

# Article VIII.—NEW OR LITTLE KNOWN MAMMALS FROM THE MIOCENE OF SOUTH DAKOTA.

AMERICAN MUSEUM EXPEDITION OF 1903.

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Part IV.<sup>1</sup> EQUIDÆ. J. W. G.

In the Loup Fork collection from South Dakota obtained by the 1903 Expedition, there are several species of horses represented. This new material adds much to our knowledge of the Miocene Equidæ.

The object of the present paper is simply to report the known species represented and to describe new material. A complete revision of all the Miocene horses will be undertaken in a future publication.

## *Hypohippus affinis* Leidy.

This species, the type of the genus, is apparently represented in the collection by a fragment of lower jaw containing three teeth,  $p_3$ ,  $p_4$ , and  $m_1$ , of the permanent series (No. 10834 Amer. Mus. Coll.) from the upper Miocene formation (Loup Fork beds) at Big Spring Cañon. The characters of the adult teeth of the genus *Hypohippus* are well known from *H. equinus* (*Anchitherium equinum* Scott), an older Miocene form, but *H. affinis* is at present known only from the type tooth, an upper milk molar  $dp_4$ ,<sup>4</sup> from the Loup Fork beds in the vicinity of Fort Niobrara, Nebraska. Hence the reference to this species of the lower teeth from Big Spring Cañon is only on the ground of equality in size and inferred height of the molar crowns, and of its derivation from the same formation at a locality not far removed from that of the type.

Compared with the corresponding teeth in *H. equinus* they show a marked progressive stage, especially in (1) their greater size; (2) their proportionately longer crowns; and (3) the better development

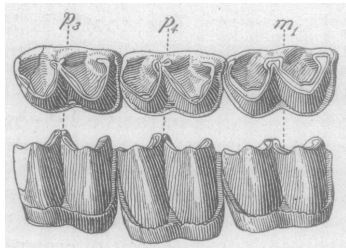


Fig. 1.—*Hypohippus affinis* Leidy. Lower teeth, half natural size. No. 10834. Loup Fork formation, South Dakota.

<sup>1</sup> Parts I and II were published in this Bulletin, Vol. XX, 1904, pp. 241-268. Part III will be published later.

of the metastylid which, at its summit in the little worn teeth, is slightly separated from the metaconid by a shallow groove which extends but a short distance down the side of the metaconid pillar. The continuous external basal cingulum is well developed in a broad heavy band of enamel.

*Measurements.*

Diameters of type tooth,	dp <sup>4</sup> .....	Antero-post. 27 mm.	Transv. 29 mm.
Diams. of lower teeth (No. 10834)	p <sub>3</sub> .....	28 "	20 "
	p <sub>4</sub> .....	27.5	21 "
	m <sub>1</sub> .....	28.5 "	20 "
Height of crown, p <sub>4</sub> , inside 20 mm., outside 25 mm.			

**Hypohippus** sp. indet.

A single left lower molar (No. 10835 Amer. Mus. Coll.), m<sub>1</sub> or m<sub>2</sub>, from Big Spring Cañon, represents a second Upper Miocene species of *Hypohippus* much smaller than *H. affinis*.

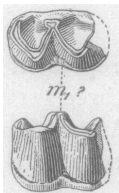


Fig. 2.—*Hypohippus* sp. indet. Lower molar, half natural size. No. 10835. Loup Fork formation, S. Dakota.

This tooth shows less progressive characters: (1) The crown is relatively shorter; (2) the metastylid is less developed, with no separating notch; (3) the basal cingulum is relatively weaker and narrower. The tooth is larger than the corresponding one in *H. equinus*. It differs further from that species in having a narrower cingulum and somewhat greater comparative height of crown.

The measurements are:

Antero-post. diameter .....	23.5 mm.
Transv. " .....	23 "
Height of crown inside .....	12 "
" " " outside .....	16 "

The tooth probably represents an undescribed species, but we prefer not to name a species on such an incomplete and uncharacteristic specimen.

**Protohippus perditus** Leidy.

This species is represented by a nearly complete skull (No. 10838 Amer. Mus. Coll.), which may be regarded as a hypotype,<sup>1</sup> and a well preserved palate containing the milk molars (No. 10866), both

<sup>1</sup>See Schuchert's definition, *Science*, Vol. V, 1897, p. 637.

from the Loup Fork beds of the Little White River near the Rosebud Indian Agency, South Dakota.

The skull is of a young individual still retaining the milk molars, but with  $m^1$  fully formed and slightly worn and  $m^2$  just protruding

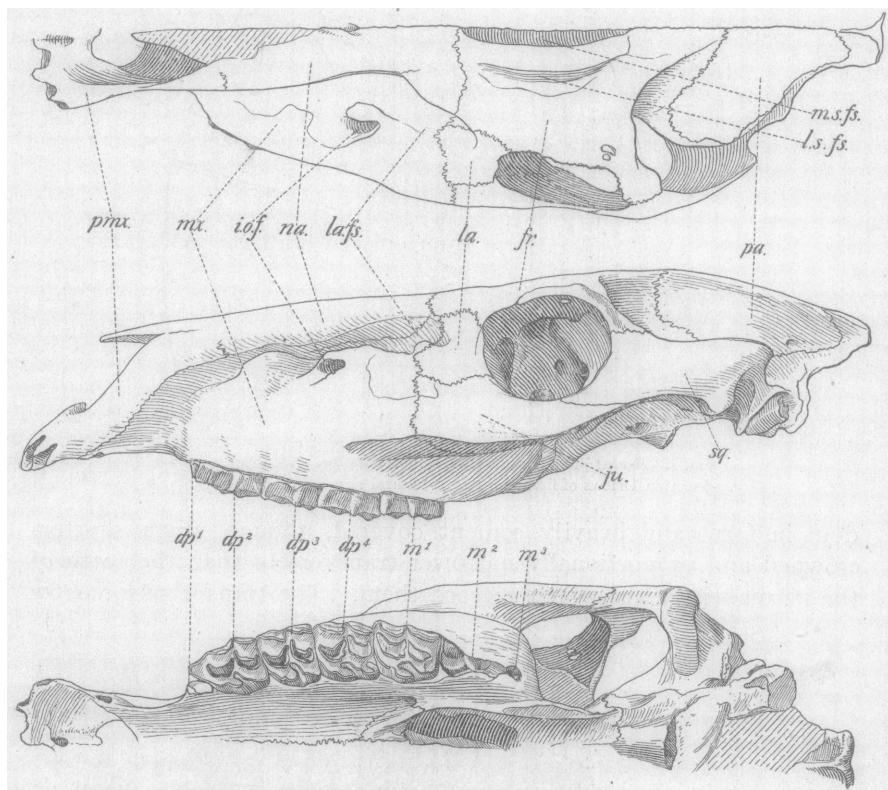


Fig. 3.—*Protohippus perditus* Leidy. Immature skull, one third natural size. Hypotype, No. 10838, Loup Fork formation, Little White River, S. Dakota.

*pmx.*, premaxillary; *mx.*, maxillary; *na.*, nasal; *la.*, lacrimal; *fr.*, frontal; *pa.*, parietal; *ju.*, jugal; and *sq.*, squamosal bones of the skull. *la. fs.*, lacrimal fossa; *m. s. fs.*, *l. s. fs.*, median and lateral superior (frontal) fossæ; *i. o. f.*, infraorbital foramen.

from the bone. Though young it presents some distinctive characters which add to our knowledge of this important species, which is the type of the genus *Protohippus*, and among the first of the three-toed horses described from this country.

A section of the first true molar, taken at about the same height above the fangs to which  $m^1$  of the type was worn by use, agrees nearly with that tooth in size and characters of tooth pattern. This, with the close correspondence of the malar region of the face with so

much of the same region as is prererved in the type specimen, makes the reference to this species reasonably positive.

The milk molars, as is always the case in *Protohippus*, are hypso-

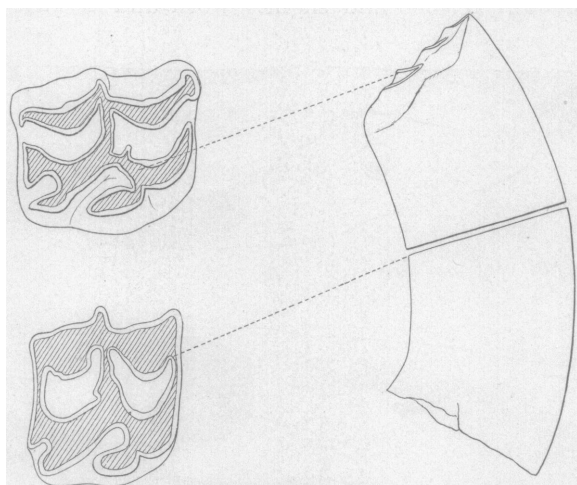


Fig. 4.—*Protohippus perditus* Leidy. Hypotype. No. 10838. Crown and sectional views of first true molar, natural size.

dont in form and heavily cement covered, though much shorter-crowned and proportionally narrower transversely than the teeth of the permanent series which succeed them. The transversely narrow

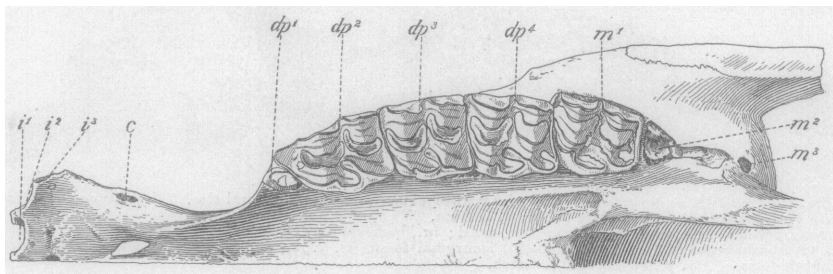


Fig. 5.—*Protohippus perditus* Leidy. Upper jaw, half natural size. Hypotype, No. 10838.

proportions of the milk teeth, however, are characteristic of all horses.

Compared with *Neohipparion whitneyi* the skull is proportionally shorter, especially in the region of the muzzle, and relatively less in vertical depth. The palate is moderately arched, being especially high forward of the premolars, a character observed in all the zebra skulls compared, and the maxillaries are deeply constricted in this region. The anterior palatal foramina are small, oval in outline,

and do not extend as far forward as in *N. whitneyi*. The basisphenoid is very short and broad and is overlapped by the vomer. The side face is marked by a single fossa, the lachrymal,<sup>1</sup> which begins in a depression in the lachrymal bone and runs forward along the line of the naso-maxillary suture. This pit is long, moderately deep at its posterior end, but not sharply outlined. The top view of the skull is very remarkable. The nasals are very broad at the point of articulation with the premaxillaries. Passing backward they curve deeply in and downward on either side to form the upper portion of the lachrymal fossæ, thus greatly constricting the top of the skull in this region. The lachrymal fossæ are plainly seen from the top view, and in addition to these are three long symmetrically arranged furrows in the middle forehead region, the median deep, long, and straight, the lateral ones shorter, shallower, and crescentic. If these frontal fossæ are normal, they present a unique character.

#### Measurements.

(Type Specimen.)

	Antero-post.	Transv.
Diameters of m <sup>1</sup> .....	19.5 mm.	22 mm.
“ “ p <sup>4</sup> .....	20 “	22 “
Length of molar series.....	59 mm.	

Skull No. 10838.

	Antero-post.	Transv.
Diameters of m <sup>1</sup> (tritulating surface).....	23 mm.	18 mm.
“ “ “ (cut section).....	20 “	22 “
Length of milk molar series.....	76 mm.	
Length of muzzle, p <sup>2</sup> to i <sup>1</sup> .....	58 “	
Width of palate between first premolars.....	38 “	
Width of palate at narrowest point.....	23 “	
Width across incisive border.....	48 “	
Depth of skull at m <sup>1</sup> (estimated).....	85 “	

#### *Protohippus simus* sp. nov.

*Type* (No. 9820 Amer. Mus. Coll.). Anterior portion of adult skull with nearly complete dentition, from the Little White River.

A second adult specimen (No. 10871), consisting of fragmentary upper jaw with p<sup>2</sup> to p<sup>4</sup>, m<sup>2</sup> and m<sup>3</sup>, from the Niobrara River locality, is referred to this species.

<sup>1</sup>In many skulls of Miocene horses there are two distinct preorbital fossæ, hence it is of great convenience to employ a more distinctive term for each. The upper fossa, though formed principally in the nasal and maxillary, usually has its origin in the lachrymal bone, hence this term which has already been used seems appropriate. In the lower depression the posterior border is in the malar bone, hence the term “malar fossa” may be appropriately used to designate its position.

These specimens represent an animal very distinct from species of the *P. mirabilis* and *P. supremus* type, but apparently more closely allied to *P. perditus*, though somewhat larger and differing from that species in the following characters:

In the upper teeth the protocones show a more progressive stage in their fuller development anteriorly, thus forming a deeper infolding of the enamel between them and the protoconules. In other respects the teeth do not differ greatly from those of *P. perditus* except that the cement lakes are narrower transversely.

The chief points of difference are in the skull characters. The muzzle is short but much broader than in *P. perditus*. The incisive border is but little curved. This, together with its great breadth, gives the muzzle a rather truncate appearance.

The palate is broader and less arched than in *P. perditus*, especially forward of the premolars, where it is relatively very flat. The anterior palatine foramina are elliptical in outline and are placed in about the same relative position as in *P. perditus*.

The malar fossa is wanting, as in *P. perditus*, and the lachrymal fossa is broader, much shallower, and less sharply defined than in that species. The skull appears to have a comparatively great vertical depth, but this may be due in part to distortion, as it is somewhat compressed laterally.

#### *Measurements.*

Type (No. 9820).

Length of dental series $m^3$ to $i^3$ .....	200	mm.
“ “ molar-premolar series $m^3$ to $p^2$ .....	135	“
“ “ molar series....	62	“
“ “ diastema between canine and $i^1$ .....	15	“
“ “ muzzle from $p^2$ to $i^1$ .....	65	“
Diameters of $m^1$ (antero-posterior).....	20	“
(transverse).....	23	“
Diameters of $p^4$ (antero-posterior).....	21	“
(transverse).....	24.5	“
Width of palate between fourth premolars.....	48	“
“ “ “ “ first.....	41	“
“ “ “ at narrowest point.....	31.5	“
“ across incisive border.....	61	“
Depth of skull taken in line with $m^1$ .....	112	“

#### *Protohippus placidus* Leidy.

*P. placidus* is apparently an abundant species in the Loup Fork beds, and is represented by several well preserved specimens in the collection from Big Spring Cañon and the Little White River. Four

fragmentary upper jaws containing teeth (Nos. 10830, 10826, 10843, and 9830), and five more or less fragmentary lower jaws (Nos. 10849, 10850, -a, 10853, 10855, and 10857), are apparently referable to this species. Since, with possibly a few exceptions, the specimens referred

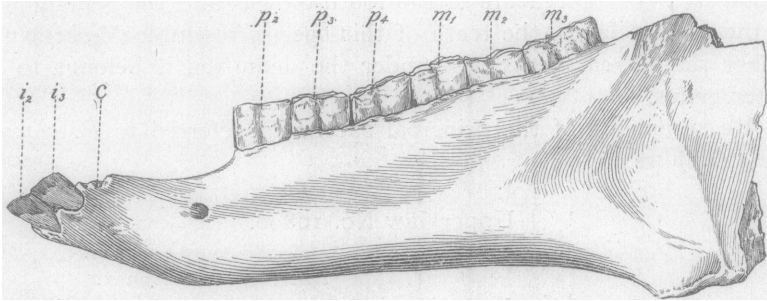


Fig. 6. —*Protokippus placidus* Leidy. Lower jaw, external view, half natural size. No. 18040, from Loup Fork formation, Little White River, S. Dakota.

by Cope to this species were wrongly identified, *P. placidus* has really been known only from the type specimen and three other single teeth, all second upper premolars, reported by Leidy, from the Little White River. These teeth, including the type, agree in size and general character with those of the specimens collected by us in the same locality. This new material now admits of a clearer and fuller definition of the species.

In the upper molariform teeth the protoconules are joined with the protocones which are directed well backward as in *P. perditus*, and the borders of the cement lakes have a like simplicity of enamel folding, but they differ from that species in (1) their much smaller size; (2) their greater comparative length; (3) less curvature of the

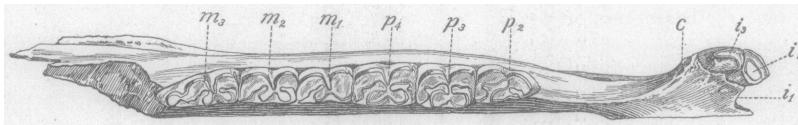


Fig. 7.—*Protokippus placidus* Leidy. Lower jaw, superior view, half natural size. No. 10849.

crowns; and (4) the relatively less transverse width of the cement lakes, especially in the true molars.

The fragment of skull preserved in No. 10830 shows there is a slight depression in the malar bone immediately in front of the orbit, but otherwise the face in this region is full and smooth as in *P. perditus*. Judging from what is shown in this imperfect specimen the lachrymal fossa, which is present is shallow and not sharply defined.

The lower jaw is short, and very deep behind the molars. It tapers rapidly forward to the symphysis with the lower border of the ramus nearly straight. The external pair of incisors are much smaller than the others and are not fully cupped. In the comparative length and relatively slight curvature of the tooth-crowns and the general form of the cement lakes, the teeth of this species resemble *Neohipparion* rather than *Protohippus*, yet under the definition it belongs to the latter genus.

Measurements of the principal specimens referred to *P. placidus* are as follows:

Upper Jaw No. 10830.

	Antero-post.	Transv.
Diameters of p <sup>2</sup> .....	17.5 mm.	14.5 mm.
" " p <sup>3</sup> .....	15 "	17.8 "
" " p <sup>4</sup> .....	15 "	18.3 "
" " m <sup>1</sup> .....	13.2 "	17 "
" " m <sup>2</sup> .....	15.3 "	17.5 "
" " m <sup>3</sup> .....	16.5 "	16 "

Total length of molar-premolar series excluding p<sup>1</sup>... 102 mm.

Upper Jaw No. 10826.

	Antero-post.	Transv.	Height of mesostyle.
Diameters of p <sup>4</sup> .....	17.5 mm.	17 mm.	43.5 mm.
" " m <sup>1</sup> .....	16.5 "	16 "	39 "
" " m <sup>2</sup> .....	17.5 "	15 "	45 "
" " m <sup>2</sup> near base of crown.....	14.5 "	17.5 "	

Lower Jaw No. 10849.

	Antero-post.	Transv.
Diameters of p <sup>2</sup> .....	15 mm.	10 mm.
" " p <sup>3</sup> .....	15.5 "	11 "
" " p <sup>4</sup> .....	17 "	10.5 "
" " m <sup>1</sup> .....	14.5 "	8.5 "
" " m <sup>2</sup> .....	15 "	8.5 "
" " m <sup>3</sup> .....	20 "	8.5 "

Total length of molar-premolar series..... 98 mm.

*Protohippus mirabilis* (Leidy).

This species appears to be represented in the collection by a fragment of maxillary bone containing two well worn teeth, m<sup>1</sup> and m<sup>2</sup> of the permanent series (No. 10840 Amer. Mus. Coll.).

The teeth agree in size and general character with those of the



type, and the malar fossa and portion of the masseter ridge preserved correspond well with those in that specimen. A feature apparently characteristic of the very deep malar fossa in *P. mirabilis* is that it is double, being divided by a low, rounded ridge running parallel with the tooth crowns which underlie it.

***Protohippus supremus* (Leidy).**

A fragmentary skull and lower jaws possessing the milk molars (No. 10844), and a fragment of maxillary containing  $p^3$ ,  $p^4$  and part of  $p^2$  (No. 10858), both from the Little White River, apparently represent this species, which was founded on a single upper molar  $m^1$  or  $m^2$ .

Cope considered *P. supremus* synonymous with *P. mirabilis* Leidy.<sup>1</sup> But the type tooth is too large for that species and moreover agrees

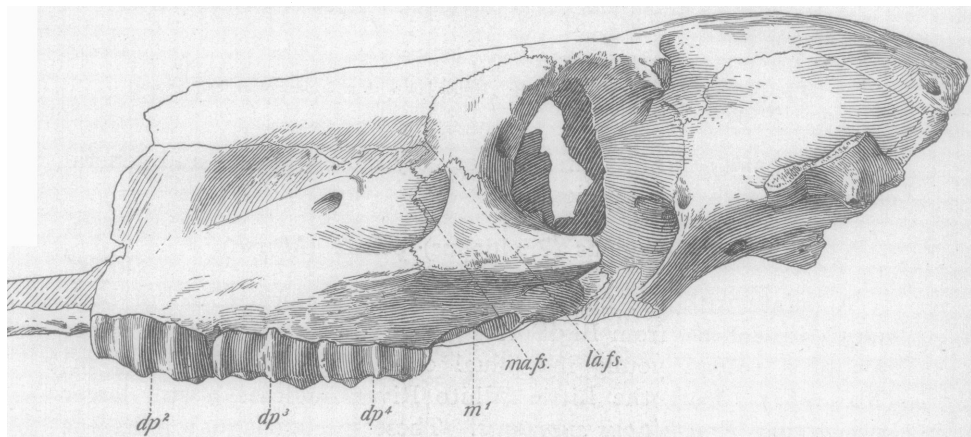


Fig. 8.—*Protohippus supremus* Leidy. Skull of young individual, half natural size. No. 10844, Loup Fork formation, Little White River, S. Dakota. *La. fs.*, Lachrymal fossa; *ma. fs.*, malar fossa; *dp²-⁴*, milk premolars.

well both in size and character with the fully formed  $m^1$  preserved in the young skull No. 10844, which is clearly distinct from *P. mirabilis*. Hence *P. supremus* seems now to be well founded.

Comparing skull No. 10844 with the type of *P. mirabilis*(1) the teeth are larger, (2) the crowns of the milk molars are comparatively longer and (3) are proportionally narrower transversely. (4) The enamel foldings bordering the fossettes in both the milk and permanent molars are more simple. (5) The crowns of the permanent molars are of moderate length and very much curved.

The malar fossa has no dividing ridge, and is comparatively

<sup>1</sup>Geol. Surv. Texas, 4th Ann. Rep., 1892 (1893), p. 25.

smaller and shallower than in *P. mirabilis*. The pit ends posteriorly in a small backwardly directed pocket in the malar bone. This portion of the malar pit is not preserved in the type of *P. mirabilis*. The lachrymal fossa occupies the same relative position as in *P. perditus* but is shallower and is less sharply defined than in that species. The basisphenoid is proportionally longer than in *P. perditus* and is not overlapped by the vomer.

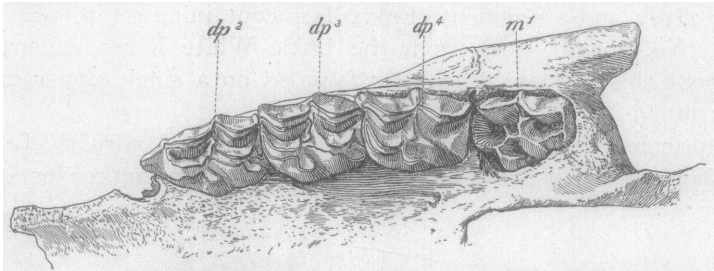


Fig. 9.—*Protohippus supremus* Leidy. Upper jaw with milk premolars, half natural size. No. 10844.

*Pliohippus robustus* Marsh agrees very closely in size and general characters with this species.

#### ***Protohippus (Pliohippus) pernix* (Marsh).**

A palate with the milk molars and the preformed  $m^1$  of both sides (No. 10836), from Big Spring Cañon, and a fragment of upper jaw of a second young individual containing the preformed  $m^1$  (No. 10827), from the Little White River, indicate a still larger species than *Protohippus supremus*. These specimens may represent an undescribed species, but we prefer at present to provisionally refer them to *Pliohippus pernix* Marsh, although the type of that species is smaller and seems to correspond more nearly with *Protohippus supremus*.

Both specimens being of young individuals may be compared very accurately with the specimens referred to *P. supremus*. The teeth are larger than in *P. supremus* but are proportionally shorter crowned.  $Dp^1$  is comparatively large with an unusually long antero-posterior diameter. The protocone in  $m^1$  is relatively larger and broader antero-posteriorly. There is a deep fold of the enamel in the cement valley between the protocone and metaloph. In *Protohippus perditus* and *P. supremus* this enamel fold seems to be wanting or only slightly developed.

The masseter ridge and malar fossa, which are preserved in No. 10827, also show some differences. The malar fossa is intermediate in comparative size and depth between *P. mirabilis* and *P. supremus* but is undivided as in *P. supremus*. The masseter ridge is comparatively thin and sharply defined.

*Measurements, No. 10836.*

		Antero-post.		Transv. <sup>2</sup>		Height of
Diameters of						mesostyle.
dp <sup>1</sup>	.....	19	mm.	7.5	mm.	10.5 mm.
dp <sup>2</sup>	.....	36	"	22.5	"	17 "
dp <sup>3</sup>	.....	27.5	"	26	"	20 "
dp <sup>4</sup>	.....	29	"	25	"	23 "
m <sup>1</sup>	.....	28	"	26	"	
Total length of milk molar series, dp <sup>2</sup> to dp <sup>4</sup>						92.5 mm.

***Neohipparion occidentale* (Leidy).**

A few isolated teeth (No. 10827), apparently represent *N. occidentale* in the 1903 collection, but they add nothing to our knowledge of the species.

***Neohipparion gratum* (Leidy).**

This species is resented by sepreveral specimens from the Little

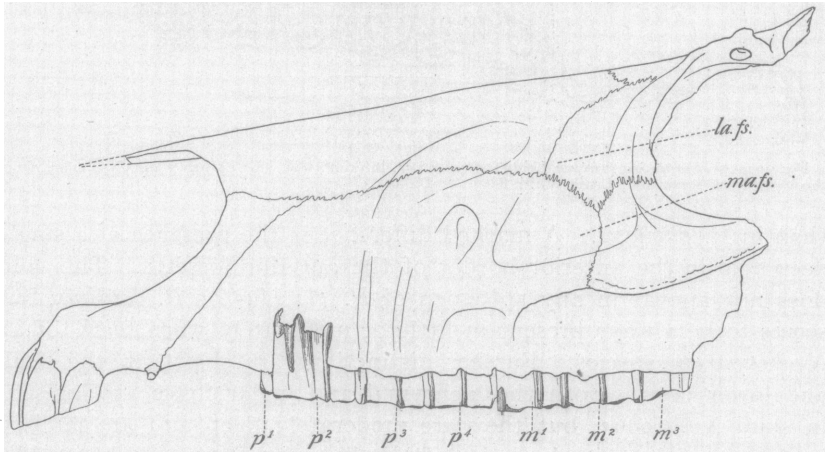


Fig. 10.—*Neohipparion gratum* Leidy. Anterior part of skull, side view, half natural size. No. 10863. *La. fs.*, lacrymal fossa; *ma. fs.* malar fossa.

White River. The most complete are a portion of skull with all the teeth except the molar-premolar series of one side (No. 10863), a complete pair of lower jaws (No. 10845), and two other lower jaws

<sup>1</sup>Transverse diameter taken across base of tooth, not at triturating surface.  
[May, 1906].

(Nos. 10851 and 10855). Other specimens in the 1903 collection referred to this species are a fragment of lower jaw containing teeth,  $p^2$  to  $m^2$  (No. 10862), and two fragments of young jaws containing the milk molars (Nos. 10854 and 10860). The type tooth, with a few other isolated upper teeth, reported by Leidy from the Little White River locality, have hitherto represented all that was known of this species.

Cope considered it synonymous with *Protohippus placidus*,<sup>1</sup> but, though the teeth are only slightly larger than those of *P. placidus* and have in common comparatively long and slightly curved crowns, they cannot be referred, under the definition, to that genus. The protocone in *N. gratum* is free for the greater part of its length, while in *P. placidus* the protocone is joined to the protoconule for nearly its entire length. The new material shows other characters which make yet clearer distinctions between the two species.

The protocones are usually small, and elliptical in cross-section. The enamel borders of the fossettes are a little more deeply folded

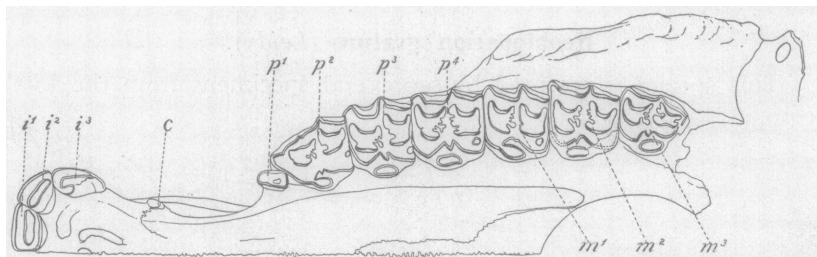


Fig. 11.—*Neohipparion gratum* Leidy. Upper jaw, inferior view, half natural size. No. 10863, from the Loup Fork formation, Little White River, S. Dakota.

than in *P. placidus*. A marked difference is the presence of a single deep fold in the anterior border of the anterior fossette. This fold does not appear in any specimen of *P. placidus* or *P. perditus*, but seems to be always present in little or moderately worn teeth of all *Neohipparion* species. Further distinctions are shown in the skull and lower jaws. Both the lachrymal and malar fossæ are present in skull No. 10863, but they are moderately deep and are limited in extent. There is also a broad, shallow depression in the middle of the forehead. The palate is high-arched, especially in the anterior portion. The anterior palatal foramina open backward into long, narrow slits left between the palatal portion of the premaxillaries and maxillary bones. This character is apparently universal in all

<sup>1</sup> Geol. Surv. Texas, 4th. Ann. Rept. 1892 (1893), p. 26.

modern species of horses. The nasals are short-tipped, but very broad where they join the premaxillaries, thus forming a full, round anterior narial opening.

The lower jaws are short and deep as in *P. placidus*, but with the following differences: (1) The symphysis is longer and somewhat heavier, though the length of the jaw forward of the premolars is comparatively a little less than in *P. placidus*; (2) the angles of the jaws are proportionately smaller; and (3) the lower borders of the

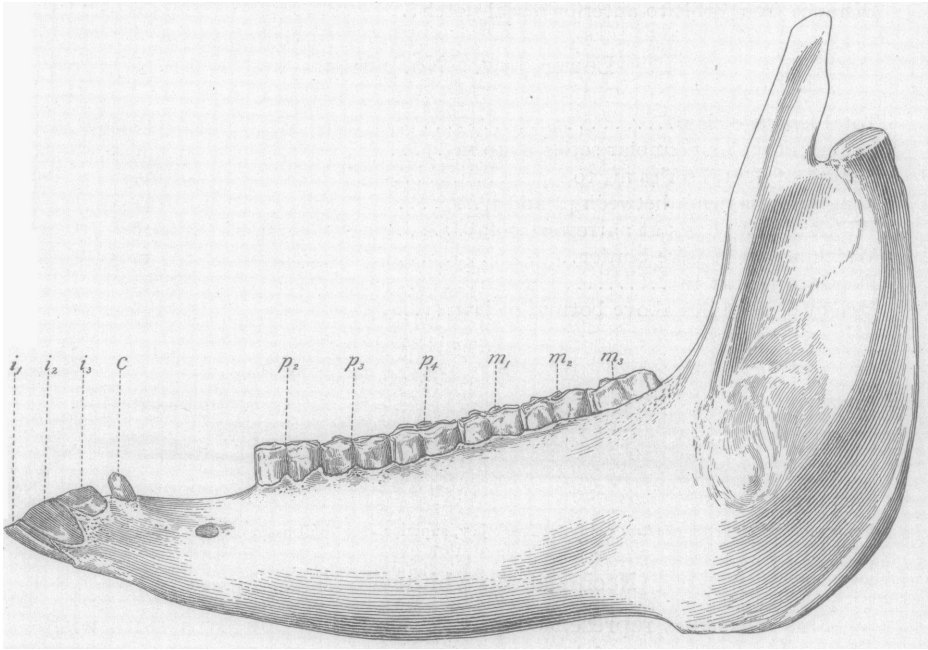


Fig. 12.—*Neohipparion gratum* Leidy. Lower jaw, external view, half natural size. No. 10845, Loup Fork formation, Little White River, S. Dakota.

rami are much curved or bowed. This character is apparently common to the species of *Neohipparion*.

*Measurements of Specimens referred to N. gratum.*

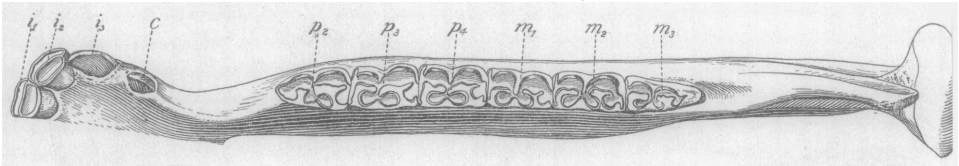
Skull No. 10863.

	Antero-post.	Transv.
Diameters of p <sup>1</sup> .....	8 mm.	5 mm*
“ “ p <sup>2</sup> .....	20.5 “	18 “
“ “ p <sup>3</sup> .....	18. “	20 “
“ “ p <sup>4</sup> .....	18.5 “	20 “
“ “ m <sup>1</sup> .....	17.5 “	19 “

Diameters of $m^2$ .....	17.5 mm	18.5 mm
" " $m^3$ .....	17.5 "	15 "
Total length of dental series $m^3$ to $i^1$ .....	179	"
Length of molar-premolar series $p^1$ to $m^3$ .....	113	"
Length of diastema between $p^1$ and $i^3$ .....	42.5	"
Width of palate between first molars.....	50	"
Width of palate between second premolars.....	35	"
Width of palate in front of first premolars.....	21.5	"
Width across incisive border.....	43	"
Height of skull above $m^1$ .....	85	"
Distance from orbit to anterior narial notch.....	110	"

## Lower Jaw. No. 10845.

Total length of jaw.....	248 mm
Length of molar-premolar series $p_2$ to $m_3$ .....	111.5 "
Length of dental series $m_3$ to $i_1$ .....	179 "
Length of diastema between $p_2$ and $i_3$ .....	42 "
Width of symphysis at narrowest point.....	26 "
Width across incisive border.....	39.5 "
Depth of jaw at $m_1$ .....	60 "
Height of condyles above bottom of jaw.....	136 "

Fig. 13.—*Neohipparion gratum* Leidy. Lower jaw, superior view, half natural size. No. 10845.***Neohipparion whitneyi* Gidley.**

This species is represented in the 1903 collection by a skull with lower jaws and part of skeleton of a young individual (No. 10869), which is unfortunately in a poor state of preservation, and an upper premolar,  $p^3$  (No. 10843a). Both specimens are from the cañon of the White River. They add nothing to our knowledge of the species.

***Neohipparion dolichops* sp. nov.**

*Type.* A portion of upper jaw containing teeth,  $p^2$  to  $m^2$  (No. 10865 Amer. Mus. Coll.), from the Little White River. *Paratype.* Complete lower jaws with associated upper molar,  $m^2$  (No. 10832), from Big Spring Cañon.

These specimens represent a species about equal in size to *N. affine* (Leidy). But they differ from that species in (1) the more

open fossettes in the upper teeth, (2) the greater complexity of the enamel foldings, and (3) the proportionally smaller and more rounded protocones.

From *N. occidentale* this species differs in (1) its smaller size and (2) different proportions of the premolars, which are relatively broader transversely.

Compared with *N. whitneyi* it is distinguished by (1) its smaller size and (2) by the greater number of folds in the enamel walls of the metaloph in the upper teeth, (3) the more open fossettes, and (4) the more rounded forms of the protocones. The small portion of skull preserved in the type does not admit of many comparisons, but a distinctive feature is shown in the extreme forward position of the infraorbital foramen, which is placed directly above the space between  $p^2$  and  $p^3$ . The masseter ridge extends but little farther forward than in *N. whitneyi*.

The lower jaw is much longer and more slender than in *N. whitneyi*, or any other known Miocene species of horse. The muzzle portion is proportionally longer than the average of a dozen specimens of *Equus caballus* examined.

The lower border of the ramus is bowed as in *N. whitneyi* and *N. gratum*.

#### Measurements of Type (No. 10865).

Diameters of		Antero-post.		Transv.	
			mm.		mm.
"	$p^2$	30		22	
"	$p^3$	23		23.5	
"	$p^4$	23.5		23+	
"	$m^1$	20		22	
"	$m^2$	20		21.5	

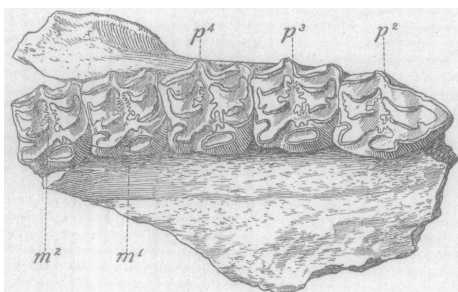


Fig. 14.—*Neohipparion dolichops* sp. nov. Upper jaw, type specimen, half natural size. No. 10865. Loup Fork formation, Little White River, S. Dakota.

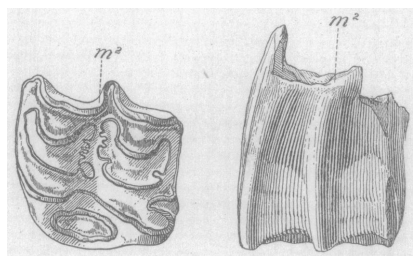


Fig. 15.—*Neohipparion dolichops*. Paratype, No. 10832. Upper molar. Natural size. Loup Fork formation, Little White River, S. Dakota.

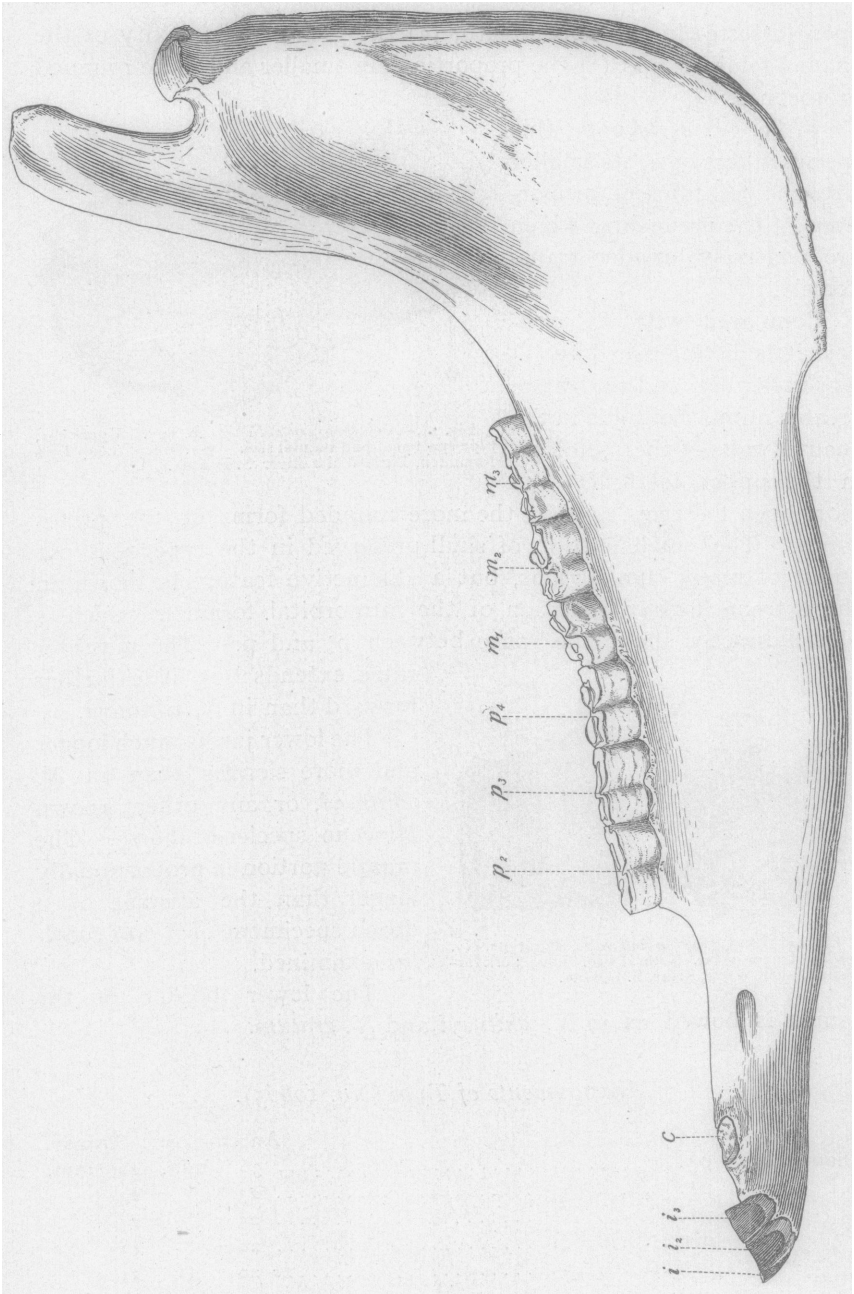
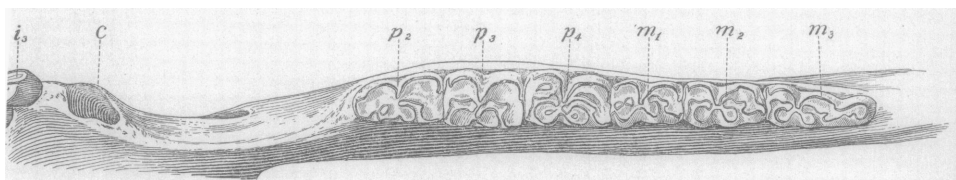


Fig. 16.—*Neohipparion dolichoceph.* Paratype, No. 10832. Lower jaw, external view, half natural size. The depth of the symphyseal region has been exaggerated in the drawing and its length somewhat reduced in proportion to the remainder of the jaw.



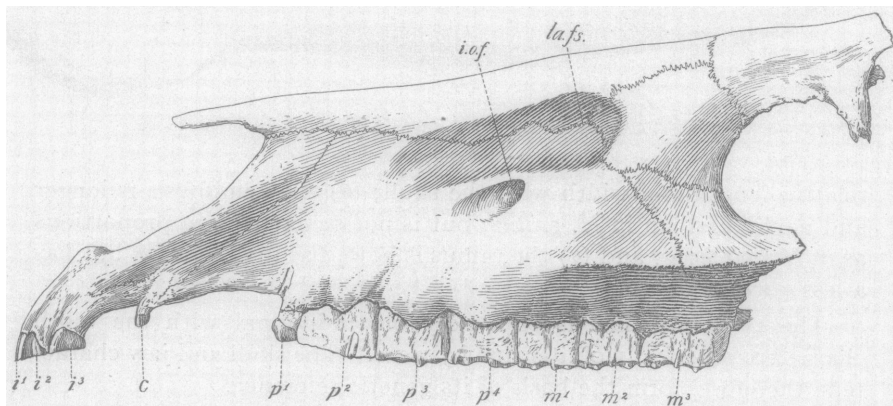
*Lower Jaw and Upper Molar (No. 10832).*

	Antero-post:	Transv.
Diameters of upper molar $m_2$ .....	21 mm.	21 mm.
Total length of jaw .....	352	mm.
"    "    " molar-premolar series.....	138	"
Length from $p_2$ to and including $i_1$ .....	108	"
" of diastema between $p_2$ and $i_1$ .....	83	"
Width of symphysis at narrowest point.....	28	"
" across incisive border.....	45	"
Width of jaw across last molars (outside).....	65	"
"    "    "    " condyles (outside).....	122 +	"

17.—*Neohipparion dolichops*. Lower jaw, superior view, half natural size. Paratype, No. 10832.**(?)*Neohipparion niobrarense* sp. nov.**

*Type.* Anterior portion of skull with lower jaws (No. 10828), from the vicinity of Fort Niobrara, Nebraska.

This specimen represents a species but little larger than *N. gratum* and differing from it in the following characters:

Fig. 18.—*Neohipparion niobrarense* sp. nov. Anterior part of skull, half natural size. Type specimen, No. 10828, Loup Fork formation, near Fort Niobrara, Nebraska. *I. o. f.*, infraorbital foramen; *la. fs.*, lachrymal fossa.

(1) The skull, especially in the nasal and premaxillary region, is longer and narrower; (2) the palate is narrow and more arched; (3) the anterior palatine foramina are more open but do not extend as far

backward as in *N. gratum*; the posterior palatal notch apparently extends as far forward as the middle of  $m^1$ ; (4) the malar fossa is wanting; (5) the lachrymal fossa is larger, extends farther backward, and has a rather sharply defined posterior border; the lower jaws correspond in

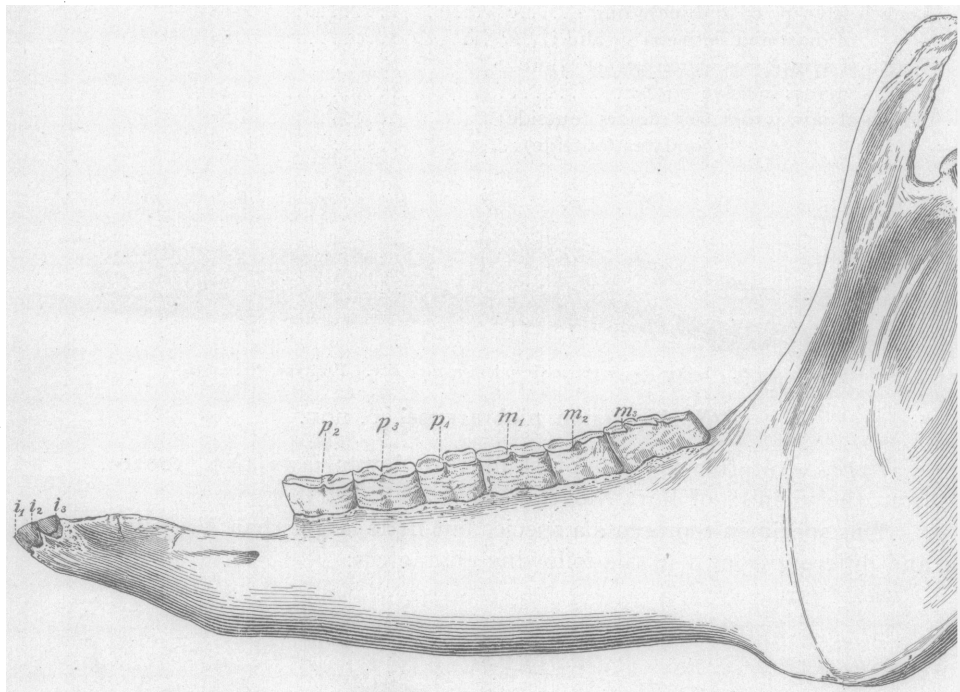


Fig. 19.—*Neohipparion niobrarense*. Lower jaw of type, half natural size, external view.

relative length and width with the skull; (6) the symphysis is longer and narrower than in *N. gratum* but is not so extreme in proportions as in *N. dolichops*; and (7) the ramus is bowed as in *N. gratum* but has a less vertical depth.

The type specimen is of a very old individual with the tooth characters practically obliterated by wear. The skull and jaw characters, therefore, form the basis of its generic reference.

In a lot of upper teeth in the United States National Museum, referred by Leidy to his "*Hipparion speciosum*," there are several specimens which agree in size with the teeth of *N. niobrarensis*. These specimens are clearly of the *Neohipparion* pattern and are possibly referable to this species.

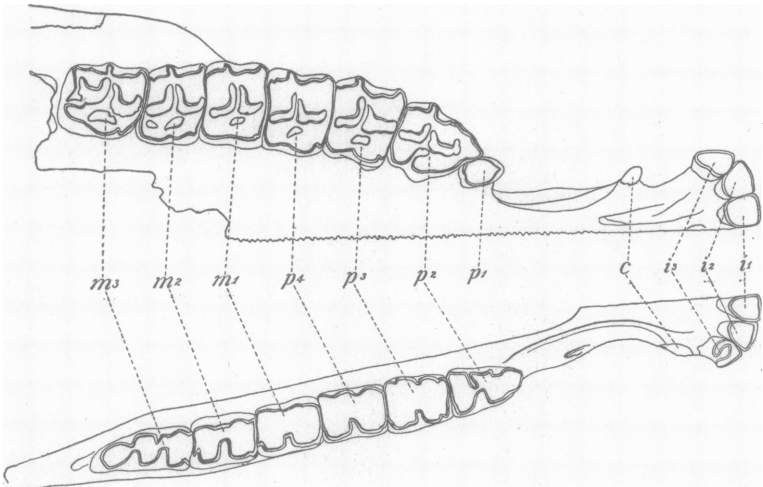


Fig. 20.—*Neohipparion niobrarense*. Upper and lower dentition, half natural size. Type specimen. No. 10828.

*Measurements of Type (No. 10828).*

		Antero-post.	Transv.
Diameters of p <sup>1</sup> .....	11	mm.	7 mm.
“ “ p <sup>2</sup> .....	22	“	19.5 “
“ “ p <sup>3</sup> .....	16.8	“	21.8 “
“ “ p <sup>4</sup> .....	17	“	21.5 “
“ “ m <sup>1</sup> .....	16.5	“	20.5 “
“ “ m <sup>2</sup> .....	16.4	“	20 “
“ “ m <sup>3</sup> .....	21	“	19 “

*Skull.*

Total length of molar-premolar series including p <sup>1</sup> .....	117	mm.
Total length of molar-dental series, m <sup>3</sup> to i <sup>1</sup> .....	185	“
Length of diastema between p <sup>1</sup> and i <sup>3</sup> .....	53	“
Width of palate between first molars.....	38	“
Width of palate between second premolars.....	27.5	“
Width of palate in front of first premolars.....	21	“
Width of incisive border.....	28	“
Height of skull above m <sup>1</sup> .....	86	“
Distance from orbit to anterior narial notch.....	115	“

*Lower Jaw.*

Total length of jaw.....	265	“
Length of complete dental series m <sup>3</sup> to i <sup>1</sup> .....	185	“
Length of molar-premolar series.....	110	“
Length of diastema between p <sub>2</sub> and i <sub>3</sub> .....	52	“
Width of symphysis at narrowest point.....	21	“
Width across incisive border.....	34	“
Depth of jaw at m <sub>1</sub> .....	53	“
Height of condyles above bottom of jaw.....	140	“

