ART. IX.—*Primitive Pecora in the Yale Museum;* by RICHARD S. LULL.

[Contributions from the Othniel Charles Marsh Publication Fund, Peabody Museum, Yale University, New Haven, Conn.]

The genus *Hypertragulus* was established in 1873 by Professor Cope to include a group of deer-like creatures which in some respects resembled those of the genus *Leptomeryx* very closely. The main distinctions as shown by the dentition are as follows:

Hypertragulus possesses: the superior laniary canine, P^1, separated from both C^1 and P^2 by diastemata, upper molars without mesostyle, and M^3 bearing three ribs on its outer face, all of which are the converse of *Leptomeryx*. The lower dentition differs from that of *Leptomeryx* in the development of a caniniform P_1, a diastema behind P_2, a compressed and elevated P_3 which is shorter than the three-lobed P_4, and in the fact that in M_3 the posterior crescents are opposite each other, subequal in size, and not separated posteriorly by a fissure.

The geological range of *Hypertragulus* is apparently from Middle Oligocene Oreodon beds to Lower Miocene Rosebud. Geographically, the genus is found in the Great Plains region—Colorado to South Dakota, Montana, Canada, and the John Day Basin of Oregon.

The following species have been named, *H. calcaratus* Cope from the Great Plains region being the type of the genus.

H. calcaratus Cope 1873.
H. tricostatus Cope 1873.
H. transversus Cope 1889.
H. hesperius Hay 1902.
H. ordinatus Matthew 1907.
Allomeryx planiceps Sinclair 1905.

To which are added in this paper:

H. minutus, sp. nov.
Leptomeryx obliquidens, sp. nov.
Nanotragulus loomisi, gen. et sp. nov.

Hypertragulus calcaratus Cope.

The original description of the genus is brief, and two species, *H. calcaratus* and *H. tricostatus,* are mentioned without definition, the first adequate description appearing in Paleontological Bulletin No. 16, p. 7, under the genus *Leptauchenia.* In this description Cope mentions several characters which are really of generic value, the real specific distinctions of *H. calcaratus* being apparently as follows:

Molars bear a slight external cingulum which has a small cusp between the two outer crescents, representing either an incipient or vestigial mesostyle. M^3 relatively somewhat smaller in *H. calcaratus,* and the metastyle, while variable, never as pronounced as in the John Day form. In general, the teeth are somewhat smaller than in the John Day jaws, and in one instance where P_3 is preserved, it is markedly smaller. Interrupted cingula are present in all the *Hypertragulus* jaws before me, although omitted from every published figure.

Cope's measurements are:

	mm.
Length of five molars	26
Length of three true molars	17.5
Length of last true molar	8
Width of last true molar	7

This species is smaller than the smallest of the genus yet described (Cope).

Of the Yale material, assuming Cope's figures to be correct, but one specimen agrees exactly with the type in the combined length of the five teeth, and even in this specimen M^3 is only seven-eighths as long. The third molar, however, has been shown to be variable and the degree of wear also affects its dimensions. I find no evidence in the Yale Great Plains material of even subspecific departure from *H. calcaratus.*

Hypertragulus tricostatus Cope.

Cope thought he recognized a second species about the size of *H. calcaratus* but distinguished therefrom by the presence of but three ribs on the outer side of the third

molar, the characteristic heel being absent. This molar also lacked the posterior cingulum. *H. tricostatus* is considered a synonym of *H. calcaratus* by Hay, and with this the present writer agrees, for out of twenty-four individuals in the Yale Collection represented by the upper molar teeth, the metastyle of M^3 varies from good development to marked reduction in at least four specimens, but is never entirely absent. The degree of development of the posterior cingulum is also variable to total obsolescence. As *tricostatus* is founded upon a single specimen, it seems to represent merely the extreme of a variational series of which the means were still extant and therefore not a separate species but a varietal tendency. Cope himself says in 1884 (p. 24): "I know but the one species, the *H. calcaratus* Cope," a statement which, as Matthew rightly says, invalidates *H. tricostatus*.

Material from the John Day Formation.

Hypertragulus hesperius Hay.

Both Cope and Leidy have discussed hypertragulids from the John Day Basin of Oregon, but have referred them either to *H. calcaratus* or to *Leptomeryx evansi* without further attempt at specific differentiation. Scott has also figured John Day material belonging to this genus under the name *H. calcaratus*. Hay, however, in his catalogue, p. 675, gives the new name *H. hesperius* to the John Day hypertragulids, with neither definition, indication of type, nor restriction to any one level. Doctor Matthew informs me (personal communication) that Cat. No. 7918, A. M. N. H., the specimen figured by Cope and later by Scott, is to be regarded as the type. It consists of the skull and jaws and a few fragments of the skeleton. The matrix is "greenish tinged with buff and rather hard" but there is no record of its exact level or locality, save that it is from the John Day. The matrix color, judging from the known distribution of the large amount of John Day material in the Yale Collection, would indicate middle John Day as the horizon of this type.

Cope's description of *H. hesperius* gives no specific characters other than that the size is the same as *H. calcaratus*, sometimes distinctly larger; later (1884, p. 25)

he says "I can not distinguish the John Day species from the *H. calcaratus,* although the size is generally distinctly larger." He does, however, use the John Day material for his description of the morphology of the feet of the genus, but this part of his description is generic and not specific.

The type skull is fairly complete, except that it is injured in the pterygoid region, and represents a fully mature animal in which the tooth pattern of M^1 is entirely obliterated. Anteriorly, a portion of the large canine alveolus is present, but no trace of the premaxillaries is preserved. There is no jugal process, but the postorbital process of the frontal forms about half the posterior margin of the orbit. Scott's figure, which was drawn by Mr. R. Weber, is the more accurate of the two except for the restoration of the superior canine *behind* the caniniform P_1, which the author evidently mistook for the true lower canine tooth. Scott further restores the orbit as though it were closed behind, for which there is no evidence.

Allomeryx planiceps Sinclair.

This form agrees with *Hypertragulus* in the absence of the mesostyle on the molars and in the development of the metastyle on M^3. It is distinguished by the closure of the orbit behind by the frontal and jugal processes which overlap but are not completely fused. The bullæ are small and separated from the basi-occipital by an outgrowth of the petrosal. The brain-case is shorter than in *Hypertragulus,* and the interorbital tract and sagittal crest lie in one plane.

Merriam and Sinclair in a later paper (1907) doubt the generic rank of these several characters. The closure of the orbit, however, is an evolutionary advance which is significant, especially as in the known species of *Hypertragulus* the jugal process is undeveloped.

An imperfect skull, No. 10227, Y. P. M., shows *Allomeryx* characters in so far as preserved, especially those noted in the basicranial region. It also possesses an ample brain-case. Unfortunately the postorbital region is not preserved. The Yale skull is from the upper John Day beds.

Hypertragulus ordinatus Matthew.

This species is based on a complete lower jaw (No. 13011, A. M. N. H.) from the lower Rosebud beds on Porcupine Creek, South Dakota. It is larger than the type species of the genus, *H. calcaratus,* and about equal to *H. hesperius.* It may be distinguished from either by the following characters: Closing of diastema between P_2 and P_3, and great reduction of diastema between C_1 and P_1; increased length of diastema between caniniform P_1 and P_2, so that general proportions of jaw are about the same; molar crowns more hypsodont than in *H. hesperius,* about as in *H. calcaratus;* P_1 and P_2 shorter and proportionately higher than in the John Day species but less reduced than in that from the White River. In the upper Rosebud this species is replaced by *Blastomeryx.*

Hypertragulus minutus, sp. nov.

Holotype, Cat. No. 10545, Y. P. M. Upper Oligocene (upper John Day), Oregon. Fragments of upper and lower jaws and teeth.

A very small form, apparently *Hypertragulus.* Distinguishable from *H. hesperius* mainly by its small size. Cingula well developed, but metastyle of M^3 much reduced, not forming the conspicuous "heel" of *hesperius.* Its measurements are, compared with those of *hesperius:*

	H. minutus mm.	*H. hesperius* Yale spm. mm.
Length, M^1 to M^3	14	20
Length, M^3	5.8	8.5
Width, M^3	5	8.5

Leptomeryx obliquidens, sp. nov.

Holotype, Cat. No. 10541, Y. P. M. Oligocene (Protoceras beds), Hermosa, South Dakota. Poorly preserved skull and jaws, with entire series of cheek teeth.

Distinguishing characters.—Large size; superior molars obliquely set; temporal ridges meeting at a wide angle to form the sagittal crest which is sharp and thin throughout its preserved length; bullæ laterally compressed, elongated oval in shape.

This form is distinguished from *L. evansi* of the Oreodon beds, aside from its geological level, by being about one fourth larger, and by the great obliquity of the molars. The bullæ in all specimens of *L. evansi* before me are more inflated. The type is an aged animal, hence in their present state of wear there is little that is distinctive about the teeth. The general shape of the mandible and the position of the mental foramina, of which there are two, are about the same in both species. Cingula are absent and the external basal pillars are feebly developed, as in *evansi*.

Measurements are as follows:

	L. obliquidens Holotype mm.	Ratio	*L. evansi* Cat. No. 10542 Y. P. M. mm.
Length, tooth-row, P^2 to M^3 (left)	48	1.23	39
Length, M^1 to M^3	26	1.24	21
Length, M^3	9	1.20	7.5
Width, M^3	12	1.54	7.7
Width, P^2	5	1.25	4
Length, tooth-row, P_2 to M_3	51.7	1.21	42.5
Length, M_1 to M_3	31	1.26	23.7
Length, M_3	14	1.29	10.8
Width, M_3	7	1.40	5

Nanotragulus loomisi, gen. et sp. nov.

(Fig. 1.)

Holotype, Cat. No. 10330, Y. P. M. Collected by R. S. Lull in 1908 at Castle Butte, Big Muddy River, near Spanish Mines, Wyo. Miocene (lower Harrison). Palate with upper cheek teeth complete, right lower jaw fairly complete, with six teeth, left with series of four teeth. Detached premolar. Imperfect petrosal?

Distinguishing characters: Upper dentition.—Teeth subhypsodont; P^2-M^3 a compact series without diastemata; mesostyle lacking on molars; no trace of molar cingula nor of internal basal pillars; molars simple, of four crescents each; M^3 with four external pillars; metastyle enlarged toward base of tooth. Premolars three only, preserved in situ; P^2 trenchant, single-cusped, two-rooted, slightly grooved on outer face. P^3 also trenchant, of greater antero-posterior diameter than P^2, apparently three-rooted, with postero-internal cingulum but no internal cusp (deuterocone), and with two faint external

ridges. P^4 a unique tooth, triangular in section, with outer crescent not fully evolved, flanked by three faint ridges on its outer face; postero-internal cingulum forming a sharp, straight ridge abutting against the well developed deuterocone but distinct therefrom in the unworn tooth. Measurements:

	mm.
Length P^2 to M^3	27
Length, M^1 to M^3	17
Length, M^3	7
Width, M^3, at base of ant. crescent	5

Lower dentition.—P_3-M_3 a continuous series. Probably slight diastema separating P_2 and P_3, but condition of specimen renders this uncertain. Molars simple, with

FIG. 1

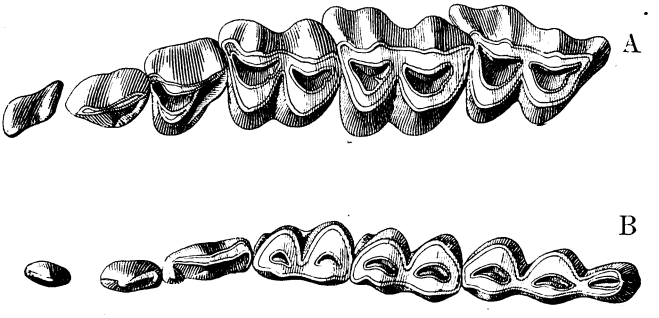

FIG. 1.—*Nanotragulus loomisi*, gen. et sp. nov. Holotype. A, left upper dentition. B, right lower dentition. × a little more than 3.

slightly developed cingula on anterior face. No accessory pillars. Posterior column of M_3 as in *Hypertragulus,* with outer and inner lobes opposite and not separated posteriorly by a cleft as in *Leptomeryx.* P_2 a simple, compressed cone, two-rooted, slightly recurved. P_3 high-crowned, but not so much so as in *Hypertragulus,* hardly rising above P_4, with a main anterior cusp and rather prominent heel. P_4 the most complex, laterally compressed, high protoconid, and pronounced heel. Antero-internal cusp well developed. Protoconid flanked on inner side by a second cone which is confluent with it,

while a third bears the same relation to the heel. Thus there are three internal buttresses separated by valleys. No traces of cingula on premolars. Measurements:

	mm.
Length, P_2 to M_3	ca. 28*
Length, M_1 to M_3	18.3
Length, M_3	8
Width, M_3	3.5

*Slightly elongated by fracture between P_2 and P_3.

A detached small, slender, two-rooted premolar is present. It probably represents P_2 of the left ramus and is not distinguishable from that already described.

Relationships.—This is the smallest artiodactyl thus far described from the Lower Miocene. In this respect it is suggestive of the Oligocene *Hypisodus,* with which it also agrees in hypsodonty and in the absence of the mesostyle. They differ, however, in the absence of a buttress on the posterior external crescent of $M^{1\cdot2}$ and in the character of the premolar teeth. The inner anterior crescent of M^1 is markedly different.

The form under discussion differs from *Leptomeryx* in the absence of mesostyles, character of heel of posterior lower molar and of the premolars, and in size. With *Hypertragulus* it agrees in the absence of mesostyle and the character of the heel of M_3, but differs again in its much smaller size and the character of its premolars. *Nanotragulus* differs markedly from *Merycodus* in size and geologic level, also morphologically in the absence in the former of the mesostyle, in the convergence of the molar crowns, and in the character of the premolar teeth. They agree mainly in hypsodonty.

From its contemporary, *Stenomylus,* the new genus also differs very markedly in size and in the character of the premolars. The two genera agree, however, in hypsodonty, and in the absence of mesostyle, though the latter is indicated on M^1 of *Stenomylus.* In *Stenomylus,* moreover, the external face is relatively smooth except for parastyle and metastyle. In the lower dentition of *Stenomylus* there is greater simplicity, especially in P_4, which in no way resembles that of *Nanotragulus.* In other words, *Nanotragulus* is deer-like, not camel-like as is *Stenomylus.*

I can not at present place the new genus elsewhere than in the Hypertragulidæ, but it is not clearly derivable from any known Oligocene form except possibly *Hypisodus*.

The generic name *Nanotragulus* refers to its dwarfed size, while the species is named for Professor F. B. Loomis of Amherst College, leader of the joint Amherst-Yale expedition of 1908 during which the type was collected, and the first to recognize its unique character.

REFERENCES.

Cope, E. D. 1873A. [On *Menotherium lemurinum*, etc.] Proc. Acad. Nat. Sci., Philadelphia, 25, 419-420.

—1873B. Third notice of extinct Vertebrata from the Tertiary of the Plains. Pal. Bull. 16.

—1884. On the structure of the feet in the extinct Artiodactyla of North America. Proc. Amer. Philos. Soc., 22, 21-27.

—1889. The Artiodactyla. Amer. Nat., 23, 111-136.

Leidy, Joseph. 1873. Contributions to the extinct vertebrate fauna of the Western Territories. Rept. U. S. Geol. Survey Terr., 1, 14-358.

Matthew, W. D. 1907. A Lower Miocene fauna from South Dakota. Bull. Amer. Mus. Nat. Hist., vol. 23, 169-219.

Merriam, J. C. and Sinclair, W. J. 1907. Tertiary faunas of the John Day region. Univ. Calif., Bull. Dept. Geology, vol. 5, 171-205.

Scott, W. B. 1899. The selenodont artiodactyls of the Uinta Eocene. Trans. Wagner Free Inst. Sci., Philadelphia, 6, 1-121.

Sinclair, W. J. 1905. New or imperfectly known rodents and ungulates from the John Day series. Univ. Calif., Bull. Dept. Geology, vol. 4, 145-161.