

THE SKELETON OF NANNOTRAGULUS.

F. B. LOOMIS.

During the summer of 1931 the Amherst College Expedition found a deposit of small bones in the Lower Rosebud beds near Porcupine Creek in South Dakota. This included a skeleton of *Oligobunis gemmarosae*, parts of several individuals of *Merychys curtus* and parts of at least four individuals of the small hypertragulid, *Nannotragulus*, to be considered here. All parts of the skeleton, except the cervical and dorsal vertebrae, and the humerus, are represented, the feet being preserved even to the sesamoids under the toes. This animal belongs to the same species as do the skull fragments found nearby and assigned by Matthew¹ to Lull's *Nannotragulus loomisi*. The type specimen of the genus and species was found by Lull² in 1908 on Big Muddy Creek in eastern Wyoming in beds which at the time were referred to Lower Harrison age; but which have since been regarded as equivalent to the Lower Rosebud because of the considerable number of species common to the two beds.

When Lull described the genus he was inclined to place it near *Hyphisodus*, and Matthew placed it near *Hypertragulus*, both genera in the family Hypertragulidae. I find my material very close to *Hypertragulus hesperius* of the John Day. Matthew differentiates the genus mainly on the greater hypsodonty of the molars; but in spite of this I would be inclined to place the material in the genus *Hypertragulus*, were it not for one feature brought to light by this new material, namely, the presence of complete side toes on the hind feet. Had the material been less well preserved, this would have been overlooked as the toes are directly behind the larger median ones. The presence of these toes is a fundamental distinctive feature, unless at some future time such side toes are also found on *Hypertragulus*: but until then the genus *Nannotragulus* is distinctly separated from the other Hypertragulids.

The skull here figured is a composite of the Amherst specimens, one of which has the complete upper and lower dentitions, together with the bulla and occipital condyle from Matthew's specimen. It shows a skull moderately prolonged in front so that the anterior premolars are widely spaced. The whole snout is compressed from side to side so that the nasal

¹ American Museum Novitates, 215, p. 4, fig. 3, 1926.

² This Journal, 4, 116, 1922.

region is very narrow. The orbits are large and the whole skull widens just in front of the eye sockets and also swells upward. The orbit is open behind and the brain case not much

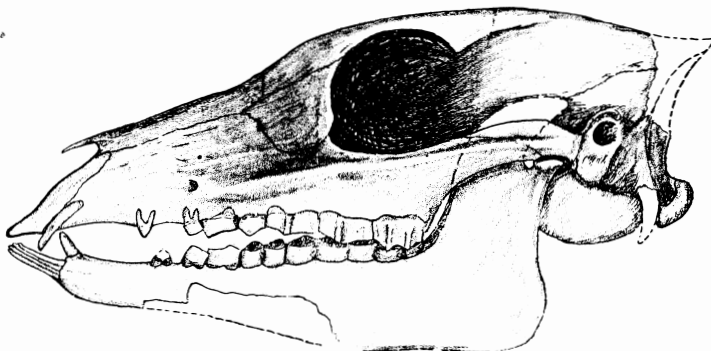


Fig. 1. *Nannotragulus loomisi*, skull, nat. size.

swollen. Beginning at the rear of the jugal arch an almost straight ridge runs forward, not dying out until the region of premolar 2, a ridge very suggestive of that on *Tragulus*. The bulla is moderately large, and the auditory meatus situated rather high in relation to the jugal arch.

The dental formula is $\frac{0}{3} \frac{1}{1} \frac{4}{4} \frac{3}{3}$. In the upper series the incisors are entirely wanting, a shallow groove occupying the surface where the alveoli would be. The canine is slender and curved and behind it there is a considerable gap back to premolar 1. This first premolar is a tiny two-rooted tooth



Fig. 2. *Nannotragulus loomisi* upper dentition above and lower dentition below, nat. size.

behind which there is a lesser gap before one comes to the two-rooted second premolar. Premolar 3 is three-rooted and widened transversely but does not have an inner cusp. Premolar 4 has the single inner crescent-like cusp and a fairly large cingulum on the posterior side of the tooth. The molars have

the outer crescents thickened as in *Hypertragulus* and bovids. On the well-worn teeth of the Amherst specimens there are no tiny spurs projecting into the interior pits; but in the Yale specimen where the teeth are little worn, these do show. On the inner side there are weak cingula in the gaps between the anterior and posterior crescents. The three lower incisors are long and slender, the crowns flattened to narrow spatulate form, and the incisiform canine shows no differentiation from the incisors. Premolar 1 is caniniform and follows close behind the incisor group, but behind it there is a long gap back to the two-rooted second premolar. Behind premolar 2 there is but a short gap to premolar 3. Premolar 4 is of the hypertragulid type with the anterior ridge curved inward to the front and the posterior ridge bifurcated behind. The molars have the inner crescents thickened and in our specimens there are small but well-developed mesostyles.

MEASUREMENTS.

Length of the skull, snout to occipital condyle.....	91 mm.
Length of upper dentition, canine to molar 3.....	49 mm.
canine to premolar 1.....	9 mm.
premolar 1 to 2.....	5 mm.
molar 1 to 3.....	19 mm.
Length of lower dentition, incisor 1 to molar 3.....	55 mm.
premolar 1 to 2.....	10 mm.
molar 1 to 3.....	21 mm.

The scapula has a small oval glenoid cavity, and a relatively long and narrow neck. It is peculiar in the uncompromisingly angular outline, the upper end being cut almost straight across. The spine is low and placed close to the anterior margin, as in *Tragulus* and the hypertraguloids. We have no humerus. The radius and ulna are fused throughout their entire length. There is some variation in the three specimens at hand, but in all cases the ulna is behind the radius and stands away from it as it does in the modern *Tragulus*. The upper end of the olecranon process is squared and the sigmoid notch is relatively small. The carpus is typically hypertraguloid, the upper row being made up of the scaphoid, lunar and cuneiform, while the lower row is reduced to two ossicles, the unciform and a fused magnum and trapezoid. The manus is composed of four metacarpals all free from each other, but closely appressed. Metacarpals II and V are reduced and partly behind the two median ones. On the distal ends of metacarpals III and IV are sharp carinae, which, however, only occupy the posterior or palmar half of the surfaces. Behind each metacarpal there

are two sesamoids, those of digits III and IV being short and wide, almost hemispherical in outline, while those of digits II and V are relatively smaller and narrower. The phalanges are long and slender. Throughout, the whole front leg approximates that of *Tragulus*.

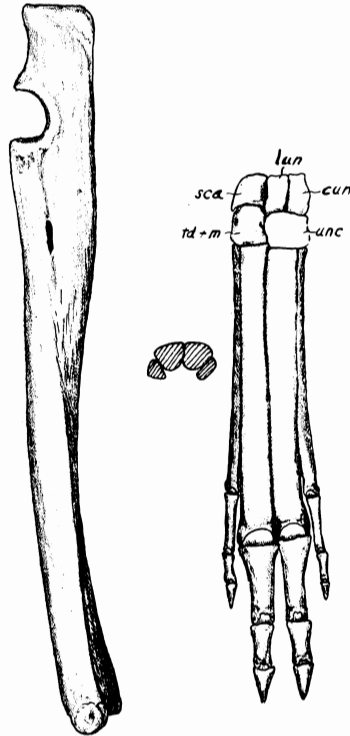


Fig. 3. *Nannotragulus loomisi*, fused radius and ulna and the right fore-foot, nat. size. cun. cuneiform, lun. lunar, sca. scaphoid, td. m. trapezoid fused with magnum, unc. unciform.

MEASUREMENTS.

Length of radius	79 mm.
Length of ulna	94 mm.
Length of carpus	10 mm.
Length of metacarpus III	41 mm.
Length of metacarpus II	32 mm.
Length of proximal phalanx III	11 mm.
Length of proximal phalanx II	7 mm.
Length of middle phalanx III	6 mm.
Length of middle phalanx II	3 mm.
Length of ungual phalanx III	5 mm.
Length of ungual phalanx II	2 mm.

The pelvis is long and slender, very like that of *Tragulus*, the illium with a long neck and the pubis sharply turned under and uniting with the ischium along an angular suture. The

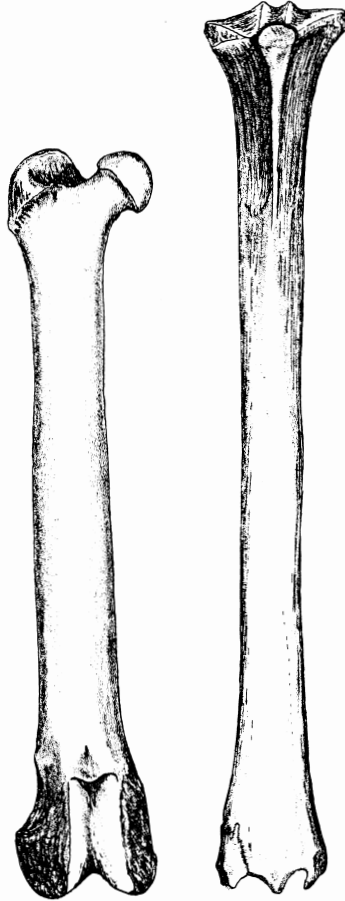


Fig. 4. *Nannotragulus loomisi*, the femur and tibia, nat. size.

femur, of which we have three, has a small head on a short neck with a relatively heavy shaft. The bone seems short for the rest of the leg. The patella is short with a slender distal process. In contrast to the femur the tibia is long and slender, the cnemial crest high and uncommonly narrow. There is no trace of the upper end of the fibula, but the lower end is present

and completely coossified to the tibia making the external malleolus, as in *Tragulus*. The astragulus is of moderate length with acute crests on the roller surface. The calcaneum has

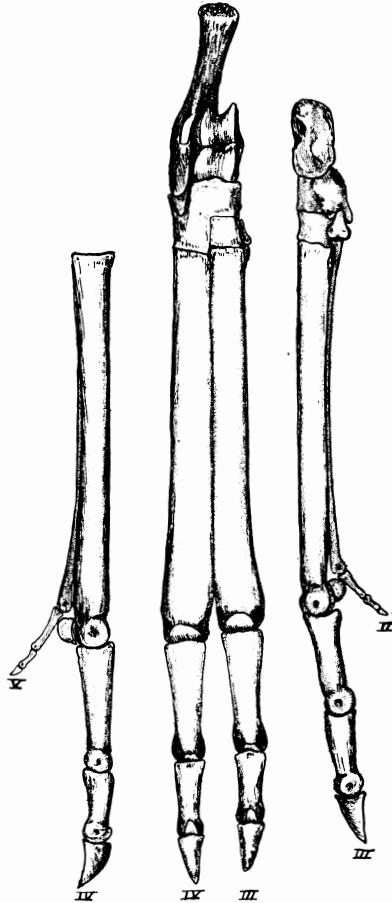


Fig. 5. *Nannotragulus loomisi*, the hind foot, in the middle figure as seen from the front, and in the lateral figures as seen from the inner and outer sides, nat. size.

no special characters. The navicular is fused to the cuboid and the ectocuneiform is well developed. What is unexpected, however, is the presence of a vestige of the mesocuneiform as a tiny ossicle to which the second metatarsus is attached. The tarsus is represented by metatarsals III and IV, well developed

but not fused, and by vestiges of metatarsals II and V. Here-
tofore these lateral metatarsals have been found among hyper-
traguloids only with *Hyopsidus*. They are surely lacking in
Leptomeryx which is specialized in other ways also; and so
far have not been found with any of the *Hypertragulus* mate-
rial. As in the front foot there are sharp carinae on the rear,
or plantar, side of the distal ends of the metatarsals. On
either side of each carina there are sesamoids, those of digits
III and IV being short and wide, while those of the two lateral
digits are tiny. Metatarsal II is complete, articulating with
the tiny mesocuneiform. The upper fourth of metatarsal V
is not represented. Each of these lateral metatarsals has a
complete toe, though of very small size. These toes are
peculiar in that the metatarsals end just above the sesamoids
of digits III and IV and, as though forced to it, the lateral
toes project sharply to the rear. Throughout, this foot is
almost identical with that of *Tragulus*.

MEASUREMENTS.

Length of pelvis	94 mm.
Length of femur	97 mm.
Length of tibia	118 mm.
Length of tarsus	20 mm.
Length of calcaneum	26 mm.
Length of metatarsal III	56 mm.
Length of metatarsal II	47 mm.
Length of proximal phalanx III	16 mm.
Length of proximal phalanx II	5 mm.
Length of middle phalanx III	9 mm.
Length of middle phalanx II	2 mm.
Length of ungual phalanx III	7 mm.
Length of ungual phalanx II	1½ mm.

Of the vertebrae I have only the lumbar and sacral which
correspond closely in character to those of *Tragulus*, except
that they are uniformly about 10% larger.

In making the restoration of *Nannotragulus* I have used the
cervicals and dorsals of *Tragulus memmina*. *Nannotragulus*
proves to be an animal which has anatomical characteristics
very like those of *Tragulus* but differs slightly in its propor-
tions. The skull and the pelvis of *Nannotragulus* are approxi-
mately the same size as in *Tragulus*, but the limbs are regularly
20% longer and about the same amount heavier.

As to relationships, *Nannotragulus* is one of the Hyper-
tragulidae, which also includes *Heteromeryx*, *Leptomeryx*,
Hyposodus and *Hypertragulus*. In dental characteristics it is

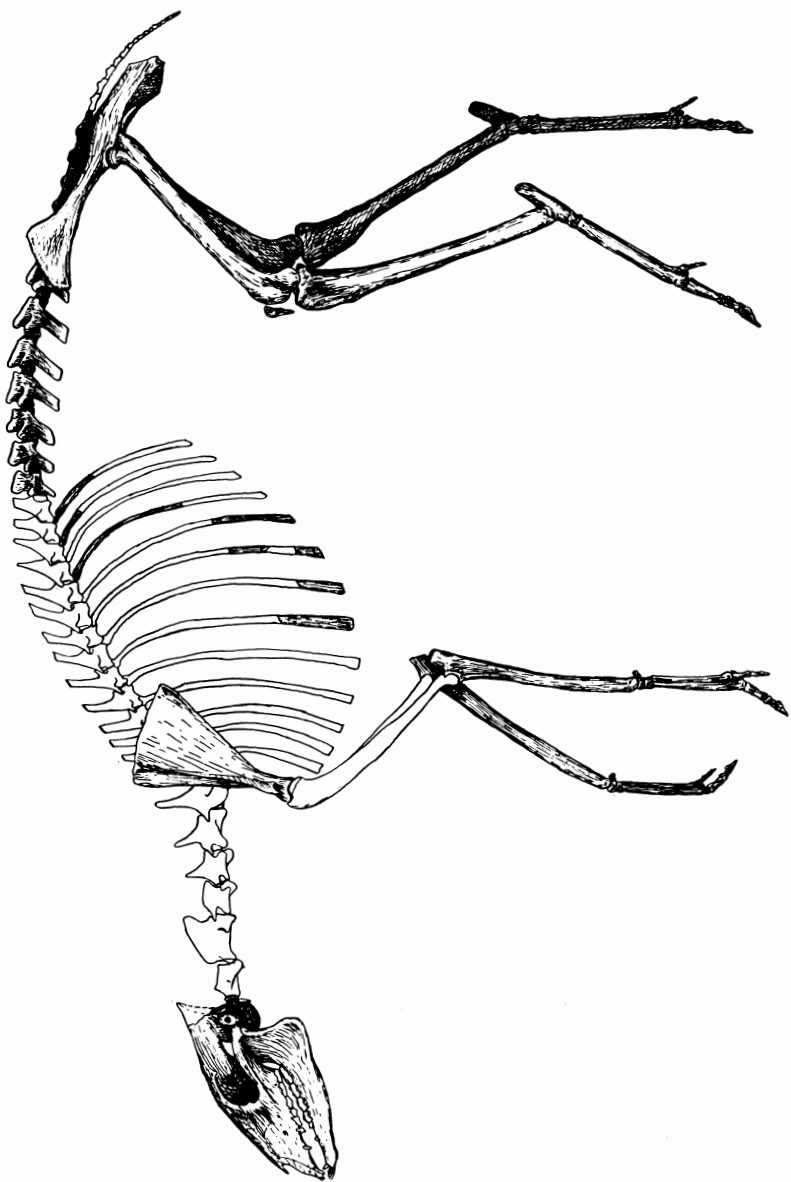


Fig. 6. *Nannotragulus loomisi*, restoration of skeleton, about $\frac{1}{3}$ nat. size.

nearest to *Hypertragulus*, for which, however, no lateral toes have been found in the pes. In this family *Heteromeryx* is the oldest representative, coming from the Titanotheres beds. While its dentition is little specialized, it is not such as would lead directly to the other members of the family. Also the orbit is closed behind, there is a lacrymal vacuity and the pes is reported as didactyl. It might well lead to *Leptomeryx* of the Oreodon beds, which is differentiated by having lost upper premolar I, by well-developed inner cusps on the upper premolars, and by having the pes reduced to two fused metatarsals. As far as the other members of the family are concerned *Leptomeryx* is a side line, which, however, Matthew³ thought led to the *Blastomeryx* group. *Hypisodus*, also of the Oreodon beds, with its extreme hypsidonty and greater crowding of the premolars, while near *Nannotragulus*, represents another specialized side line. *Hypertragulus* of the Oreodon and John Day beds has the dentition very like that of *Nannotragulus*, except less advanced, has the orbit open behind, and feet of the same character except as to the lateral toes on the hind foot; and I take it to be the immediate predecessor of *Nannotragulus*. So far no representatives of the family have been found in the later Miocene horizons. *Nannotragulus*, however, as has been noted several times in preceding descriptions, has so many close affinities with *Tragulus* of the present, that I can not but feel it is an early representative of this family. *Tragulus* has progressed by the reduction of the premolars to $\frac{3}{3}$ and by the fusion of the median metapodials of both front and hind feet; but throughout it alone has the peculiarities which are so characteristic of *Nannotragulus*. Just what the intermediate forms were I do not know, for I feel that *Dorcattherium* and the other closely related European genera are side lines and are more advanced than is *Tragulus* itself.

³ Bul. Amer. Museum of Nat. Hist., 24, 535, 1908.