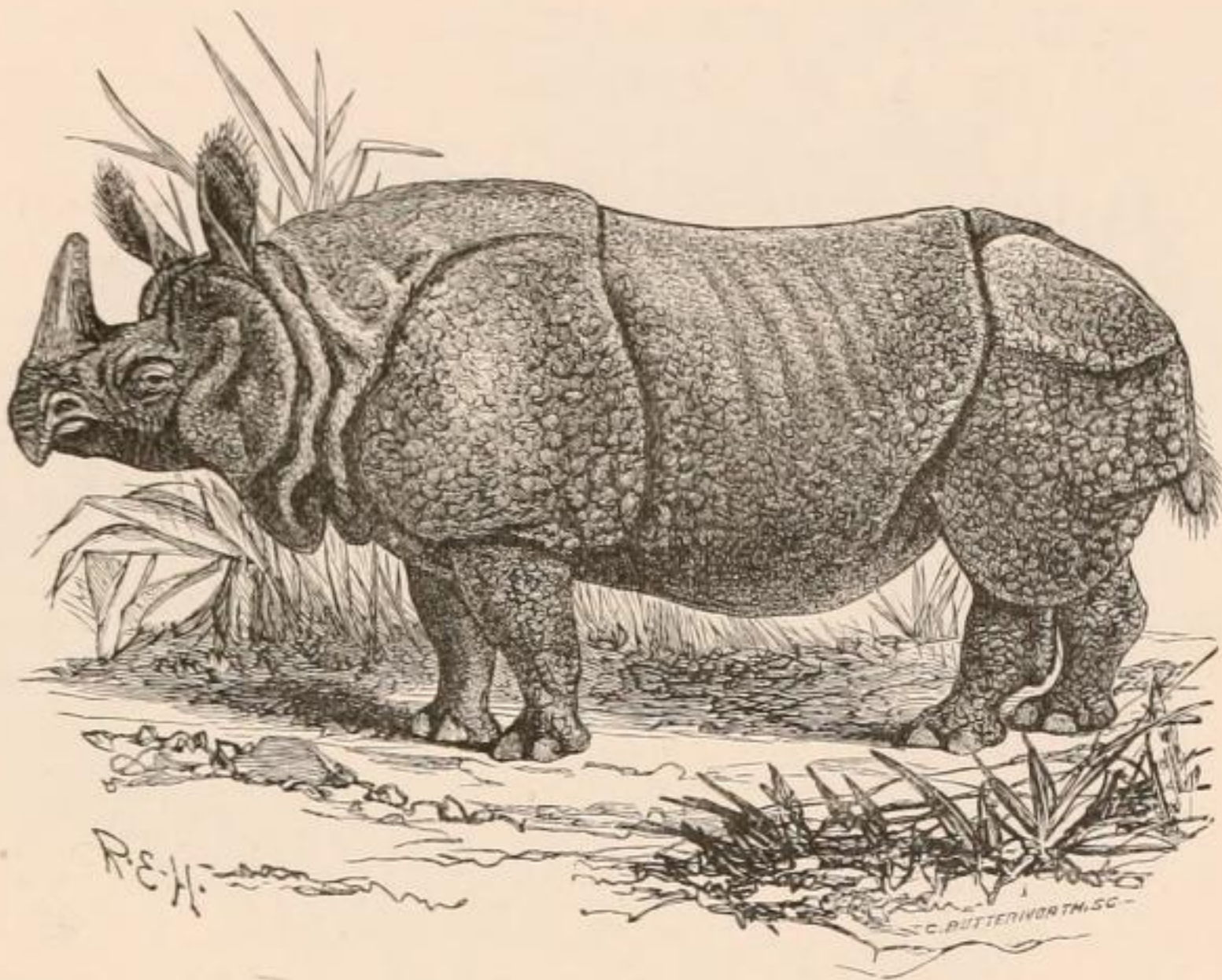


FIG. 169.—Indian Rhinoceros (*Rhinoceros unicornis*). This figure, and also figures 170, 172, are reduced from drawings by J. Wolf, from animals living in the London Zoological Society's Gardens.

the absence of a distinct buttress at the antero-external angle. The stomach departs from the ordinary Perissodactyle type. The small intestine is beset over most of its surface with long and fine villi; and the Spigelian lobe of the liver is well developed. There is a gland behind the foot. Teeth from the Pleistocene of the Narbada valley in India apparently indicate the existence of the Indian Rhinoceros at that epoch. (2) The Javan Rhinoceros (*R. sondaicus*, Fig. 170) is a smaller form, readily distinguished by dental and internal characters, as well as by the different arrangement of the plications of the skin (as seen in the figures); the horn in the female appears to be very little developed, if not altogether absent. This species has a more extensive geographical range, being found in the Bengal Sunderbans near Calcutta, Burma, the Malay Peninsula, Java, Sumatra, and probably Borneo. The molar teeth have shorter crowns than in the preceding species, and wear into ridges; those of the upper jaw (Fig. 168, *a*) having no combing-

plate, and a strongly-marked buttress at the antero-external angle (not distinctly shown in the figure). The visceral anatomy, according to Beddard,¹ does not differ materially from that of the next species. In respect to its dentition and anatomical characters this species is indeed more nearly allied to the Sumatran than to the Indian Rhinoceros; and thereby indicates that the division of the existing Rhinoceroses into separate genera is not advisable.



FIG. 170.—Javan Rhinoceros (*Rhinoceros sondaicus*).

Ceratorhine Group.—The adults with a moderate-sized compressed incisor above, and a laterally placed, pointed, procumbent canine below, which is sometimes lost in old animals. Nasal bones narrow and pointed anteriorly. A well-developed nasal, and a small frontal horn separated by an interval. The skin thrown into folds, but these not so strongly marked as in the former group. The smallest living member of the family, the Sumatran Rhinoceros, *R. sumatrensis*, Cuvier, now represents this group. Its geographical range is nearly the same as that of the Javan species, though not extending into Bengal; but it has been found in Assam, Chittagong, Burma, the Malay Peninsula, Sumatra, and Borneo. So far as can be determined during the life of the type specimen, it appears that the hairy form from Chittagong, described as *R. lasiotis*, is only a variety of this species.² The molar teeth of the Sumatran Rhinoceros are almost indistinguishable from those of the Javan species,

¹ *Trans. Zool. Soc.* vol. xii.; see also *Proc. Zool. Soc.* 1889, p. 9.

² See Beddard and Treves, *Proc. Zool. Soc.* 1889, p. 9.

and reference has already been made to the resemblance between the visceral anatomy of these species.¹ The form of the stomach is very similar to that of the Horse. The liver (Fig. 171) has a comparatively large caudate lobe, but is chiefly remarkable for the peculiar shape of the Spigelian lobe, which mainly consists of a thin strip of tissue, 8 inches long, $\frac{3}{4}$ inch wide, and $\frac{1}{4}$ inch deep. The small intestine, in place of the villi of *R. unicornis*, has throughout the greater part of its length a uniform series of thin and nearly or quite continuous transverse foldings, like the valvulæ conniventes of the human small intestine. There is no gland behind the foot.

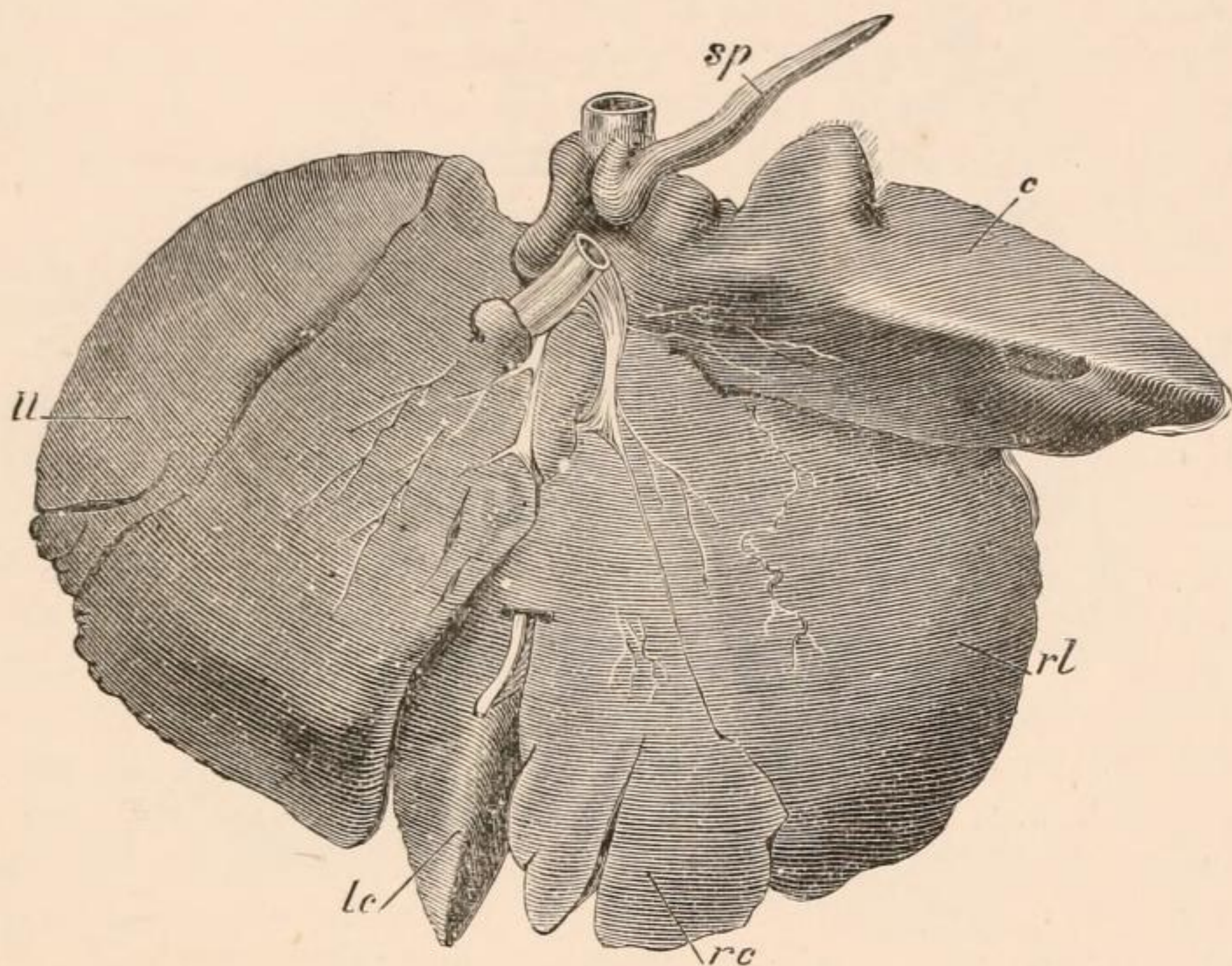


FIG. 171.—Posterior aspect of the liver of *Rhinoceros sumatrensis*. *rc*, Right central lobe; *rl*, right lateral lobe; *lc*, left central lobe; *ll*, left lateral lobe; *c*, caudate lobe; *sp*, Spigelian lobe. (From Garrod, *Proc. Zool. Soc.* 1873, p. 102.)

The post-glenoid and post-tympanic processes of the squamosal do not unite below the auditory meatus. The presence of a lateral nasal diverticulum, like that of the Horses and Tapirs, has been verified only in this species, although it doubtless occurs in the others.

Atelodine Group.—In the adults the incisors and canines quite rudimentary or entirely wanting. Nasal bones thick, rounded and truncated in front. Well-developed anterior and posterior horns in close contact. Skin without any definite permanent folds.

The two well-marked existing species are peculiar to the African continent.

¹ For the internal anatomy of *R. sumatrensis* see Garrod, *Proc. Zool. Soc.* 1873, p. 92; and Beddard and Treves, *loc. cit.*

The common Two-horned Rhinoceros, *R. bicornis*, is the smaller of the two, with a pointed prehensile upper lip, and a narrow compressed deep symphysis of the lower jaw. It ranges through the wooded and watered districts of Africa, from Abyssinia in the north to the Cape Colony, but its numbers are yearly diminishing, owing to the inroads of European civilisation, and especially of English sportsmen. It feeds exclusively upon leaves and branches of bushes and small trees, and chiefly frequents the sides of wood-clad rugged hills. Specimens in which the posterior horn has attained a length



FIG. 172.—Common African Rhinoceros (*Rhinoceros bicornis*).

as great as, or greater than, the anterior have been separated under the name of *R. keitloa*, but the characters of these appendages are too variable to found specific distinctions upon. The Common African Rhinoceros is far more rarely seen in menageries in Europe than either of the three Oriental species, but one has lived in the gardens of the London Zoological Society since 1868. The molar teeth of this species are of the general type of those of *R. sondaicus*, having no combing-plate to join the crotchet in those of the upper jaw. The conch of the ear is much rounded at its extremity, and edged by a fringe of short hairs; while the nostrils are somewhat rounded. The eye is placed immediately below the posterior horn.¹ Both in this and the following species the post-glenoid and post-tympanic processes of the squamosal do not unite below the

¹ These external points of distinction from *R. simus* are taken from a paper by Selater in the *Proc. Zool. Soc.* 1886, p. 143.

auditory meatus. Nothing is known of the anatomy of the soft parts of either of them.

Burchell's or the Square-mouthed Rhinoceros (*R. simus*), sometimes called the White Rhinoceros, though the colour (dark slate) is not materially different from that of the last species, is the largest of the whole group, and differs from all the others in having a square truncated upper lip and a wide, shallow, spatulate symphysis to the lower jaw. In conformity with the structure of the mouth, this species lives entirely by browsing on grass, and is therefore more partial to open countries or districts where there are broad grassy valleys between the tracts of bush. It is only found in Africa south of the Zambesi, and of late years has become extremely scarce, owing to the persecutions of sportsmen; indeed, the time of its complete extinction cannot be far off. No specimen of this species has ever been brought alive to Europe. Mr. F. C. Selous¹ gives the following description of its habits from extensive personal observation:—

“The square-mouthed rhinoceros is a huge ungainly-looking beast, with a disproportionately large head, a large male standing 6 feet 6 inches at the shoulder. Like elephants and buffaloes they lie asleep during the heat of the day, and feed during the night and in the cool hours of early morning and evening. Their sight is very bad; but they are quick of hearing, and their scent is very keen; they are, too, often accompanied by rhinoceros birds, which, by running about their heads, flapping their wings, and screeching at the same time, frequently give them notice of the approach of danger. When disturbed they go off at a swift trot, which soon leaves all pursuit from a man on foot far behind; but if chased by a horseman they break into a gallop, which they can keep up for some distance. However, although they run very swiftly, when their size and heavy build is considered, they are no match for an average good horse. They are, as a rule, very easy to shoot on horseback, as, if one gallops a little in front of and on one side of them, they will hold their course, and come sailing past, offering a magnificent broadside shot, while under similar circumstances a prehensile-lipped rhinoceros will usually swerve away in such a manner as only to present his hind-quarters for a shot. When either walking or running, the square-mouthed rhinoceros holds its head very low, its nose nearly touching the ground. When a small calf accompanies its mother it always runs in front, and she appears to guide it by holding the point of her horn upon the little animal's rump; and it is perfectly wonderful to note how in all sudden changes of pace, from a trot to a gallop or *vice versâ*, the same position is always exactly maintained. During the autumn and winter months (*i.e.* from March to August) the square-mouthed

¹ *Proc. Zool. Soc.* 1881, p. 726.

rhinoceros is usually very fat ; and its meat is then most excellent, being something like beef, but yet having a peculiar flavour of its own. The part in greatest favour among hunters is the hump, which, if cut off whole and roasted just as it is in the skin, in a hole dug in the ground, would, I think, be difficult to match either for juiciness or flavour."

The molar dentition is of the type obtaining in *R. unicornis*, so that in this respect *R. simus* has the same relation to *R. bicornis* as is presented by *R. unicornis* to *R. sondaicus*. The ear-conch of the Square-mouthed Rhinoceros is very large, elongated, and pointed at its extremity, which bears only a slight tuft of hair ; it is much expanded in the middle, and the lower portion has its edges united to form a short tube. The nostrils have a long slit-like aperture ; and the eye is situated behind the posterior horn.

Extinct Species.—Using the generic term *Rhinoceros* in its widest signification, a very large number of fossil forms may be referred to it, the earliest of which date from the Upper Eocene (Oligocene) Phosphorites of Central France. Only a few of the more important of these types can, however, be even mentioned in this place.

In the Pliocene Siwaliks of India *R. sivalensis* appears to have been the direct ancestor of *R. sondaicus* ; while *R. palæindicus* was probably nearly related to *R. unicornis*, although the upper molars had not developed a combing-plate.

R. schleirmacheri, of the Lower Pliocene of Europe, falls into the Ceratorhine group, although differing from *R. sumatrensis* by the union of the post-glenoid and post-tympanic processes of the squamosal beneath the auditory meatus. The Middle Miocene *R. sansaniensis* was a closely allied if not identical form.

The Atelodine group was very widely spread in past epochs. Thus the huge *R. platyrhinus* of the Indian Pliocene, and the equally large *R. antiquitatis* of the Pleistocene of Europe, were specialised forms with a dentition resembling that of *R. simus*, to which they were probably allied. An upper molar of *R. antiquitatis*—the so-called Tichorine, or Woolly Rhinoceros—is shown in the woodcut on p. 402. Of this species nearly whole carcasses, with the thick woolly external covering, have been discovered associated with those of the Mammoth, preserved in the frozen soil of the north of Siberia. In common with some other extinct species it had a solid median wall of bone supporting the nasals, from which it is inferred that the horns were of a size and weight surpassing that of the modern species. In the Lower Pliocene of Attica *R. pachygnathus* appears to have been closely allied to *R. bicornis*. Several species, such as *R. leptorhinus* (Fig. 173), *R. megarhinus*, and *R. etruscus*, occur in the European Pleistocene which do not present a marked relationship to any of the living forms. This group is also repre-

sented in the Pleistocene of Southern India by the small *R. deccanensis* and *R. karnuliensis*.

In the Upper Miocene, or Lower Pliocene, of North America numerous Rhinoceroses with incisor teeth occur which have no nasal horn, although in those forms of which the limbs are known the fore feet resembled those of existing species in having only three digits. These species have been generically separated as *Aphelops*, but so closely do they resemble existing Rhinoceroses that at one time Professor Cope proposed to refer the hornless female of *R. sondaicus* (described by Lesson as *R. inermis*) to the same genus. If these American types be included in *Rhinoceros* there seems no valid reason for separating the European Lower Pliocene and Miocene forms described as *Aceratherium*, at least some of which have

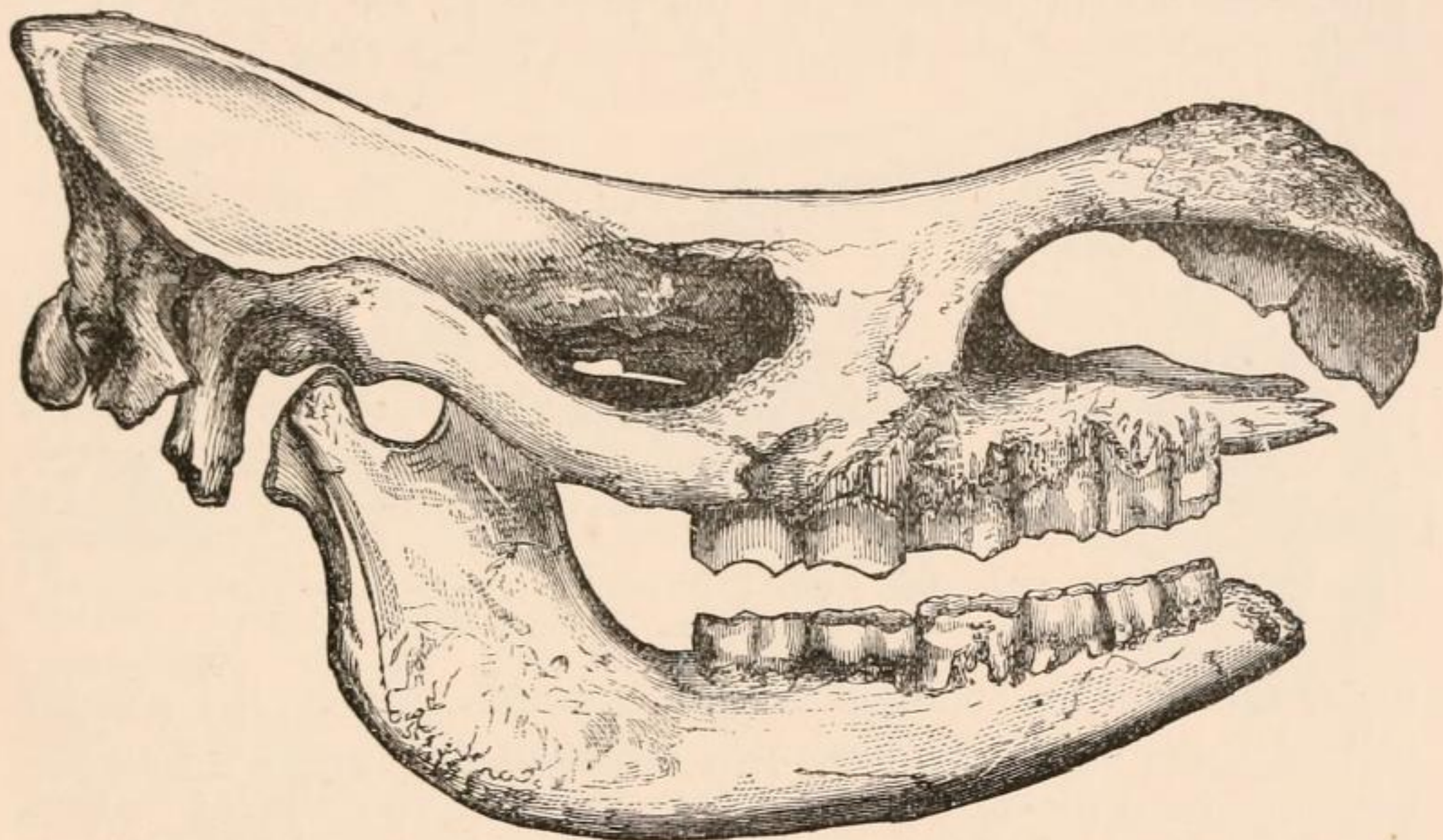


FIG. 173.—Skull of *Rhinoceros leptorhinus*, from the Pleistocene of Essex. About $\frac{1}{2}$ natural size.

four digits in the manus. This group is represented in the Upper Eocene Phosphorites of France, and also by a very large species in the Pliocene of India. Lastly, *R. minutus*, of the Lower Miocene of France, and an allied North American species are distinguished by carrying a pair of very small horns placed transversely across the nasals, from which feature it has been proposed that they should be separated generically as *Diceratherium*.

Extinct Generic Types.—The Tertiary deposits of different parts of the world have yielded remains of many extinct forms more or less closely related to the Rhinoceroses, and some of which should certainly be included in the same family; although others perhaps form the types of one or more distinct families. One of the most remarkable of these extinct types is the huge *Elasmotherium*, from the Pleistocene of Siberia, in which the dentition was reduced to two premolars and three molars on either side of each jaw. The

structure of the skeleton is essentially rhinocerotid, the skull having an ossified nasal septum, and a huge frontal prominence for the support of a very large horn. The teeth are extremely hypsodont, with the enamel plicated to a remarkable degree, and unlike those of *Rhinoceros*. The genus is evidently a very specialised one.

The other genera we have to notice are more generalised types. Of these the North American *Hyracodon*, with the full typical number of teeth, and without nasal horn, appears to connect the Rhinoceroses with the Lophodont *Hyrachyus*. The genera *Amyrnodon* and *Metamynodon* (Fig. 174), from the American Tertiaries, are forms allied to the Rhinoceroses, with the full number of incisors and canines, and the hinder lobe of the last upper molar not aborted. The lower canines are either upright, or less proclivous than in the Rhinoceroses; in *Metamynodon* the premolars are reduced to $\frac{3}{2}$. Molar teeth from the Phosphorites of Central France, described



FIG. 174.—Right half of the palatal surface of the cranium of *Metamynodon planifrons*, from the Upper Miocene of North America. (After Scott and Osborn.)

under the name of *Cadurcotherium*, are constructed on the general plan of those of the Rhinoceroses, although distinguished by their extreme narrowness; this type of tooth being very similar to that found in *Homalodontotherium* from Tertiary deposits in Patagonia. The latter has the full number of teeth, without any diastema in the series. Until we have some knowledge of the skeleton of these remarkable forms nothing definite can be said as to their serial position.

Families LAMBDOOTHERIIDÆ, CHALICOTHERIIDÆ, AND TITANOTHERIIDÆ.

These families contain a large number of more or less nearly related extinct types from Tertiary beds of both the Old and New Worlds, some of which present most remarkable deviations from the ordinary Ungulate structure. All are characterised by their brachydont molars, which depart widely from the normal lophodont type. The upper molars consist of four columns, of which the two external ones are expanded to form an outer wall; the posterior pair being connected in some cases by an oblique transverse ridge,

while there may be traces of an anterior ridge. The premolars are simpler.

Lambdaotheriidae.—This family is confined to the Upper Eocene and Miocene of North America, where it is represented by *Lambdaotherium*, *Palæosyops*, and *Limnosyops*; it presents the normal type of foot structure, and all the genera except the first have the full complement of teeth. There were four digits in the manus. The last lower molar has a third lobe. *Limnosyops* differs from *Palæosyops* in having two inner columns to the last upper molar.

Chalicotheriidae.—The genus *Chalicotherium*, which is found in the Tertiaries of Europe, Asia, and North America, differs so remarkably in the structure of the feet from all other Ungulates that it has been proposed to regard it as the representative of a distinct order, Ancylopoda. The molars are, however, almost indistinguishable from those of the preceding and following families; while the cervical vertebræ and portions of the limbs are of a Perissodactyle type. On the other hand, the femur has lost its third trochanter; while the phalanges are strangely modified, the terminal ones forming long curved claws, while the others (Fig. 175) have strong ginglymoid distal articulations. These phalanges were, indeed, long regarded as referable to Edentates, being described in Europe as *Macrotherium*, and in the United States as *Moro-therium* and *Moropus*. *Ancylotherium*, of the Grecian Pikermi beds, is founded upon phalanges which indicate an allied genus. The Indian species of *Chalicotherium* is distinguished by the loss of the incisors and the upper canine; while all the species want the first premolar.

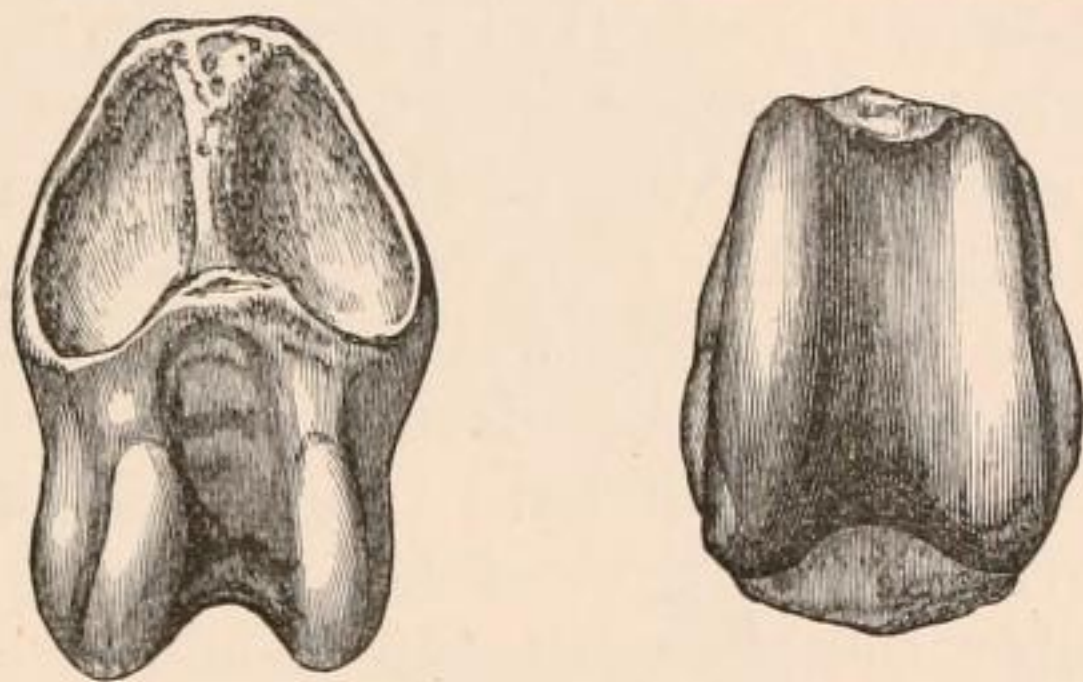


FIG. 175.—Anterior and distal aspects of a phalangeal bone of *Chalicotherium sivalense*. (From the *Palæontologia Indica*.)

Titanotheriidae.—This exclusively North American family includes gigantic forms closely allied to the *Lambdaotheriidae*, but with the last upper premolar as complex as the molars, and frequently with large bony protuberances in the nasal region. The best known genus, *Titanotherium* (*Menodus*,¹ *Brontotherium*, *Symborodon*, *Allops*, etc.), may either have the full complement of teeth, or the incisors may be reduced to $\frac{2}{0}$. The canines and incisors are small, and there is no diastema when the full dental series is developed. The skull is very like that of the Rhinoceroses; but has a transverse pair of large bony prominences on the nasal region, varying considerably in shape and size in the different species, which in the living animal were probably covered with horny sheaths. The third

¹ This name is the earliest, but is preoccupied.