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EXTINCT HORSE, FOUND IN
CENTRAL ALASKA

(WITH TWO PLATES)

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On January 25, 1913, there arrived at the U. S. National Museum the fossil skull of a horse which had been sent from the interior of Alaska. Hitherto our knowledge of Alaskan horses has depended on very scanty remains, such as single teeth, or a very few associated teeth, and a few bones, or fragments of them. These scanty remains had, however, been found at a considerable number of places; and, meager as they were, they showed that at some time in the past horses had been widely distributed in that apparently inhospitable region. A map is here presented (fig. 1) which shows the localities, where, as far as the writer knows, evidences of fossil horses have been found in Alaska and Yukon territories. Doubtless many remains have been discovered which have not been reported; and possibly a few announcements have escaped the notice of the writer.

The skull here described was discovered, in the course of mining operations, by Mr. C. P. Snyder, near Tofty, Alaska (fig. 1 (13)), a small mining town situated on Sullivan's Creek, about 24 miles southwest of Rampart and 7 miles northwest of Hot Springs. Rampart is on the Yukon River, about 4° east of the center of the territory. Sullivan's Creek empties into the Tanana River. The skull has been deposited for the present in the U. S. National Museum, and has been given the number 7700. In some of the cavities of the specimen is an extremely fine-grained deposit; a fact which shows that the skull had been buried in the silts, which are so abundant along the great rivers of Alaska.

The skull (pls. 1, 2) lacks the lower jaws, also the greater part of both nasals, the ascending processes of the premaxillæ, and the upper borders of the maxillæ over the premolar teeth. Otherwise it is in fine condition. The bone is stained brown; and, while thoroughly mineralized, retains its original structure. Nearly all the sutures are yet open. The teeth, too, are in fine condition and in the most favorable stage for study. The animal appears to have been

about 6 years old. Inasmuch as the upper canines are well developed, it was quite certainly a male.

After having made a careful study of the skull, taken many measurements and made careful comparisons with the accessible materials, the writer concludes that the animal probably belonged to the

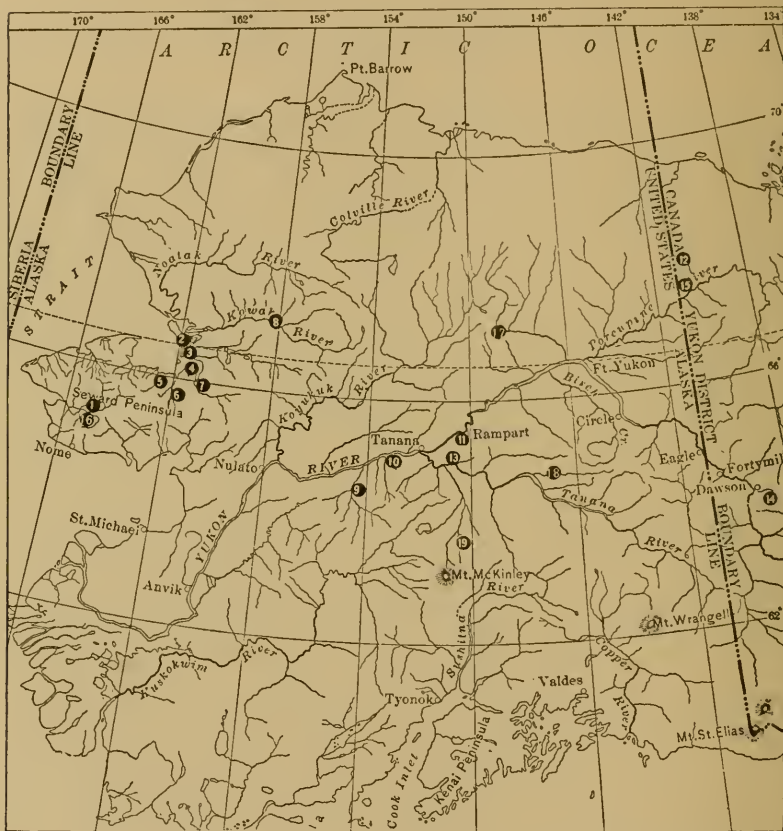


FIG. 1.—Map showing localities in Alaska where remains of fossil horses have been found.

species which he described recently (Proc. U. S. Nat. Mus., Vol. 44, pp. 569-593, pls. 69-73, and text figures) under the name *Equus niobrarensis*. Nevertheless, there appear to be certain differences which, although apparently not of specific value, make it proper to signalize this horse as a distinct form. It may be named and characterized as follows:

EQUUS NIOBRARENSIS ALASKÆ, new subspecies

Skull somewhat smaller than in the typical form; premaxillæ relatively wider, and differing in outline; region about articulation of the lower jaw and zygomatic arch modified.

The differences between this form and that found in Nebraska will appear in greater detail as the description proceeds. It is especially to be noted that the Alaskan horse is considerably smaller than the other. The type of *Equus niobrarensis* was found at Hay Springs, in northwestern Nebraska; but other members of the species have been recognized in teeth from western Texas, eastern Nebraska, and western Iowa. A lower molar, found at Wathena, Kansas, is referred to the same species. The deposits at Hay Springs are known as the Sheridan, or Equus, beds. The teeth from Iowa occur in the Aftonian, as do probably those from eastern Kansas and western Nebraska.

The following measurements have been taken from the skull and the teeth; and these are accompanied by the corresponding measurements of the type *Equus niobrarensis*, No. 4999, U. S. National Museum:

MEASUREMENTS OF SKULL AND TEETH OF *E. niobrarensis*.

	No. 7700 mm.	No. 4999 mm.
1. From middle of incisive border to rear of occipital condyles. .	518	556
2. From middle of incisive border to front of foramen magnum. .	498	530
3. From middle of incisive border to rear of hard palate.	268	290
4. From middle of incisive border to rear of occipital crest.	540	582
5. From middle of incisive border to line joining fronts of pm. ² . .	129	137
6. From middle of incisive border to line joining the rear of the orbits	368	400
7. From middle of occipital crest to line joining the rear of the orbits	174	181
8. Length of the orbit	65	84
9. Distance between i. ³ and pm. ²	93	105
10. Width across post-tympanic processes	117	119
11. Width across glenoid fossæ.	195	217
12. Width at rear of orbits	220	240
13. Width at front of orbits.	158	158
14. Width on maxillary ridge at maxillo-malar suture.	182	187
15. Width of palate at m. ³	72	70
16. Width of palate at pm. ² , least	50	50
17. Width of palate at diastema, least.	54	45
18. Width from outside to outside of m. ³	124	123
19. Width from outside to outside of pm. ⁴	128	125
20. Width from outside to outside of canines.	68	—

21. Width from outside to outside of outer incisors.....	77	78
Length of premolar-molar series.....	170	179
Length of premolar series.....	95	98
Length of molar series.....	77	81
Pm. ¹ , height.....	60	75
length.....	39	38
width.....	26.5	27
protocone.....	9.5	10
Pm. ² , height.....	68	75
length.....	30	30
width.....	28	28
protocone.....	12	13.5
Pm. ⁴ , height.....	68	85
length.....	28.5	29
width.....	28.5	27
protocone.....	15	14
M. ¹ , height.....	—	80
length.....	25.5	27
width.....	27.5	28
protocone.....	12	13
M. ² , height.....	—	80
length.....	26	27
width.....	26	25
protocone.....	12	14
M. ³ , height.....	—	75
length.....	26.5	26
width.....	24.5	23
protocone.....	13	14
Canine, length, fore and aft.....	12	—
width.....	9	—
I. ¹ , greater diameter.....	18	19
shorter diameter.....	10.5	13
I. ² , greater diameter.....	22	20
shorter diameter.....	11	12
I. ³ , greater diameter along worn surface.....	24	21
shorter diameter.....	10	11

It seems proper to make some remarks regarding certain of these measurements. The orbit of the type of *Equus niobrarensis* appears to be much larger than that of the Alaskan specimen; but this is probably due to some distortion in the type. To the same is probably to be attributed the apparent narrowness of the skull of the type at the fronts of the orbits; likewise, the narrowness of the palate; while it is probable that the width at the rear of the orbit is somewhat exaggerated. The relatively somewhat greater width at the glenoid fossæ is hardly due to distortion.

The measurement numbered 2 is that called by Osborn (Mem. Amer. Mus. Nat. Hist., n. s., Vol. I, p. 85) the basilar length; that

numbered 4, the vertex length; that numbered 6, the facial length; that numbered 7, the cranial length; that with the numeral 12, the frontal width. From these measurements we may obtain certain indices, viz., the cephalic index (measurement $12 \times 100 \div$ measurement 2); the facio-cephalic index (measurement $6 \times 100 \div$ measurement 2); and the cranio-cephalic index (measurement $7 \times 100 \div$ measurement 2). These operations performed give us the following results. For comparison, there are included the same indices determined from the skull of a large Percheron gelding, No. 174960, U. S. N. M.; from the skull of an Arabian horse, No. 172454, U. S. N. M.; from four skulls of Grevy's zebra (*Equus grevyi*); from four skulls of Grant's zebra (*Equus burchelli granti*); and from three skulls of *Equus przewalskyi*.

These details are added for the purpose of contributing to the determination of the value of the various indices which have been employed in determining the races and species of horses. All the skulls employed in these estimates belong to the U. S. National Museum, except those of *Equus przewalskyi*. These are in the American Museum of Natural History, where the author has been kindly permitted to study them. The zebras were collected by the Smithsonian African Expedition of 1909, most of them by Mr. Edmund Heller.

INDICES OF SKULLS OF HORSES AND ZEBRAS

Indices	<i>E. niobrarensis</i>		<i>E. caballus</i>		<i>E. grevyi</i>			
	Type	E. n. alaskæ	174960	Arab	163228	163227	163331	163238
Cephalic index.....	45.2	44.2	40	43	39	40	38.3	37.2
Facio-cephalic index.....	75.4	73.9	75.3	75	75.7	76.1	77.6	76.8
Cranio-cephalic index.....	34.3	35	36.6	35.5	35.1	35.1	35.6	35.1
Palato-cranial angle, in degrees.....	14.5	11	19.5	15.3	18	29	22.5	21

Indices	<i>E. burchelli granti</i>				<i>E. przewalskyi</i>		
	161930	161932	162962	162955	136	32686	71
Cephalic index.....	40.9	40.2	41	40	43.1	43	43.2
Facio-cephalic index.....	74.2	75.6	76.3	74.3	76.9	77	76.2
Cranio-cephalic index.....	36	36.4	36.8	39.1	36.2	36	33.7
Palato-cranial angle, in degrees.....	6.5	20	18.5	17	19	15.5	17.5

As regards the cephalic index, it will be observed that, especially among the skulls of Grevy's zebra, there is a good deal of variation. It has been regarded as an animal possessing a very long, narrow skull; while Grant's zebra, to the eye, seems to have a rather broad

skull. Yet one of the four skulls of Grevy's zebra has the same relative breadth as one of Grant's zebra. When, however, the average of the four skulls of each species is taken, that of the skulls of Grevy's zebra equals 38.6, that of the skulls of the other zebra 40.5. It is, therefore, pretty certain that measurements made on a large number of skulls of the two species will show, as regards breadth, a decided specific difference. Nevertheless, individuals will be found which trespass the limits.

It will be noted that the relative breadth of the skull of the Przevalsky horse is much higher than that of either of the zebras, equaling that of the Arabian horse here measured. The specimens of *Equus niobrarenensis* stand above all the others. On looking through the figures representing the facio-cephalic index, it seems to be hopeless by this means to distinguish species. The average for *Equus grevyi* amounts to 76.5; that of Grant's zebra, 75.1; that of Przevalsky's horse, 76.7. These figures seem, however, to exclude the possibility that the Alaskan skull belonged to *Equus przewalskyi*.

One of the skulls of the Przevalsky horse has a very low cranio-cephalic angle, and this reduces much the average for this species. The skull was that of a horse much younger than the other two, and this may have something to do with its shortness behind the orbits. The average for Grevy's zebra is 35.5; for Grant's, 37.1; for the Przevalsky horse, 35.3. All the four skulls of *E. grevyi* have this index less than any of those of Grant's zebra.

An examination of the figures representing the palato-cranial angle shows that there is, in some cases, great variation among members of the same species. Among the three individuals of *Equus przewalskyi* the range of variation is not wide, although there is much difference in age. The specimen numbered 32686 is regarded by Mr. Chubb, of the American Museum of Natural History, who has given much attention to the osteology of horses, as having had the age of thirteen years; number 136, twelve years; and number 71, four and one-half years. The differences do not, therefore, appear to be due to age, the youngest horse standing between the other two. In the case of the skulls of *Equus grevyi* there is a range of 11°. The youngest, No. 163227, yet retains the milk-teeth, but has the second upper molar through the bone. It has the highest angle, 29°. The next in age, No. 163238, had the last molar just beginning to wear and the third incisors not yet cut; its angle is 21°. The other two animals were of practically the same age, with all the permanent teeth in use and with the incisors yet cupped. The angles are, as seen, respectively, 18° and 22.5°.

The greatest range in the size of the palato-cranial angle is seen in the four skulls of Grant's zebra; and the greatest difference is seen to exist between No. 161930 and No. 161932. These two animals were mature, but not aged, of nearly the same age, both males, and both secured on the same farm in British East Africa. One has an angle of 6.5° ; the other an angle of 20° . It will be observed that this angle is relatively small in the type of *Equus niobrarensis* and in the skull from Alaska; but other skulls of the species might furnish quite different results.

The gelding and the Arabian agree in having the occiput-vertex angle equal to 77.5° ; the type of *Equus niobrarensis* and the Alaskan skull agree in having it equal to 73.5° .

The grinding teeth of the Alaskan specimen (pl. 1, fig. 2) resemble greatly those of the type of *Equus niobrarensis*. The table above given shows that those of the two skulls differ little in size. The outer styles are equally prominent in the teeth of both. In both skulls the protocone of the last premolar is longer than the protocones of the molars. In the two hinder premolars of both skulls, the post-protoconal valley is broad, has a deep re-entering loop in front, and sends a long branch to the center of the grinding surface. In both skulls these peculiarities of this valley are not so prominent in the molars as in the premolars, and slightly less so in the molars of the Alaskan skull than in the molars of the type. As regards the enamel surrounding the cement lakes, there appear to be no important differences. In the type skull the hinder border of the hinder lake in the first and second molars has a rather deep notch, while in the Alaskan skull this is absent or extremely small.

The incisors of the Alaskan skull (pl. 1, fig. 3) are in a slightly more advanced stage of wear than are those of the type skull. All have deep cups, that of the second incisor being 30 mm. deep. This incisor, evidently, had the hinder wall notched, as shown by a sharp groove in the rear of the tooth. The third incisor is worn down just to the bottom of the notch.

The width of the posterior nares, in front of the hamular processes, is 46 mm. In the type of *Equus niobrarensis* the width is 46 mm.; in the Arabian horse, 50 mm.; in the gelding, 60 mm. In the Alaskan skull the width across the occipital condyles is 80 mm.; in the type of *Equus niobrarensis*, 84 mm.; in the Arabian horse, 90 mm.; in the gelding, 99 mm.

The Alaskan skull differs from all the others here mentioned in the condition of the sagittal crest (pl. 2, fig. 1). The ridges which run

backward from the orbits do not coalesce on the parietals, but are separated by a space of about 8 mm. A ridge which runs forward from the occipital crest passes between these and finally disappears on the general surface. However, in examining a number of skulls of Grant's zebra, the cranium of which usually has a well-developed crest, two are found with the post-orbital ridges separated to the rear of the skull, but not so widely as in the Alaskan horse. One of these two zebra skulls belonged to a young animal, the other to one with the incisors well worn down.

It is observed also that the hinder border of the palate extends forward to nearly the middle of the second molars; while in the type of *Equus niobrarensis* it reaches only to the hinder end of this molar.

The premaxillæ in the Alaskan skull have the same absolute width at the incisors that these bones have in the type skull. The outline of the two jaws in this region are somewhat different, as seen from above.

The zygomatic arch, where narrowest, is 29 mm. wide in the Alaskan skull; while in that from Nebraska this arch is absolutely and relatively much wider, 37 mm. Its upper border above and behind the glenoid fossa is much thicker and more obtuse than in the type skull. The width of the occipital crest, at the suture between the superoccipital and the parietals, is equal to 68 mm. in the Alaskan skull; in the Nebraskan, 74 mm.; and the form is different in the two; especially does the occipital crest in the Nebraska skull project more backward.

The face of the type of *Equus niobrarensis* is more elevated than that of the Alaskan skull, the midline being at a height of 123 mm. above the rear of the palate, while in the Alaskan skull the height is 111 mm. This is 5 mm. more than is required by the greater length of the skull; but slight distortion of the skull as restored, or individual variation in either of the skulls, may easily account for the difference.

There are some distinct differences found in the glenoid fossæ of the two skulls here compared. In the type of *Equus niobrarensis* the articulatory surface has an extent, from side to side, of 63 mm.; in the Alaskan skull this is only 51 mm. In the Nebraskan skull this surface is so concave from side to side that a straight line from its extremities is, at one point, 8 mm. from the surface. In the case of the Alaskan skull such a line is nowhere more than 4 mm. from the surface. In the case of a considerable number of zebra and horse skulls examined, this region shows much constancy in form.

It has been suggested to the writer that the skull here described might belong to *Equus przewalskyi*. The thought readily suggests itself that this horse of eastern Asia might have crossed, with many other species of mammals, into America at a time when Bering Strait was temporarily abolished and that later it became extinct in this country. However, the Alaskan horse differs in many ways from *Equus przewalskyi*. The teeth are of practically the same size in the two forms, but the enamel of the Asian species has a still less complicated arrangement. The upper incisors are narrower and are curved more strongly downward. It is the writer's opinion that the horses and the bisons, probably also the mammoths and many other species, found in Alaska, became extinct about the middle of the glacial epoch.

They probably flourished during the Aftonian and the Sangamon stages.

In the U. S. National Museum are various teeth and fragments of jaws from Alaska. One lot of these (Cat. No. 2313, U. S. National Museum) consists of a part of the right maxilla, with the three molars (fig. 2). It was collected on Quartz Creek, in the Seward peninsula, by A. H. Jose, and presented to the U. S. Geological Survey. The locality is indicated on the map here presented (fig. 1) by the numeral (1). For an account of this locality see Mr. A. T. Collier, in Professional Paper, No. 2, U. S. Geological Survey, page 27. These teeth, also, the writer refers to *Equus niobrarensis alaskæ*, but they present some differences. The following are the dimensions:

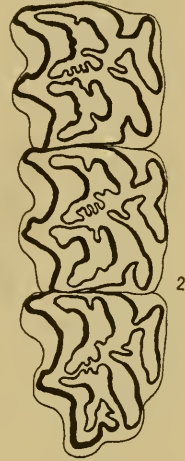


Fig. 2. Three upper molars of right side, No. 2313, U. S. Nat. Mus. $\times \frac{3}{4}$

MEASUREMENTS

Molar series, length .....	.58
M. ¹ , height .....	.24
length .....	.26
width .....	.26.5
protocone .....	.13
M. ² , height .....	.51
length .....	.25
width .....	.25
protocone .....	.15
M. ³ , height .....	.58
length .....	.28
width .....	.24
protocone .....	.15

It will be seen that these teeth are slightly smaller than those of both the type of *Equus niobrarensis* and those of the Alaskan skull from Tofty. Likewise the protocones are longer, equaling the length of that of the fourth premolar of the Tofty skull. These teeth have, too, a greater complication of the enamel which bounds the opposed faces of the two cement lakes. That on the hinder face of the front lake is especially folded, forming five loops. However, it is only a little more complicated than that of the lakes of the first molar of the Tofty skull.

The numeral (2) on the map here shown marks Hotham Inlet, latitude 162° West, where, close to the Arctic Circle, Mr. L. S. Quackenbush (Bull. Amer. Mus. Nat. Hist., Vol. 26, p. 121, pl. 18) found, in very barren deposits, the metatarsal bone of a horse. This specimen, as well as others found by Mr. Quackenbush, are in the American Museum of Natural History, New York.

Various specifically unidentifiable remains of fossil horses have been found around Eschscholtz Bay. The earliest mentioned were discovered by Captain Beechey and his companions in 1827 at Elephant Point. The parts then found were an astragalus, a metacarpal, and a metatarsal. They were mentioned and figured by Buckland in the second volume of the Narrative of the Voyage of the Blossom, p. 597, pl. 3, figs. 13-15.

The same region was visited by the ship "Herald," in 1848; and some bones of horses, together with those of various other extinct animals, were found. These were described by Sir John Richardson in the Zoölogy of the Voyage of the Herald, pp. 17-20. Of the horse he described a sacrum, a right os innominatum, a part of a right ischium, a radius and part of the attached ulna, a whole tibia and parts of four others, two astragali, and a part of a metatarsal. To these were applied simply the name, *Equus fossilis*. All these specimens are in the British Museum of Natural History (Lydekker, Cat. Foss. Mammalia, Brit. Mus., pt. 3). None of these seem to have been figured.

In the summer of 1907 Mr. L. S. Quackenbush explored the region around Eschscholtz Bay in the interests of the American Museum of Natural History, New York. His report was published in the bulletin of that museum, Vol. 26, 1909. On the north shore of the bay, eastward of Chloris Peninsula, he found some remains of an undetermined species of horse. In the same locality he found *Elephas*, *Bison*, *Ovibos*, *Rangifer*, *Canis*, and *Castor* (op. cit., p. 106). This locality is marked by the numeral (3) in the map here shown.

On the south side of Eschscholtz Bay, from Elephant Point eastward, Quackenbush (op. cit., p. 94, *seq.*) collected various remains of *Equus*, foot bones, a cervical vertebra, some loose teeth and a fragment of a lower jaw, with the premolars. The grinding faces of these teeth are shown in fig. 3. The teeth were well worn down. The height of the jaw at the front of the last molar is 90 mm.; at the front of pm.₄, 78 mm.; at the front of pm.₂, 45 mm. These measurements indicate a horse with a more slender jaw than that found in the type of *Equus niobrarensis*. This is to be expected on account of the evidently greater age of the animal; but in the type the width at the front of pm.₂ is 67 mm., in place of 45 mm., in the fragment here described. The following are the measurements of these teeth:

Pm.₂, height 10 mm., length 33 mm., width 13.5 mm.

Pm.₃, height — length 26 mm., width 15 mm.

Pm.₄, height 35 mm., length 26 mm., width 15.5 mm.

These teeth appear to belong to *Equus niobrarensis alaska*, although the arrangement of the enamel is somewhat less complicated than in the horse from Nebraska.

The same explorer found indications of the horse along Buckland River (fig. 1 (7)), together with *Elephas*, *Bison*, *Rangifer*, *Ovibos*, *Alce*, *Ursus*, *Canis*. Mr. Quackenbush visited also the region south of Spafarief Bay, along the basin of the Keewalik River (fig. 1 (6)) and the Kugruk River (fig. 1 (5)). From both regions he reported *Equus* remains. Along Candle Creek, a branch of the Keewalik, he found an upper premolar, probably the third or the fourth. The height is 81 mm.; the length, 29 mm.; the width, 26 mm.; the length of the protocone, 14.5 mm. It is curved so as to be concave on the inner and the hinder faces. It is referred provisionally to *Equus niobrarensis alaska*.

In the U. S. National Museum are two horse teeth, which were collected somewhere in the region about Kotzebue Sound, or probably Eschscholtz Bay, and presented by the Board of Education of the Department of the Interior. One is a second upper left premolar, with a length of 40 mm. and a width of 26 mm. on the grinding surface. There is nothing to distinguish it from the same tooth of *Equus caballus*, although it is not probable that it belonged to that species. The other tooth, a lower left molar or premolar, differs from that of the domestic horse, and resembles that of *Equus niobrarensis*.



Fig. 3. Three lower premolars, No. 14337, Amer. Mus. Nat. Hist. $\times \frac{3}{4}$

Mr. C. W. Gilmore, who led an expedition into Alaska in 1907, reported (Smithsonian Misc. Coll., Quarterly Issue, Vol. 2, p. 31) that fossil horse remains, a single bone or two, now in the U. S. National Museum, were found on the Kowak, or Kobuk, River (fig. 1 (8)). He also ascended the Nowitna River, a southern affluent of the Yukon, a distance of about 180 miles and found, on the sand bars, remains of horse, mammoth, extinct bison, etc. (fig. 1 (9)). Mr. Gilmore further reported the finding of *Equus* remains along the Palisades on the Yukon (fig. 1 (10)). These



FIG. 4.—Left last lower molar, No. 866, U. S. Nat. Mus. $\times 34$.

FIG. 5.—Left lower second premolar, No. 2645, U. S. Nat. Mus. $\times 34$.

FIG. 6.—Left lower tooth, probably first molar, No. 2645, U. S. Nat. Mus. $\times 34$.

FIG. 7.—Left lower third molar, No. 2645, U. S. Nat. Mus. $\times 34$.

FIG. 8.—Left lower tooth, premolar or molar, No. 2645, U. S. Nat. Mus. $\times 34$.

Palisades begin about 35 miles below Tanana. The materials secured by Mr. Gilmore included no teeth and are specifically indeterminable.

In the U. S. National Museum is a part of the left side of the lower jaw of a horse and in it is found the last molar. The catalogue number is 866. In an older catalogue the information is given, under the number 6563, that this jaw was collected in the region of Rampart (fig. 1 (11)). It was secured by Dr. William H. Dall, who tells the writer that the discoverer of the jaw was Mr. J. Lockhart, an old trapper in the employ of the Hudson Bay Company. The tooth is worn down to a height of about 45 mm. The length of the grinding surface (fig. 4) is 37 mm.; the width in front is 16 mm. This is greater by about 3 mm. than the width of the same tooth in the type of *Equus niobrarensis*; but that tooth may not have yet reached its full width. No other differences of importance are observed.

The catalogue number, 2645, in the U. S. National Museum, belongs to a lot of four lower teeth, which were collected by Mr. A. G. Maddren for the museum in 1904, on the Old Crow River, in Yukon Territory, not far from the boundary line between this territory and Alaska (fig. 1 (12)).

It seems probable that three of these teeth belonged to one individual, the fourth to another and much younger one. The three are represented by figs. 5-7, the fourth tooth by fig. 8. One of the three (fig. 5) is the second premolar, another (fig. 7) the third molar, the other (fig. 6) probably the first molar; and all belonged to the left side of the lower jaw. The following are the dimensions of these teeth:

MEASUREMENTS

Pm. ₂ , height	.....53
length	.....38
width	.....17.5
M. ₁ , height	.....56
length	.....30
width	.....17
M. ₃ , height	.....65
length	.....33.5
width	.....14

On comparing the figure of pm.₂ (fig. 5) with that of the same tooth of the type of *Equus niobrarensis* (Proc. U. S. Nat. Mus., Vol. 44, p. 579, fig. 20) it will be seen that the Alaskan tooth is broader and has somewhat more complicated enamel. The supposed first molar (fig. 6) differs from that of the type of *Equus niobrarensis* in having slightly more complicated enamel bands, but especially in having the valley which enters the tooth from the outside pushed between the two longitudinal valleys and nearly to the enamel of the opposite side. In about the same way the last molar (fig. 7) differs from that of the Niobrara horse. It does not appear probable that these teeth belonged to *Equus niobrarensis alaska*.

The fourth tooth (fig. 8) evidently belonged to a younger horse, having been worn down very little. It is considerably damaged, but the essentials of its structure can be made out. The height of the tooth is 82 mm.; the length is about 34 mm.; the width, 11 mm. The drawing will show the extreme complication of the enamel. It is probable that it is the tooth of a third Alaskan species.

During the summer of 1912 Mr. Copely Amory, Jr., made a small collection of fossil mammal bones on the Old Crow River, about fifty miles above its mouth. Among the animals represented are the mammoth, bison, a camel, and one or more horses. The horse

remains consist of a tooth, a part of a femur, parts of two tibia, two astragali, three proximal, and two second phalanges. The tooth presents all the characters of an upper left premolar of *Equus niobrarenensis alaskæ*. The grinding surface is 28 mm. long and 28 mm. wide. The protocone is unusually long, 16 mm.

Mr. L. S. Quackenbush (op. cit., p. 91) states that he collected a fragmentary pelvis of a horse on the tailings of a mine, at Fox Gulch, not far from Dawson, Canada (fig. 1 (14)). The fossil bones occur here in a muck, which overlies a bed of gravel. They are sometimes found partly imbedded in the gravel.

Lydekker (Cat. Foss. Mamm., Brit. Mus., pt. 3, pp. 78, 86, 87) records the presence, in the British Museum of Natural History, of part of the right ramus of the lower jaw of a young horse, a part of a metatarsal, and a first phalange. These had been collected many years ago by Rev. R. McDonald, on the Porcupine River, Canada. The locality is not more exactly indicated; but it was probably not far from New Rampart House (fig. 1 (15)).

On a map, which forms a part of his paper already referred to several times, Mr. Quackenbush indicated (pl. 25) the localities in Alaska and Yukon where up to that time horse remains had been discovered. Four of these localities remain to be noted here. The first of these (fig. 1 (16)) is in the Seward Peninsula, on the Pilgrim River, south of the Kuzitrin River. To Mr. Quackenbush there was presented, by a civil engineer, Mr. A. Gibson, in whose statements he had full confidence, a tooth of a horse, which had been found on the river mentioned, and which is now in the American Museum of Natural History.

The three following localities were reported by the well-known collector, Mr. Charles Sheldon, to Prof. Henry F. Osborn, and communicated by him to Mr. Quackenbush. At some point on the Chandler River (fig. 1 (17)), at about latitude 67° north and about longitude 149° west, Mr. Sheldon found a terminal phalanx of a horse; and this he presented to the American Museum of Natural History. From some point along the Chena River (fig. 1 (18)), east of Fairbanks, somewhat south of latitude 65° north and not far from longitude 147° west, Mr. Sheldon reported the skull of a fossil horse. Where this skull now is the present writer does not know. Likewise, evidences of the existence of a fossil horse were found by Mr. Sheldon somewhat north of Mount McKinley. This was apparently not far north of latitude 63° north and somewhat west of longitude 150° west (fig. 1 (19)).

Mr. Quackenbush kindly informs the writer that a trader gave him a fossil horse tooth, which had been picked up on the ocean side of an island at the mouth of Schismareoff Inlet. Mr. Quackenbush regarded it as possible that the tooth had been carried there by floating ice; consequently, the locality is not recognized on the map.

At the American Museum of Natural History, New York, the writer saw three fragmentary horse teeth, which had been brought back by the Stefansson and Anderson Expedition and found about fifteen or twenty miles southwest of Point Barrow. Since, however, these teeth were discovered on the sites of Eskimo villages, it is probable that they had been taken there by human agency. For this reason this locality is not placed on the map.

One who studies the animals, living and extinct, of Alaska, is naturally led to consider those found on the other side of Bering Strait. The writer has not had the time and opportunity to enter into this subject thoroughly. He has, however, examined the descriptions and figures of fossil horses which were prepared by Tscherski (Mem. Acad., St. Petersburg, ser. 7, Vol. 40, pp. 257-380, pls. 5, 6). This author had in his possession a skull, well preserved and lacking few important parts, which had been obtained on Liakhof Island, situated in the Arctic Ocean, latitude 73° north, longitude 140° east. This is more than a degree farther north than Point Barrow, Alaska. The horse to which the skull belonged was supposed to be eight or nine years old. Tscherski figured this skull in three positions and presented a view of the grinding surfaces of the upper premolars and molars. He likewise described the skull in great detail and gave numerous measurements of its parts and of the corresponding parts of many other horses, existing and fossil. The skull had a basilar length of 502 mm., only 4 mm. more than the Alaska skull. It is, therefore, easy to make comparisons between the two. The width at the rear of the orbits is 216 mm., slightly less than in the Alaska skull; the cephalic index is, therefore, 43 instead of 44.2 mm. This difference is due to the fact that in the Liakhof Island horse the hinder part of the rim of the orbits does not project beyond the zygomatic arches, as it does in the Alaska skull. Tscherski attached considerable importance to this feature; but a study of the skulls of a number of Grant's zebras seems to show that in this respect, as in so many others, there is a good deal of variation. The facio-cephalic index in the Liakhof skull is 73.1; in the Alaska horse, 73.9. Tscherski measured carefully the postorbital bar, the height of the zygomatic arch below the orbit and behind it, and obtained indices thereof and compared them with those obtained from other horses;

but it needs only an examination of such a set of zebra skulls as have been gathered at the U. S. National Museum to convince one that there exists in probably every species of *Equus* great individual variations in the regions under consideration.

In the Liakhof horse the width of the skull at the articulation for the lower jaw is 14 mm. greater than in the Alaska skull. The width across the hinder ends of the nasals, taken in a straight line, is 118 mm. in the Alaska skull; in the Liakhof skull it is given as 126? The orbit in the Alaska skull is smaller than that of the other, the horizontal measurements being respectively 66 mm. and 67 mm.; the perpendicular, 55 and 61. The face of the Alaska horse appears to have less height than that of the Liakhof horse, the height measured at the rear of the last premolar, being in the former, 132; in the latter, 140 mm. The nose of the Alaska skull appears to have been, somewhat longer (from front of the premaxillæ to the front of pm.²) than in the other skull, being 134 mm. as compared with 129 mm., a relatively small difference. The length of the diastema between i.³ and pm.² is the same in both. Tscherski notes, in the skull discovered by him, a concavity which occupied a considerable area just above the maxillary ridge. In the Alaska skull there is a corresponding cavity somewhat larger and deeper. In some specimens of Grant's zebra this region is strongly convex; in others, it is slightly concave. It is possible, of course, that a character variable in one species will be constant in another. The face of the Liakhof skull is somewhat wider on the maxillary ridge than in the Alaska skull, being 191 mm. as compared with 182 mm. These maxillary ridges extend farther forward in the Alaska skull than in the other, reaching nearly to the middle of the hinder premolar; in the Liakhof skull, to about the middle of the first molar.

The hard palate of the skull last named ends in the midline opposite the middle of m.³; in the Alaska skull it ends opposite the hinder end of the protocone of m.² The distance from the front of the foramen magnum to the hinder edge of the hard palate is almost exactly the same in the two skulls. From the front of the foramen to the edge of the vomer, at the midline, the distance is 131 mm. in the Liakhof skull; in the Alaska skull, 121 mm. From the same point of the vomer to the edge of the hard palate is 109 mm. in the Liakhof skull; in that from Alaska, 114 mm. In the last-named skull the index obtained by dividing the smaller distance multiplied by 100, by the greater is 83.2; in the former skull, 94.2. It remains to be proved that this difference is of specific value. Tscherski stated that the incisive foramina, or fissures, in the skull which he described

were extraordinarily short, 30 mm.; while in other horses examined by him the length ranged from 41 mm. to 53 mm. In the Alaska skull these slit-like openings are 29 mm. long. In a number of skulls of Grant's zebra these fissures vary greatly in length.

It remains to compare the teeth of the Liakhof skull with those of the Alaskan. They differ little in measurements. The length of the premolar-molar series in the former, measured in a straight line, is 170 mm., exactly that of the Alaskan skull. In the following table the measurements of both are given for easier comparison.

MEASUREMENTS OF TEETH

Teeth	Liakhof horse mm.	Alaskan horse mm.
Pm. ² , length	41	39
width	24	26.5
protocone	10	9.5
Pm. ³ , length	27	30
width	29	28
protocone	13	12
Pm. ⁴ , length	26	28.5
width	30.5	28.5
protocone	14	15
M. ¹ , length	24	25.5
width	28.5	27.5
protocone	13.5	12
M. ² , length	23.5	26
width	27.5	26
protocone	15	12
M. ³ , length	29	26.5
width	25	24.5
protocone	16	13

It will be seen that there are no remarkable differences in the dimensions of the teeth, probably not greater than would be found in different individuals of the same species. The Liakhof skull, having belonged to an older horse, would naturally be expected to have the anterior premolar and the hinder molar longer, and the others shorter, on the grinding surface, than the younger horse. The protocones are of about the same length, except that those of the hinder molars of the Liakhof skulls are 3 mm. longer than those of the Alaskan skull.

As far as can be judged from Tscherski's figure the arrangement of the enamel around the two cement lakes of each tooth appears to be not especially different from that seen in the Alaskan skull. A considerable difference is seen, however, in the valleys which enter the interior of the tooth on the inner side. The median, or postproto-

conal, valleys of the teeth of the Liakhof skull are not so wide as those of the Alaskan skull and do not extend nearly so far toward the center of the tooth. The little bay entering the tooth behind the hinder inner pillar (hypocone) is much narrower in the Liakhof horse than in the Alaskan. Likewise the bay entering the tooth in front of the protocone is narrower, and the anterior end of the protocone extends further forward inside of it.

Tscherski attached much importance to the feature just mentioned, the elongation of the anterior end of the protocone, and proposed an index to express this. He measured the distance from the hinder border of the tooth to the anterior border of the protocone and divided this, multiplied by 100, by the distance from the hinder border of the tooth to the nearest point of the anterior bay. His results on the teeth of the Liakhof skull are given below, and with them the indices derived from the skull forming the type of *Equus niobraren-sis*, the Alaskan skull here described, two skulls of *Equus grevyi*, and two of *Equus burchelli granti*. In each case the present writer has taken the measurements from the hinder end of the under inner pillar (hypocone).

INDICES SHOWING EXTENSION FORWARD OF PROTOCONE IN *Equus*.

Teeth	Liakhof horse	<i>E. niobraren-sis</i> type	<i>E. niob. alaska</i> type	<i>E. grevyi</i> No. 163228	<i>E. grevyi</i> No. 163331	<i>E. bur. granti</i> No. 162951	<i>E. bur. granti</i> No. 161927
Pm. ³	127.2	120	108.3	115.8	108	112.5	106.9
Pm. ⁴	123.6	119.7	109.9	115.8	111.6	123.3	115
M. ¹	119.5	112.5	106.7	117.6	117.6	111.2	106.9
M. ²	127.5	117.8	111.1	120.9	113.9	116.1	106.4

It will be seen from this table that the indices of the Liakhof skull stand above all the others here measured. It will be observed also that there is a considerable range in the cases of the two specimens of Grevy's zebra and in the two of Grant's zebra. Inasmuch as both the depth of the anterior bay and the extension forward of the protocone may vary independently of each other, it would probably be better to compare each with the length of the grinding surface or with its width.

While it must be admitted that the Liakhof skull resembles greatly that from Alaska, the writer is not prepared to say that they belong to the same species. It must be stated here also that, while Tscherski in his work calls the Liakhof horse *Equus caballus*, he (p. 341) expresses the opinion that in case the peculiarities of the skull should be found repeated in other specimens, this might justify the specific independence of the animal.



EQUUS NIOBRARENSIS ALASKÆ
1. Side view of skull. x 1. 2. Upper premolar and molar teeth. x 1. 3. Upper incisor teeth. x 1.



1



2

EQUUS NIOBRARENSIS ALASKÆ x $\frac{1}{2}$.

1. View of skull from above. 2. View of skull from below.