

Article IV.—A COMPLETE SKELETON OF TELEOCERAS FOSSIGER. NOTES UPON THE GROWTH AND SEXUAL CHARACTERS OF THIS SPECIES.

By HENRY FAIRFIELD OSBORN.

PLATES IV AND IVA.

The remarkable series of Rhinoceros skulls in the Cope and American Museum Collections from the Upper Miocene or Loup Fork Beds of Kansas and Nebraska, has finally been prepared for exhibition and research purposes. Associated with them, and of very great value, is a complete skeleton representing an aged female of very large size, mounted from materials belonging to several individuals secured by our excavations in Phillips Co., Kansas, under the direction of Dr. Wortman in the months of September, October and November, 1894.

By the comparison of the 16 skulls and 13 jaws, representing both sexes and all stages of growth, we are enabled for the first time to positively define the animal long known as *Aphelops fossiger*, to distinguish it both from *Rhinoceros* and *Aceratherium*, and point out its important sexual and individual variations. The writer's attention was first drawn to the largely disregarded sexual and age characters of fossil Ungulates in studying the group of Titanotheres;¹ the extinct Rhinoceroses conform to the laws which were observed in that group, and which are familiar enough among living types, namely: males, of larger size with more robust and rugose skulls; horns, if present, more prominent; canines largely developed; incisors and anterior premolars disappearing in adults.

We owe to Hatcher² the valuable demonstration that *Aphelops fossiger* bore a terminal horn upon the nasals, although he assigned this character to a type which he supposed represented a new species, namely, *Teleoceras major*. Hatcher's type of *T.*

¹ 'The Cranial Evolution of Titanotherium,' Bull. Am. Mus. Nat. Hist., July 1, 1896, pp. 157-197.

² American Geologist, March, 1894, pp. 149-150.

major proves to be a middle-aged male of *A. fossiger*, and his distinction of *Teleoceras* as a genus supersedes *Aphelops* Cope,¹ because Cope² originally applied the term *Aphelops* to *A. megalodus*, defining it as an Acerathere with only three premolar teeth in the lower jaw. This is true of the type species (*A. megalodus*), but this species should, so far as we know at present, be referred to the genus *Aceratherium*, in which the lower premolars vary from four to three in number according to age and individual variation, as in the living Rhinoceros.

Technically, however, Hatcher's definition did not clearly distinguish *Teleoceras* from *Rhinoceros*, as he himself stated (*op. cit.*, page 245). Our abundant material proves not only that *Teleoceras* is a Rhinoceros with a median horn on the tips of the nasals, but that it is fully distinguished from the genus *Rhinoceros* as follows :

	Horns.	Lower Premolars.	Digits.
Genus <i>Rhinoceros</i> . . .	Upon anterior portion of nasals . . .	4 in young, 3 in aged individuals	3-3
Genus <i>Teleoceras</i> . . .	Upon tips of nasals	3 in young, 2 in aged individuals	3-3

The reduction of the lower grinders to 5 in *T. fossiger* (as compared with 6 in *Rhinoceros*) is a very important and distinctive character, as it absolutely excludes *Teleoceras fossiger* from the ancestry of any of the modern Rhinoceroses, and shows it to have represented a distinct side phylum, as Scott and Osborn had already determined from its skeletal characters.

EXCAVATION OF THE SKELETON.

The Phillips County Quarry,³ near Long Island, Kansas, was discovered in 1883 by Mr. Charles Sternberg, who collected for the University of Kansas and for the Harvard University Museum. From the latter collection Scott and Osborn procured materials

¹ American Naturalist, March, 1894, pp. 241-246.

² 'On Some New Extinct Mammalia from the Tertiary of the Plains.' Palæon, Bull. No. 14, Proc. Am. Phil. Society, July 25, 1873.

³ See Williston, 'Restoration of *Aceratherium fossiger* Cope,' Kansas University Quarterly, Vol. II, No. 4, April, 1894, pp. 289-290.

for the restoration which they published in 1890.¹ Subsequent collections were made by Sternberg and Hatcher for the United States Geological Survey, between 1884 and 1886. Later Professor Cragin collected here, and in 1891 Mr. E. P. West of the University of Kansas, aided by Mr. T. R. Overton, began the extensive collections which led to the preparation of the skeleton for the University under the direction of Professor Williston.² This skeleton, as mounted in the Kansas Museum and described by Williston, gives a much more accurate idea of this animal than the previous restoration by Scott and Osborn, in which the chest is represented far too shallow.

Its principal dimensions are as follows: Length, not including tail, 9 ft.; height, 4 ft.; greatest girth, 9 ft., 4 in.

The measurements of the American Museum skeleton as mounted are: Length, 10 ft. 2 in. to bend of tail; height at withers, 4 ft. 1 in.; greatest girth, 9 ft. 2 in.

From the above accounts, and especially from our own observations, it is seen that this quarry represents an old bone-bed, probably the deposit of some stream or small river along which the rhinoceroses herded in great numbers. The materials collected by the American Museum party are extremely numerous, especially in the skeletal parts, the figures running somewhat as follows: Skulls, 4; scapulæ, 7; vertebræ, 159; humeri, 13; radii, 20; ulnæ, 10; carpals, 90; metacarpals, 38; pelves, 5; femora, 8; tibiæ, 20; astragali, 22; calcanea, 18.

In this typical bone-bed are mingled individuals of both sexes and of all sizes, and the proximity of one specimen to another is not a certain guide. There are certain spots, however, where considerable portions of individual skeletons have drifted together. We associate the skull and pelvis in our mounted specimen, for they are of similar age and were found within about six feet of each other, the skull being that of a fully adult female, and the pelvis indicating a corresponding age, because the ilia are united above the sacrum; with the pelvis moreover was found a part of the jaw belonging to the skull; also with this pelvis

¹ 'Preliminary Account of the Fossil Mammals from the White River Formation contained in the Museum of Comparative Zoölogy.' Bull. Mus. Comp. Zoöl., Vol. XIII, No. 5, p. 92, 1890.

² *Op. cit.*

belong a femur, tibia and fibula, astragalus, calcaneum and cuboid of one side, several metacarpals and metatarsals and two cervical vertebræ. The selection of the other limb and foot-bones was made from these as a guide.

Similarly about 300 feet distant were found the principal ribs which have been selected for this mount, characterized by the very rugose appearance and oblique lines for the insertion of the abdominal muscles (*sacro-lumbalis, longissimus dorsi*). Near these ribs were large jaw and limb-bones corresponding in size with those placed in the mounted skeleton. Apart from these probable associations, the main principle of selection adopted throughout has been that of the age and size standard, after a careful comparison of all the elements. In each region the largest and oldest bones were chosen. Upon this principle the ribs are shown to be of very great length; the chest girth exceeds that indicated in the Scott-Osborn restoration, and equals that in the mount in the Kansas Museum, which has heretofore appeared extreme. In additional support of this correlation of material belonging to different individuals, this bone-bed gives evidence of the existence of only one species of Rhinoceros, namely, *T. fossiger*. All the differences observed are due to growth, individual and sexual variations, as set forth below.

The following description is supplementary to the very full statements of the skeletal characters of *T. fossiger* made by Osborn in 1890.

DESCRIPTION OF MOUNTED SKELETON.

(Museum Catalogue Number, 2604.)

Mounting.—The composite skeleton shown in the accompanying plate (Plate IV) has been mounted with remarkable skill by Mr. Adam Hermann, preparator. All the bones are traversed by small steel rods, rendering them firm and solid and the limbs self-supporting. As shown in the photograph, the only visible parts of the metal framework are the two uprights for the shoulder and skull, and pelvis. The bones are in a beautiful state of preserva-

tion, and except in the case of the artificial elongation of a few of the ribs and completion of the upper border of the scapulæ (from complete scapulæ of smaller size) no plaster was necessary.

Skull.—Nasals smooth, expanding into a laterally-compressed beak anteriorly, probably characteristic of adult females, with sharp sides and a lateral notch. Temporal ridges forming a sessile sagittal crest; premaxillaries with triple infraorbital foramina; lachrymals with well-defined, knoblike projection; zygomata very deep, with extensive attachment for masseter muscle inserted on a well-defined ridge on angle of jaw. Occiput broad and low. Jaw with a single mental foramen below the second or third premolar, and a marked median depression between the canines upon front surface of the chin.

Dentition. — Formula: $I\frac{2}{1}$, $C\frac{0}{1}$, $P\frac{3}{2}$, $M\frac{3}{3}$. Lower and median upper incisors vestigial; lower canines worn, enamel measuring 40 mm. ($1\frac{1}{2}$ inches). Adult condition indicated by very slight wear of crown of third superior molar. Upon outer surfaces of upper grinders parastyle nearly obsolete. First upper molar with enamel crown of same length as that of premolars. Second upper molar with sudden elongation or hypsodontism, with enamel crown measuring 70 mm. Thus $m\frac{2}{2}$ and $m\frac{3}{3}$ elongate or hypsodont, and of great service as reserve teeth for old age. Molars with secondary folds characteristic of the species.

Vertebrae.—Atlas much narrower than in *R. indicus*, with vertebrarterial canal directly traversing the transverse process; axis with a very low spine; cervicals 1-3, with transverse process restored; characters of inferior lamellæ somewhat conjectural.

Supposed Vertebral Formula: C.7, D.19, L.3, S.5.

The above formula is purely conjectural. It is made to conform to that of the living *R. unicornis* and *R. sumatrensis*.¹ Seventeen of the ribs are provided with both capitular and tubercular facets. The ribs are extremely long and powerful, not very widely arched; lower line of chest nearly reaching the ground, as in

¹ The definitely ascertained formula of the Oligocene *A. tridactylum* is D, 19; L, 5; S, 3. This animal gives us no clue to *A. fossiger*, because it belongs to the Diceratheres series.

the Hippopotamus ; girth (9' 2") exceeding that of *R. unicornis* (8' 9") ; chest section deep and heavy, rather than rounded as in *R. unicornis*.

Scapula very characteristic, triangular in contour, with pointed upper border ; narrow supraspinatus and very broad, triangular infraspinatus fossa ; acromion placed midway on spine, reflected backwards, so that attachment of deltoid and trapezius muscles is elevated. Coracoid process forming a prominent rugosity for short head of biceps ; bicipital tendons passing through a double osseous groove upon front of humerus (as in *R. unicornis*, *R. bicornis* and *R. simus*)^{1,2} and inserted distally in a prominent rugosity upon front of radius. Humerus exhibiting prominent rugosity for subscapularis muscle interior to inner tendon of biceps ; greater tuberosity consisting of a large incurved hook for supraspinatus muscle, and a separate and distinct knob for infraspinatus muscle ; powerful deltoid ridge, everted but not hooked ; distally a large external condyle for extensor muscles, which exhibit rugose insertion areas in the proximal ends of metapodials.

Pelvis with ilia arching over and coalescing above the five sacral vertebral spines, affording a stout area of origin for *latissimus dorsi*, *erector spinae* and *gluteus maximus* muscles, correlated with support and propulsion of the enormous abdomen ; a foramen piercing the posterior superior border of the ilium. Femur with rugose but not very prominent greater trochanter ; lesser trochanter for insertion of *gluteus maximus* muscle, much less prominent than in *R. unicornis*, and not hooked ; third trochanter not prominent. Pubis and ischium more slender than in *R. unicornis*. Tibia with a characteristic fissure in the cnemial crest dividing it into two distinct tuberosities for patellar tendons (unlike single crest of *R. unicornis* and *A. malacorhinus*). Fibula fused with tibia in aged individuals.

¹ Busk 'On the Ancient or Quaternary Fauna of Gibraltar,' *Trans. Zool. Soc.*, 1877, p. 97.

² De Blainville, 'Ostéographie,' *Atlas 3, Gen. Rhinoceros*, Pl. iv.

COMPARATIVE MEASUREMENTS.

	<i>Teleoceras fossiger.</i>		<i>Rhinoceros indicus.</i>	
	Feet.	Meters.	Feet.	Meters.
Total length to bend of tail.....	10. 2	3.10	10.8	3.05
Height, skull.....	4. 1	1.23		
" withers.....	3. 11½	1.21	5.6½	1.69
Breadth, across pelvis.....	2. 10	0.87	2.8	0.82
" " ribs.....	2. 11	0.89		
Skull, length condyles to pmx.....	1. 11½	0.59	2. 1½	0.65
" width across arches, dental series.....	1. 3	0.38		
Vert. column, total excluding caudals*.....	7. 9	2.36	8.2	2.48
Cervicals, including intervert. spaces.....	1. 6½	0.47		
Dorsals, " " ".....	4. 6½	1.39		
Lumbar, " " ".....		0.24		
Sacral, " " ".....		0.21		
Rib (? 5th)—length (around the curve).....		0.80		
(? 10th).....	3. 3½	1.01		
Girth of chest at 11th rib (estimated).....	9. 2	2.80	2.9	2.66
Fore limb, total flexed (ball of hum. vert. to ground).....	2. 4½	0.72	3.5	1.04
Scapula.....		0.38		
Humerus.....		0.31	1.4	0.40
Radius.....		0.24	1.3	0.38
Ulna.....		0.34		
Mc. iii.....		0.105	.8	0.20
Hind limb, total flexed (ball of femur vent. to ground).....	2. 7½	0.80	3.8½	1.13
Femur.....		0.41	1.8	0.52
Tibia.....		0.23	1.2½	0.36
Mt. iii.....		0.100	7. ½	0.19
Lower jaw, total length, condyle to tip of canine.....		0.51		
Dentition, to tip of canine.....		0.35		
Grinding series.....		0.26		
*Length caudals (along curve).....		0.81		

From the above measurements it appears that from head to tail *T. fossiger* is only six inches shorter than *R. unicornis*, while the back is eighteen inches (.580 mm.) nearer the ground. This remarkable lowering of the trunk is chiefly caused by the great reduction of the fore arm, fore leg and metapodials. The humerus and femur are respectively only 90 and 110 mm. shorter than in *R. unicornis*, while the radius and tibia (typically shorter elements) are respectively 140 and 130 mm. shorter, and the metacarpals and metatarsals are respectively 90 and 950 mm. shorter. This limb reduction is very striking. At the same time the abdom-

inal girth exceeds that of *R. unicornis*, justifying Cope's conclusion that this animal had rather the proportions of the Hippopotamus than of the Rhinoceros. It will be recalled¹ that *R. unicornis* has a lower abdominal line than *R. sondaicus* or *R. sumatrensis*, or than either of the African Rhinoceroses. *T. fossiger*, therefore, had a totally different external appearance from any existing form.

JUVENILE, SENILE AND SEXUAL CHARACTERS.

There are conspicuous differences in the dentition of different specimens, all of which may be explained as due to influences of growth or sex.

In the young calf jaw (No. 2608) the milk cutting teeth are as follows: di_2 , dc_1 , dp_3 . In the young *R. sondaicus* (*R. javanicus*), according to de Blainville, we similarly observe two milk incisors. A somewhat older calf of *T. fossiger* shows di_1 , dc_1 , dp_3 .

Even in older jaws there is evidence in one case (No. 8391) of two lower incisors upon one side, the formula being: i_{2-1} , c_1 , p_3 ; m_3 , as indicated by the incisor alveoli. The outer incisors (i_3) in the lower jaw tend to drop out at an early age, leaving only the alveoli; but the vestigial upper incisors (i^2) are remarkably tenacious, although entirely useless.

The canines vary strikingly in the sexes. In the females (Nos. 2604-6, 2610-11, 2623), as shown in the photographs, they are of moderate size. In certain males (Phillips Co., Kansas, No. 2612; Republican River, Nebraska, Nos. 8391-2) they exceed in size any that have been recorded in other Rhinoceroses living or extinct, as shown in Pl. IVA.

No jaw shows any vestige of p_1 . P_2 is present in young jaws, and invariably absent in very aged jaws. Its dehiscence is correlated with the coming into use of m_3 . The upper molars, especially the second and third, are extremely hypsodont, the unworn enamel of the crown measuring, respectively: $m_2 = m_3 =$. They are reserved for middle and old age.

The size of the skull differs considerably in the two sexes, the female skulls (Phillips Co., Kansas, Nos. 2604, 2607, 2622-3; Decatur Co., Kansas, No. 8388; Republican River, Nebraska, No.

¹ See Sclater 'On the Rhinoceroses now or lately living in the Society's Menagerie,' *Trans. Zool. Soc.*, 1875, pp. 645-651.

8393) being smaller and less rugose, with less prominent sagittal crests, and decidedly smaller nasals, as shown in Pl. IVA. In old females the nasals acquire a slightly rugose surface, and probably bore a small horn. In the males (Decatur Co., Kansas, Nos. 8385, 8396; Republican River, Nebraska, No. 8420) the nasals become greatly thickened at the extremities (Pl. IVA), forming a vertically compressed plate, which undoubtedly bore a considerable horn. Differences in size are observed in skulls from various localities, those from Decatur Co., Kansas, and from Nebraska, being larger than those from the Phillips Co. quarry, which are probably due to differences of geological level, the species running into a larger and more robust type before its extermination.

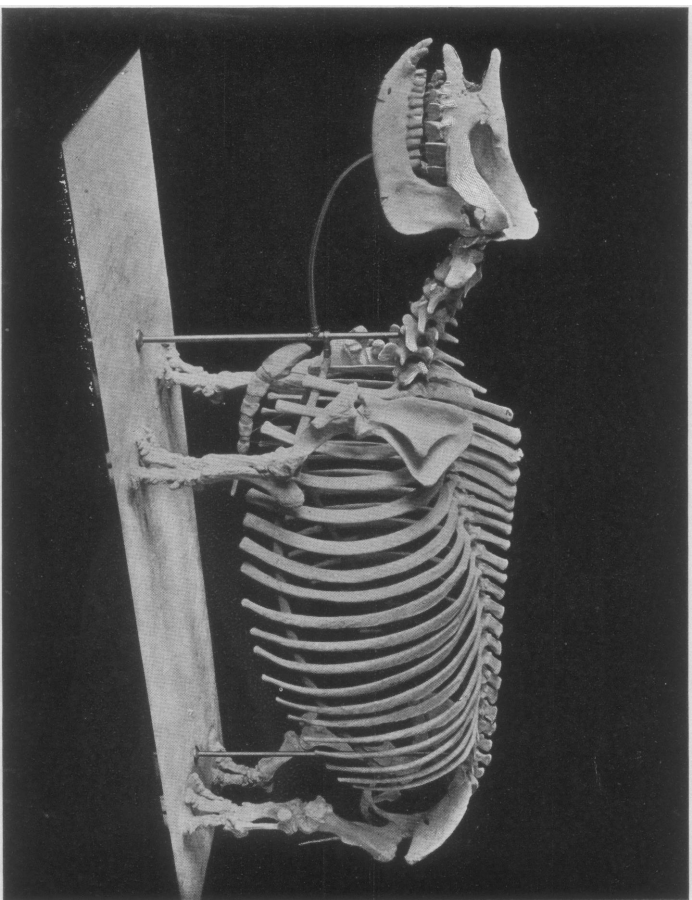
Growth-changes in the limbs are especially observed in the close fusion of the fibula with the tibia, and of the remarkable arching over of the sacrum by the superior borders of the ilium; this whole area above the sacrum forming a solid plate.

CONCLUSIONS.

T. fossiger may be briefly characterized as a brachycephalic, extremely short-limbed Rhinoceros, partly aquatic in its habits, with a very large brain and no diploë of the skull.¹ It parallels the African Rhinoceroses *R. simus* and *R. bicornis*, in the form of the humerus, femur and atlas, and in the terminal position of the nasal horn. The occiput, however, is widely different from that of the African Rhinoceroses, as well as of *R. sumatrensis*, resembling rather that of *R. unicornis*, although less pitched forward. The limbs are much shorter than in any living type, and, as pointed out by Pavlow,² at once recall those of *R. brachypus* and *R. aurelianensis*. A further comparison of *T. fossiger* strengthens the resemblance to the latter form. The proportions of the skull, limbs and metapodials are very similar. In both the cnemial crest of the tibia is double; the secondary folds of the superior molars are similar, as well as the general form of the skull. Further details will be given in the writer's forthcoming Memoir on the Extinct Rhinoceroses.

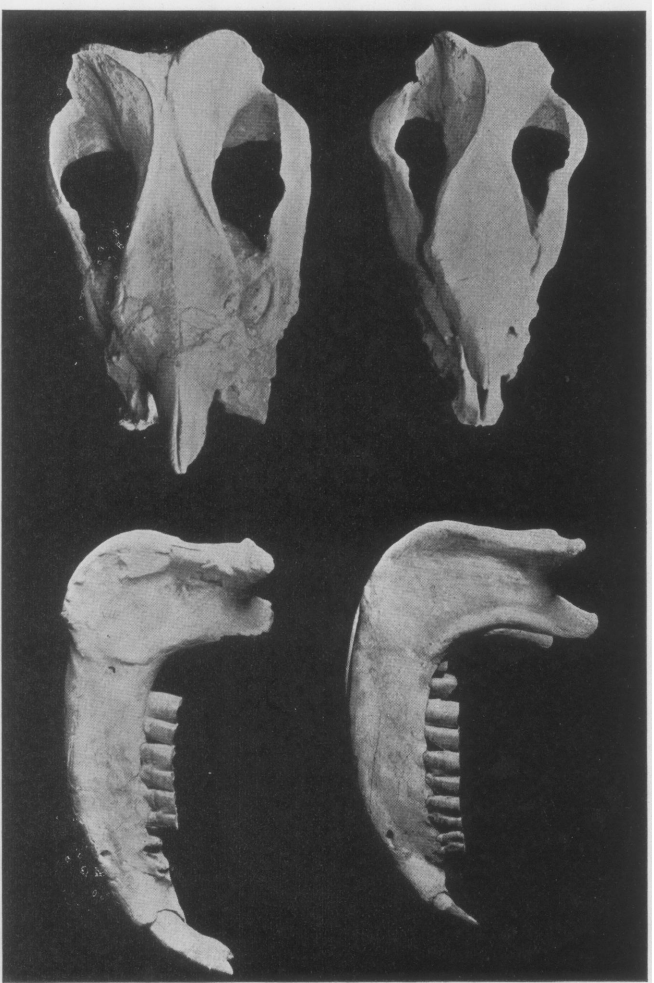
¹ See Scott and Osborn, *op. cit.*, 1890, p. 93.

² 'Les Rhinocérâtes de la Russie et le développement des Rhinocérâtes en général,' Bull. d. la Soc. d. Nat. d. Moscou, 1892.



MOUNTED SKELETON OF *Teloceras fossiger*.

One-twentieth natural size.



Taloceras fossiger.

FEMALE SKULL (No. 8393) AND JAW (No. 2606).

MALE SKULL (No. 8396) AND JAW (No. 2612).

