

that *Myiodon harlani* flourished from the Aftonian to the Sangamon stage.

In his first paper on Aftonian Mammalian Fauna already quoted, Dr. Calvin described and figured (plate XXVI, figs. 1-3) a part of a large ungual phalange which he referred to *Myiodon*, without venturing to name the species. This phalange was found in the Cox gravel pit, at Missouri Valley, and has the same shape as the one of Calvin's figures, the one illustrating the bone as seen from above is here reproduced (Pl. VIII, fig. 2). Another figure on the same plate shows the left side of the claw. The anterior part of the bone is broken off and lost. The greater part of the bony sheath which protected the base of the horny claw is likewise missing, especially on the left side. The length of the bone as found is 113 mm.; but originally it

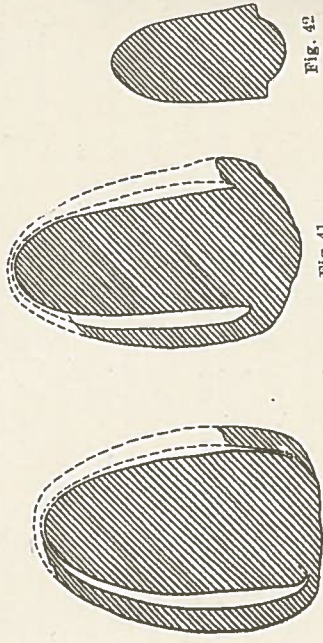


Fig. 40. *Myiodon harlani*: Sections of claw found at Missouri Valley. X $\frac{1}{2}$.
 Figs. 40-42. *Myiodon harlani*:
 40. Section taken near the base.
 41. Section taken at middle of anterior tuberosity.
 42. Section taken in front of tuberosity.

cannot have been far from 160 mm. The height at the front of the articulation with the second phalange is 52 mm.; at the rear of the tuberosity for the tendon, 58 mm., allowing nothing for the missing sheath; at the place of fracture, 32 mm. The breadth at the articulation is 39 mm.; at the place where the second section is taken, allowing something for the missing part of the sheath, about 40 mm.; at the broken end, 18 mm. The bone is more convex on the right side, showing that it was bent slightly towards the left. The upper border of the claw-core

is broadly rounded; thus differing from the same part in *Megalonyx*, in which this border comes to an acute edge in the distal half of its course. Sections are here furnished which are to be compared with similar ones of *Megalonyx*. Just behind the tuberosity in the lower border of the bone is a pair of large foramina for bloodvessels. Figure 40 represents a section of this claw taken just in front of the articulation with the second phalange; figure 41 another section taken at the middle of the tuberosity on the lower border; while figure 42 represents a section at the broken end of the specimen. These sections are to be compared with figures 25-29 on page 128.

The phalange mentioned as being found at Tecumseh, Johnson county, Nebraska, is in the State collection, at the University of Nebraska. It is a somewhat larger claw than the one found at Missouri Valley. The height at the front of the articulating surface, is 60 mm.; that at the tuberosity, 67 mm.

Recently Glover M. Allen has published (Mem. Mus. Comp. Zool. Harv. Coll., Vol. XI, pp. 317-346, pls. 1-4) a description of a new species of *Myiodon*, *M. garmani*, the type of which was found many years ago somewhere not far from Hay Springs, Nebraska. This species has a much narrower skull than *Myiodon robustus*, and there are important differences in the teeth. The lower teeth resemble rather closely those of *M. harlani*, but are yet different. The upper teeth are still more different. It is not improbable that the specimens found in the Aftonian of Iowa belong to this species rather than to *M. harlani*.

Allen regards his species as having been a browsing rather than a grazing animal.

Superorder UNGULATA.

Suborder PERISSODACTYLA.

Tapirs, Horses, Rhinoceroses, Titanotheres, Etc.

Ungulata which have the middle, or third, digit of all the feet most strongly developed; astragalus with the distal end flat; fibula usually not articulating with the heel-bone; femur with a third trochanter; presacral vertebrae 20 or 30.

This group, or suborder, of hoofed animals is represented today by only the horses, the tapirs, and the rhinoceroses; but during Tertiary times there existed a host of related forms. Many of these have been discovered in North America; others in South America, Europe, Asia, and Africa. One family that existed in our country, the Titanotheres, contained species that were as large as elephants. Because of the relatively few species now existing, the suborder may be looked on as a vanishing one.

The character which especially distinguishes the animals of this suborder from other Ungulata is the relatively large size of the third or middle toe. In all species of the group, fossil or living, the first, or inner, toe is either wholly missing, or represented in the forefoot by only a slender vestigial element; in nearly all, the fifth also is wanting. Among living genera the tapirs have the fifth present in the forefoot, but it is much reduced in size; the middle toe is, however, much larger than any of the others. In the living and in the Pleistocene horses, the middle digit alone is complete and functional, but remnants of the second and fourth toes exist in the form of splint-bones (Figure 43).

In all the perissodactyles the femur has an outstanding process, the third trochanter, on the outer side of the bone. That ankle bone on which the shin-bone rests, the astragalus, is semi-cylindrical and pulley-like at the upper end, with a deep furrow, while the lower end is cut off squarely, differing thus much from the corresponding bone in the artiodactyles.



Fig. 43. *Equus caballus*. Right hind foot, seen from front, 1, and from side, 2. a, astragalus; c, calcaneum; cb, cuboid; c1, c2, mesocuneiform; c3, ectocuneiform; m1, m2, m3, m4, metatarsals; p1, p2, p3, p4, p5, phalanges, or upper and lower pasterns and coffin bone.

Hyracotheres, Palaeotheres, Anchitheres, Protolhippines, and Horses.

Skull elongated; teeth in full number, forty-four or sometimes with canines and first premolars missing. Orbits in hinder half of the skull. Never any horns. Nasal bones long and pointed. Feet elongated.

All the animals included in this group are extinct, except the true horses; and it is mostly these which continued on into the Pleistocene.

Family Equidae.

The Horses, Asses, and Zebras.

Skull elongated and with the orbits well behind the middle of the length. Limbs fitted for great speed. Feet with three functional digits in many of the extinct genera; with only one in *Equus*. Teeth $i \frac{3}{3}, c \frac{1}{1}, pm \frac{4-3}{3}, m \frac{3}{3}$; cheek-teeth in the older forms low-crowned, in the most recent high-crowned; the upper molars showing on the unworn grinding surface two outer, two inner, and two intermediate cusps, each inner cusp joined to the corresponding intermediate by an oblique ridge. The worn molars showing an internal column (protocone) and two inner crescents separated from two outer crescents by two "lakes" of cement; lower molars with two outer crescents, two inner cusps, and an inner median column (mesostylid). The premolars of the higher genera, except the first, becoming molariform. Incisors, chisel-like, the canine and first premolars often wanting, especially in the females.

The numerous relatives of the domestic horse which belonged to other genera than *Equus* and *Neolhipparion* need not be described here. It suffices only to say that as we go further and further backward in Tertiary times, the species and genera lose gradually the distinctive characteristics of our horses. The feet come to have three or four functional toes, and the whole foot becomes larger as compared with the rest of the leg. The teeth come to have shorter and shorter crowns, the grinding

surface is furnished with rounded cusps covered with enamel, and the premolar teeth resemble less and less the true molars. The animals have no longer the great size of our horses; and the earliest forms were no larger than a small fox. The earliest known species belong to the Eocene of North America and Europe. *Eohippus* had four toes on the fore feet and three on the hinder. The crowns of the teeth were extremely low and resembled those of monkeys more than those of our horses.

Of this family there have been found in the Tertiary deposits of North America a dozen or more genera and many species; but of these only *Equus* and *Neohipparion*, so far as we now know, came into the Pleistocene. Many of the genera were common to Europe and North America. *Equus* existed in all the continents, except Australia, during the Pleistocene, probably also during a part of the Pliocene.

It may be said that good reasons may be proposed for removing from the family Equidæ many of the earlier and more primitive genera. On this question consult the recently published work by R. Lydekker, "The Horse and Its Relatives."

In a paper published in 1907 (Bull. Amer. Mus. Nat. Hist. Vol. XXIII), Mr. J. W. Gidley accepted the family in its wider sense and divided it into four subfamilies, as follows:

- I. Hyracotheriinae.
- II. Anchitheriinae.
- III. Protobippinae.
- IV. Equinae.

In Iowa there have been discovered representatives of only the last two families. Of these the Protobippinae contain about five genera most of which flourished during the Miocene and Pliocene; but one genus, *Neohipparion*, appears to have continued on into the Aftonian. The Protobippinae may be defined as follows:

Subfamily **PROTOHIPPIINAE.**

Cheek-teeth high-crowned and furnished with abundant cement, the molars well-developed. Three toes furnished with hoofs on all the feet, the median one much the largest.

GENUS **NEOHIPPARION** Gidley.

The New World Hipparions.

Cheek-teeth high-crowned and prismatic; the hinder three premolars like the molars; the first upper premolar present, but reduced in size; inner anterior column (protocone) of upper cheek-teeth not connected with the anterior crescent (protocone), on the worn surface appearing as an enamel-surrounded island of oval or elliptical form; canines present in both sexes; incisors with cups more or less well-developed. Feet each with three toes furnished with hoofs; the metacarpals and the metatarsals without keel at distal end.

This genus, which comprehends the New World hipparions, differs from the genus *Hipparion*, in which are placed the hipparions of the Old World, in having the internal anterior column of the upper teeth (as it appears on the worn face of the tooth) more or less elongated fore and aft, instead of circular. Also on the outer face of the tooth the spaces between the prominent ribs or styles are concave, as in the common horse, instead of being flat. It is thought also, that its lateral toes are more reduced than in *Hipparion*. However, the two genera are closely related.

About twenty species of this genus have been described as former inhabitants of our country; some of these will, however, probably be assigned to the genus *Merychippus*. This latter genus differs especially in having shorter-crowned teeth. Most of the species of *Neohipparion* belong to the upper Miocene, most of them coming from the regions of the Great Plains. Two species have been described from the Pliocene, and it is quite certain that the genus continued on into the early Pleistocene. *Neohipparion venustum* was described by Dr. Leidy in 1860 on specimens found in Pleistocene deposits near the mouth of the Ashley river, in South Carolina; and Dr. Calvin reported from the Aftonian at Rockport, Missouri, a tooth which is described below as probably *Neohipparion gratum*.

As in the case of the true horses, most of the species of *Neohipparion* are known from teeth only or in one or two cases from jaws. However, Professor Cope received from the upper Mio-

cene of northern Kansas a nearly complete skull of the species *N. speciosum*, which was associated with various vertebrae, one-half of the pelvis, and parts of a foreleg. The skull was figured by him in 1887 (Amer. Naturalist, Vol. XXI, fig. 38), and a description of the remains was given in 1889 (Proc. Amer. Philos. Soc., Vol. XXVI, p. 436). In order that the student may get some idea of the form of the skull of this genus, or at least a genus closely related to it, a figure is here reproduced of the skull mentioned (Pl. VIII, fig. 3). It is not improbable, however, that this species will be found to belong to *Merychippus*. The figure is from an unpublished plate prepared for Professor Cope. Its reproduction here is due to the courtesy of the United States Geological Survey.

It will be seen that it is very horse-like. In size it differs much from the skull of the domestic horse, being only about one foot long (315 mm.). This includes the occipital condyles and probably the incisor teeth. The greatest width, at the zygomatic arches, is 130 mm.; that between the third incisors is 37 mm. The horizontal diameter of the orbit is 48 mm.; the orbit is therefore relatively considerably larger than in the domestic horse. The forehead is more prominent than even in the Arabian horse, if we may judge from Cope's figure; and the height of the skull at the occipital condyles and at the temporal fosse is greater than in the Arabian horse. In the hipparion the height indicated enters into the length of the skull four times; in the Arabian horse nearly five times.

Cope described the various vertebrae which he had, but it is not practicable to do so here. The metacarpal bone had a length of 164 mm.; that of an Arabian horse fourteen and one-half hands high is 250 mm. long. On each side the metacarpal of the hipparion is beveled for union with the lateral metacarpals, showing that the animal had three toes. Cope stated that this species had a size about equal to that of the pronghorn antelope, but that the neck was shorter and the limbs more robust.

Neohipparion gratum? Leidy.

In the collection belonging to the University of Iowa is a single tooth which is to be assigned to the genus *Neohipparion* and which was discovered in the Whitman gravel pit a few miles south of Rockport, Atchison county, Missouri. This pit is located in section 22, township 64 north, range 41 west, and was regarded by Doctor Calvin as being excavated in Aftonian deposits. Besides this tooth, this pit has furnished teeth and a metatarsal of the horse, *Equus*, a tooth of a camel, and a tooth and part of a tusk of the elephant *Elephas columbi*. The tooth of the *Neohipparion* was reported by Doctor Calvin in the Bulletin of the Geological Society of America, volume xxii, page 211, and was figured on plate xix, figure 5. The figures are here reproduced (Pl. IX, figs. 1, 2). A pen drawing showing the grinding face is also presented (Fig. 44).



Fig. 44. *Neohipparion gratum?* Grinding surface of a molar tooth. X1.

The tooth has suffered the injury of having the external wall of enamel split off, but otherwise shows no evidence of post-mortem violence. It is rather strongly curved, so as to be convex on the outer face, concave on the inner. The coat of cement was well developed and is preserved, except on the outer face. The height of the tooth, measured on the outer face, in a straight line, is 34 mm.; on the inner face, 27 mm. The length of the grinding face is 17 mm.; its width cannot be determined. However, from the inner side of the protocone to the hinder extremity of the anterior lake, is 14 mm. The protocone is oval and has a fore and aft diameter of 3.5 mm. The postprotoconal valley, which in this genus opens out in front of the protocone, as well behind it, has a deep notch opposite the latter. There is a deep inlet in the hinder border of the tooth, cutting off partially the hinder inner column (hypocone). The enamel surrounding the lakes has a very simple arrangement, but hardly more simple than in some species of true horses, *Equus*. The anterior lake has no notch in the front border, but a very deep loop near the hinder end of the inner border, and another in the hinder border. Beyond this are two small loops. The posterior

lake has a deep loop in its front border and another in the hinder one.

The type of the species *Neohipparion gratum* was found somewhere along Niobrara river, in Nebraska, and is assigned to the Upper Miocene. Other specimens have been found since that time in Kansas, in Upper Miocene deposits. It seems somewhat improbable that the same species continued on through this epoch, through the Pliocene, and into the Aftonian. One has the choice, therefore, between the conclusion that the tooth described above is an undescribed species, and the conclusion that the tooth had been redeposited in the Aftonian from some Upper Miocene bed. It seems best to await further discoveries.

The tooth here under discussion appears to agree in all essential respects with the type tooth figured by Leidy, and those later described by Cope (Proc. Amer. Philos. Soc., Vol. XXVI, p. 415, figs. 16, 17).

The probability that *Neohipparion* existed during the Aftonian is increased by the fact that some remains of a small horse-like animal have been discovered in the Aftonian beds at the typical locality near Thayer, Union county. These remains consist of an astragalus, a large part of a right metatarsal, a proximal phalange and one or two unerupted teeth. These materials were first referred to by Dr. Calvin in 1910 (Bull. Geol. Soc. Amer., Vol. XX, p. 139) where he stated that the animal was less than half the height of the domestic horse. In a later paper (ibid. Vol. XXII, p. 210, pl. xix, figs. 1-4) further mention was made of these teeth and bones in connection with the tooth above described as *Neohipparion gratum*?; and figures were presented of all. Calvin's figures of the foot-bones are here reproduced (Pl. IX, figs. 3, 4, 7). The catalog number is 76. The metatarsal has a part of the lower end missing. The length of the fragment is 100 mm.; the front-to-rear diameter of the upper end, 26 mm.; the side-to-side diameter, about 28 mm.

At a distance of 75 mm. from the upper end the fore-and-aft diameter is 19 mm.; the transverse diameter, 18 mm. A part of the border of the upper articulation is abraded, so that the

measurements there taken are not wholly exact. In case this bone had the proportions that are found in the corresponding bone of another species of the genus, its length was close to 200 mm. The bone was therefore a relatively slender bone than that of the domestic horse. It differs from the metatarsal of the horse likewise in having the fore-and-aft diameter greater than the transverse. A section of the fragment, taken at any point below the head would be U shaped. The rear of the bone is nearly flat or slightly concave from side to side. On each side of the hinder face is a rough line, along which were attached the metatarsals of the second and fourth digits respectively. That border along which was attached the fourth metatarsal stands backward a little more prominently than that of the second.

The phalangeal bone is the first one of the digit. It belonged to a smaller animal than that which possessed the metatarsal; perhaps it belonged to another species. It is 36 mm. long. The fore-and-aft and the transverse diameters of the upper end are respectively 19.5 mm. and 11.5 mm., the latter taken at the middle of the articulation; at the middle of the length, 10.5 mm. and 13.5 mm.; at the lower end, 9 mm. and 16 mm.

Subfamily EQUINAE.

One-Toed Horses.

Cheek-teeth high-crowned and provided with abundant cement; the laces well developed. Only one functional digit in each foot; the lateral digits, second and fourth, appearing as splint bones.

Genus *EQUUS* Linn

The True Horses.

Cheek-teeth high-crowned and prismatic; premolars, except the much reduced and often absent first one, like the molars; in the upper jaw the inner column (protocone) attached by a slender neck to the anterior inner crescent. Incisor teeth usually with well-developed cups. Feet each with only one digit.

Of the genus *Equus*, about a dozen species are known from the Pleistocene of North America, north of Mexico. At some time during the Pleistocene, horses occupied our country from the Atlantic ocean to the Pacific, and from the Great Lakes to the Gulf of Mexico and far down to into Mexico. Even in Alaska their remains are not uncommon. Unfortunately, many of the species are known to us from their teeth only; and, in many cases, the teeth of different species resemble one another so closely that it is difficult to distinguish these species from one another and from the domestic horse. The finding of bones of fossil horses, especially skulls and whole skeletons, or large parts of them is greatly desired.

Figure 45 represents a side view of the skull of a horse. In this the bone has been cut away, so that the cheek-teeth may be seen in their full length. Of these great teeth there are six on each side of each jaw. All except the one in front and the one behind are long and nearly square prisms. A small first pre-

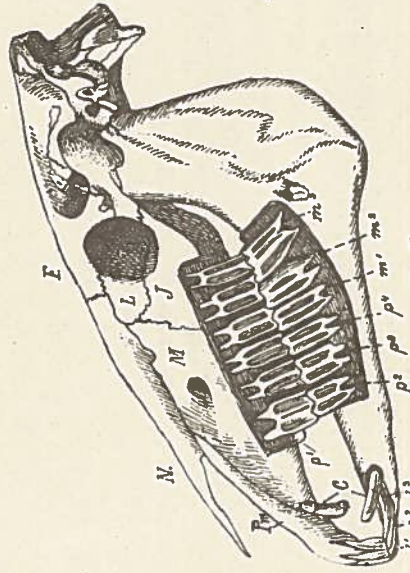


Fig. 45. *Equus caballus*.



Figs. 45-47. *Equus caballus*.
 45. Side view of skull, dissected to show the teeth.
 46. Section of right upper molar. From Max Weber. The enamel is shown by the heavy black lines, the dentine, by stippling, the cement, by parallel lines. *elph*, ectoloph; *hs*, posterior lake; *hy*, hypocone; *mets*, metacone; *miph*, metaoph.; *me*, metacone; *pv*, protocone; *pr*, paracone; *pa*, anterior lake; *ms*, protocone; *ms*, anterior lake.
 47. Section of right lower molar. From Max Weber. *end*, entostylid; *hm*, posterior inner fold, or valley; *hs*, metacone; *med*, metaconid; *m1*, median fold, or outer valley; *m2*, metaconid; *psd*, parastylid; *vm*, inner anterior fold or valley.

molar is represented in this figure as present in the upper jaw, but it is often absent.

Figures 45, 46 and 47, reproduced from Weber's *Säugetiere*, page 595, show the appearance of the grinding face of the upper and of the lower molar and premolar teeth of a horse. These and other figures here presented show how complicated is the pattern assumed by the enamel of the teeth in horses, and the relatively small differences seen among the various species. In these figures the dentine, which constitutes the largest part of the tooth, is indicated by stippling; the heavy black lines represent the enamel; the cement is shown by parallel lines. Figure 46 is lettered to show the various regions of the teeth, as seen on the worn face. The front of the tooth is directed toward the right. The regions marked *pr*, *pa*, *me*, *hy*, and *pl*, were, before the teeth began to wear down, projecting cusps. The space below *me*, surrounded by the irregular wall of enamel in the worn tooth, forms a "lake" of cement; that below *pa*, lettered *h*, forms another. In the figure of the lower tooth the constituent elements are indicated as they are in the upper. In this figure (Fig. 47) the front of the tooth is toward the left hand. Before the tooth began to wear the areas marked *prd*, *hyd*, *med*, and *end*, stood above the general surface of the tooth as enamel-covered cusps.

The three hinder premolars have, in the horses, assumed the form and structure of the true molars so thoroughly that they are almost indistinguishable from them. They are slightly larger than the molars and the column at the outer anterior angle is a little broader and is somewhat channeled the whole length of the tooth. The third true molar is larger than the others and its hinder border is not so squarely cut off as in the cases of the other teeth (Fig. 60). The second premolar is the largest tooth, and the front end of its grinding face is pointed (Fig. 68). In front of this tooth there may sometimes be found a very small first premolar (Fig. 45). It is the "wolf tooth" of veterinarians.

Far in front of the premolars are located the incisors, six in number in each jaw (Fig. 45). When somewhat worn they display on the grinding face an outer and an inner ring of

mm.), one near the front of the tooth, the other just behind the middle of the length. Between the two, are two loops of enamel (metaconid and mesostylid). Behind the second inlet is another loop of enamel, representing a ridge running up and down on the inner face of the tooth, the entoconid. At the extreme rear of the tooth is the more or less developed entostylid. Observations of these features will lead to the placing of the teeth in the proper jaw, on the proper side, and with the right end forward.

In the upper jaw the second premolar may be distinguished by its large size and pointed front end; the hinder true molar by its small size and its narrower hinder end. The other four teeth are more difficult to locate, and it is not usually necessary to do so. These same observations apply to the lower teeth.

There appear to be pretty well established at least ten species of the genus *Equus* which were inhabitants of the United States during the Pleistocene; although a number of others have been named. Much better materials of nearly all the species must yet be found and studied before our knowledge will be satisfactory.

There is need, not only of a better knowledge of the structure of the various species, but of their relation to the species that lived during the Pliocene, and therefore of the place of origin of the genus *Equus*, and what was the geographical range of sprang. We need to learn what was the geographical range of each species; but of more importance is it to learn what was the range of each species in time. It seems quite certain that true horses were present in America soon after the opening of the Pleistocene, and probably during some part of the later Pliocene. In Europe species of the genus existed during the upper Pliocene. In India the genus occurs in the upper Miocene. Therefore, the genus *Equus* appears to have had its origin in Asia, notwithstanding the fact that the genera that are most closely related to it seem to have lived in America. It seems probable that the horse-like animals that gave origin to the genus *Equus* passed by some land bridge into Asia and that later some species of *Equus* returned to America over perhaps the

enamel. Within the inner ring is a cavity, or cup, the "mark" of veterinarians. In old horses the cup disappears. At some distance on each side behind the incisors a canine tooth (Fig. 45, c) is found in the stallion, but is missing, usually at least, in the mare.

The inferior molars are much narrower than are the upper ones, nearly twice as long, fore and aft, as wide. The lower premolars also have the form and structure of the true molars, but are usually slightly larger. The hinder true molar is pointed behind, the second premolar is pointed in front. The first premolar is usually missing. There are six incisors and a pair of canines, the latter sometimes not developed.

The three hinder premolars, both above and below, are preceded by milk teeth, which have the general structure of the permanent teeth, but have a smaller transverse diameter. The fore-and-aft diameter may, however, be even greater than in the adult horse.

It may be desirable sometimes to identify the teeth of horses and to determine their positions in the mouth. They may be known from the teeth of other animals by their size, their form and the peculiar arrangement of the enamel walls. If the teeth have the grinding face nearly square, they belong to the upper jaw; if they are nearly twice as long on the worn face as broad, they are to be assigned to the lower jaw. The crown may be very high or it may have been worn down nearly to the small roots. In case the tooth has suffered little or no wear and is nevertheless short-crowned, it is to be taken as a milk tooth.

In the upper jaw the outer border of the tooth has a continuous wall of enamel; but this bends inwards somewhat at two points and leaves two prominent ridges, or styles, running up and down on the tooth (Fig. 46 *ps. ms.*). The enamel of the inner border of each upper tooth bends inward to the very center of the tooth, producing a valley directed forward, the postprotoconal valley (Fig. 46 *pv.*), so called here because it starts behind the protocone.

In each lower tooth there is, on the outer face, one inlet of the enamel, situated about the middle of the length (Fig. 47 *mf.*). On the inner border there are two deep inlets (Fig. 47

same land bridge, located perhaps somewhere in the region of Bering strait.

Another important and interesting question is that regarding the time when our native horses became extinct. It has been supposed that some species continued on until late in the Pleistocene. It has even been argued that in Mexico and South America native horses existed when white men arrived in the New World. No sufficient proof has been produced in favor of such statements. Inasmuch, on the other hand, as no authentic specimens of fossil horse remains have been reported from any deposits overlying the latest sheet of drift, the Wisconsin

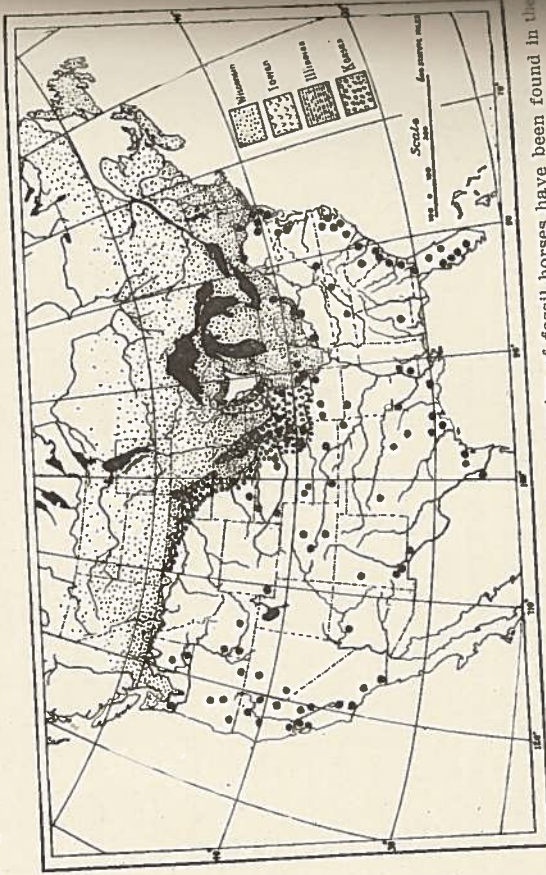


Fig. 48. Map showing localities where remains of fossil horses have been found in the United States and the relations of these localities to the various drift-sheets.

(Fig. 48), the writer believes that at least in the glaciated region, so well fitted for the mammoths, the mastodons, and the giant beaver, there existed no species of horse. It, further, seems extremely doubtful whether any remains of a fossil horse have been found in any late Pleistocene deposit in the region outside of that occupied by Wisconsin drift. However, future investigations must settle this question.

Inasmuch as remains of fossil horses have been found at many localities in Iowa, especially along the western border and

are likely to be found anywhere except where the state is covered with Wisconsin drift, it might appear proper here to describe and figure the principal parts of the skeleton. This is, however, less necessary because not only the teeth but also bones of all fossil horses resemble closely the corresponding parts of our domestic horses. Almost anywhere in the state, with a little trouble, one may find the skeleton of some domestic horse and with these one may compare any fossil teeth or bones that may be suspected to belong to a horse. Teeth of fossil horses are most likely to be found; and it is hoped that the many figures of these presented in this treatise may enable the finder to determine whether or not what he shall find belonged to a horse. One may easily judge whether any bones found are of a size befitting those of a horse and one may then proceed to make a comparison.

On page 180 will be found a figure of a skeleton of a fossil horse which was found in Texas. It will be sufficient to show the general form of most of the bones. It will be seen that the lower jaw is quite characteristic. The humerus may be distinguished from that of any oxlike animal by the fact that there are two deep grooves at the upper end in front for the passage of tendons instead of one. The nearly cylindrical metacarpals and metatarsals are quite different from those of any ruminant animal. The femur differs from that of any other large animal likely to be found in Iowa in having a prominent process on the outer side about one-third the length of the bone from the upper end. The form of the astragalus will be seen in figure 43, page 144. The hoof-bones may be recognized by anybody.

The following species of horses have been found either within the limits of Iowa or so near them as to make them of interest and they are therefore described.

Equus complicatus Leidy.

In 1847 Dr. Joseph Leidy based a species of fossil horse, called *Equus americanus*, on twelve specimens of teeth which had been sent him from Natchez, Mississippi (Proc. Phila. Acad. Nat. Sci., Vol. III, p. 265, pl. ii). Later, having learned that the name *americanus* had been applied to a fossil horse from South

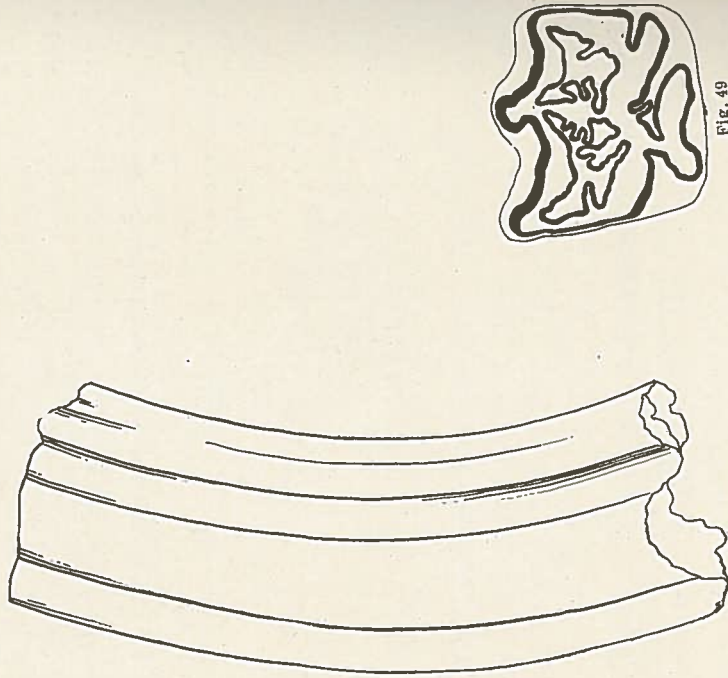
evident that in the region of the South Atlantic and Gulf states there existed at fewest three species of horse, one of large, one of intermediate, and one of small size. Unfortunately these species are at present known to us almost wholly by their teeth; and as the teeth of all the species varied somewhat in size in different parts of the jaw and in different individuals, it is not possible in all cases to determine with certainty to which species some teeth belong. It happens, too, that the enamel in both the large and the small teeth, had assumed a rather complicated and similar pattern.

Under the circumstances it has seemed proper for the present to refer to *Equus fraternus* the large teeth found on the Atlantic slope, while other names are to be applied to the horses of middling and small sizes. *Equus complicatus* is then to be used for certain horses of the Mississippi valley. It is greatly to be desired that more satisfactory remains of the large horse that roamed on the Atlantic slope shall be discovered, so that we may determine its relation to *Equus complicatus*. In 1870, Professor Cope (Trans. Amer. Philos. Soc., XIV, p. 250) mentioned a skull that had been found at Pea Shore, near Camden, New Jersey, but this skull has apparently been lost. The writer agrees with Mr. Gidley that Cope's *Equus intermedius* (Proc. Amer. Philos. Soc., Vol. XXXIV, p. 463, pl. xi, fig. 8), found at New Iberia, Louisiana, is the same as *Equus complicatus*. There are no essential differences and the types of both are from places near each other. Therefore, the fragment of upper jaw with the two hinder premolars and all three of the molars which served as Cope's type of *E. intermedius* may be used in defining *E. complicatus*. The enamel of *E. intermedius* is not so much crimped as is that of the type of *E. complicatus*; but that is probably due to the fact, as Gidley has remarked, that Cope's type belonged to an older individual and was worn down nearer the roots.

In the type of *E. complicatus* (Figs. 49, 50) the grinding face is 32 mm., fore and aft, and 27.5 mm., transversely, neglecting the cement. The internal column (protocone) equals sixty per cent of the transverse width of the tooth. The height of the crown is nearly 100 mm., and it is considerably curved.

America, he adopted for his species the name *complicatus*. In 1869, however, he abandoned this name and accepted a name, 1869, however, he abandoned this name and accepted a name, *Equus major*, which had been proposed in 1842, by J. E. DeKay, for a fossil horse. The latter name had, however, never been defined and had no nomenclatorial standing. Dr. Leidy, nevertheless, continued to use it ever afterwards.

In 1901 Mr. Gidley selected as type specimen of *Equus complicatus* the tooth which Leidy had figured in 1847 (Figs. 49, 50).



Figs. 49, 50. *Equus complicatus*. Views of the type, of an upper left molar. Slightly less than natural size.
49. Grinding surface of the tooth.
50. Side view of the tooth.

Leidy and others at various times assigned to this species remains, some of which undoubtedly belong to other species, while it is probable that some specimens that have been identified as *E. fraternus* belong really to *E. complicatus*. Indeed, it is probable, as concluded by Gidley, that the type of *Equus fraternus* chosen by Cope, belongs really to *Equus complicatus*. It is

The following are the dimensions of the teeth of the type of *E. intermedius*, as determined from Cope's figure. Cope gives the length along the crowns of the teeth 143 mm., but this seems to have been taken on the outer border. The measurements here given are taken about the middle of the face. Cope's illustration of his *E. intermedius* is here reproduced (Pl. IX, fig. 6).

MEASUREMENTS OF UPPER TEETH.

From front of pm. ³ to rear of m ³	141mm.
From front of m. ¹ to rear of m ¹	84mm.
Pm. ³ , length.....	29mm.
width.....	31mm.
protocone.....	15mm.
Pm. ⁴ , length.....	29mm.
width.....	18mm.
protocone.....	25mm.
M. ¹ , length.....	28mm.
width.....	16mm.
protocone.....	27mm.
M. ² , length.....	25mm.
width.....	15mm.
protocone.....	31mm.
M. ³ , length.....	22mm.
width.....	16mm.
protocone.....	

The maxilla itself does not furnish any valuable character for distinguishing the species. The postpalatine foramen is opposite the front end of the last molar.

Cope described and figured the front end of the lower jaw with all the incisors present, and his figure is here reproduced (Pl. IX, fig. 5). The outer incisor has no posterior wall for its cup, while in the other incisors the cups are completed. The teeth are larger than the corresponding ones of the common horse, the first one having a transverse diameter of 21 mm.

The lower jaw is remarkably narrow at or just behind the middle of the symphysis, being here only 34 mm. wide, while at the base of the outer incisor the width is 63 mm. In an Arabian horse belonging to the U. S. National Museum the width at the narrowest part of the symphysis is 37 mm.; at the base of the outer incisors, 60 mm.

Dr. Joseph Leidy, in 1889 (Trans. Wagner Inst., Vol. II, p. 37) described some teeth of a horse which had been found at Petite Anse near New Iberia, Louisiana. One of Leidy's figures is here reproduced (Fig. 51). It agrees in all essential respects with the tooth which stands as the type of the species.

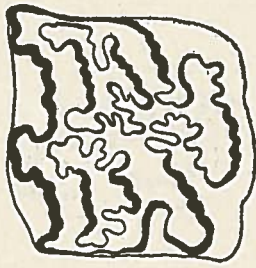


Fig. 51. *Equus complicatus*. Premolar from Petite Anse, Louisiana. XI. After Leidy.

The tooth is evidently a premolar. Its height is given as 70 mm.; the length of the grinding face, 31.5 mm.; the width, 31 mm.

The five lower cheek-teeth found at Petite Anse, Louisiana, mentioned by Leidy (Trans. Wagner Inst., Vol II, p. 38) are in the U. S. National Museum, No. 707. These appear to belong to three individuals; pm.³, and pm.⁴, of the left side of one (Fig. 52), a right m.¹, of another, and m.¹ (Fig. 53) and m.², of the right side of a third. Two other teeth, numbered 705, are the second and third right premolars (Fig. 54).

The following measurements of these teeth are taken, the cement coating being neglected:

MEASUREMENTS OF TEETH.

Tooth	Fore and aft mm.	Transverse mm.
Pm. ³	34	18
Pm. ⁴	31.5	18
M. ¹	28	16
M. ²	28	16

It will be seen that in size these teeth agree with the upper ones of *E. complicatus*. Compared with those of a domestic horse, they are somewhat longer fore and aft. The premolars are a little wider than those of the domestic horse, while the

In none of these teeth does the outer valley get in between the ends of the two longitudinal valleys. It will be observed that this outer valley sends backward a little loop, the so-called protostylid. This is found also in the domestic horse. The enamel ridges are somewhat more crimped than in the domestic horse. The inner boundary of the hinder longitudinal valley is not straight, but is pushed outward about the middle. Whether or not these features are of specific value, we cannot yet be certain.

In 1889 Dr. Leidy (Trans. Wagner Inst., Vol. II, p. 39) described a specimen consisting of a part of the left upper jaw containing all four premolar teeth, and supposed by him to belong to *Equus major*, his later name for *Equus complicatus*. This had been discovered many years before in a bog on the boundary line between Bond and Fayette counties, Illinois; but the exact locality and the depth where found were not given. This specimen is now in the collection at Springfield, Illinois, and the writer, through the kindness of Dr. A. R. Crook, has been permitted to examine it. The complication of the enamel appears to be greater than in the common horse and to be like that of the type of *E. complicatus*. In giving his measurements Dr. Leidy included the cement. These measurements are here corrected so as to exclude the cement. Leidy's figure of the teeth is here reproduced (Fig. 53):

MEASUREMENTS OF TEETH.

Tooth	Height mm.	Length mm.	Width mm.
Pm. ¹	---	8.5	5
Pm. ²	---	41	27
Pm. ³	---	31.5	30
Pm. ⁴	---	31	28.5

Although the first premolar was present in this specimen, there was no trace of the canine at a distance of three and one-fourth inches in front of the premolar. In a large specimen of the domestic horse the canine is only two and three-fourths inches in front of the premolar. Possibly the canine had not been present.

molars are slightly narrower; but individual differences may be concerned here.

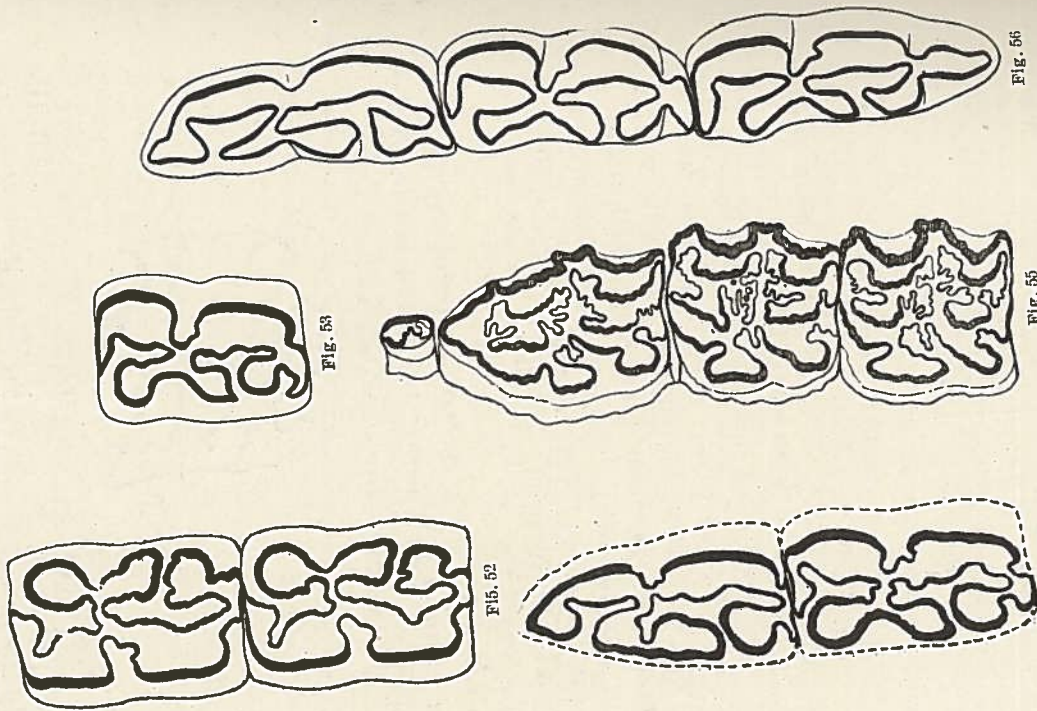


Fig. 52. *Equus complicatus*.
 Fig. 53. *Equus complicatus*.
 Fig. 54. *Equus complicatus*.
 Fig. 55. *Equus complicatus*.
 Fig. 56. *Equus complicatus*.
 XI. Third and fourth lower premolars of left side. Slightly less than natural size.
 First lower molar of right side. Slightly less than natural size.
 Second and third lower premolars of right side. Slightly less than natural size.
 Upper left premolars 1 to 4 and molar 1. Premolar 1 slightly less than natural size.
 After Leidy.
 No. 10059. Amst. Mus. Nat. Hist. Slightly less than natural size.

Nothing certain is known about the milk teeth of this species. Figure 56 shows the lower milk molars of the right side which were found by Mr. J. W. Gidley in Tule canyon, Briscoe county, Texas, within three miles of the locality where the type of *Equus scotti* was discovered. It might be supposed that these teeth belonged to a colt of *E. scotti*, but they differ considerably from the corresponding teeth of one of the five specimens of the latter species found with the type, as may be seen by comparing the figures shown here with figures on page 187. They are therefore referred provisionally to *Equus complicatus*. To what extent such teeth may vary within the same species we do not yet know. Figure 56 is from No. 10591 of the American Museum of Natural History.

Up to the present the skull of this species is known only from fragments. In the U. S. National Museum is a fragment, No. 709, which presents most of the zygomatic arch and the hinder boundary of the orbit. The specimen is from Petite Anse, near New Iberia, Louisiana. The zygomatic arch, where narrowest, just in front of the articulation for the lower jaw, is 32 mm. wide, just equalling that of a specimen of *E. caballus*. The postorbital bar, where narrowest, is 28 mm. wide; that of the domestic horse is 35 mm. wide.

In the U. S. National Museum, No. 711, from Petite Anse, Louisiana, is the symphysis of the upper jaw, with the alveoli of the incisor teeth. Immediately behind the last incisors the width of the jaw is 70 mm.; that of a domestic horse (No. 843, U. S. National Museum) being 74 mm. The premaxillary suture extends backward 58 mm.; in the domestic horse, 44 mm. The bone near the hinder end of the symphysis is 28 mm. thick, in the domestic horse only 22 mm.

No. 710, U. S. National Museum, from Petite Anse, furnishes the articulation of the under jaw and the hinder border of the jaw for about 150 mm. below the articulation. A feature to be remarked is the thickness of this hinder border. When compared with the jaw of a domestic horse of the same size, it is found that in the latter, 100 mm. below the articulation, the

bone is 10 mm. thick; in the fossil, it is 22 mm. thick. At 150 mm. below the articulation the bone in the domestic horse is 15 mm. thick; in the fossil, 29 mm. Doubtless in all these structures there is great variation within the species and not too much reliance must be placed at present on these characters in identifying remains. It may be said that nothing is known which indicates with certainty differences between the skull of *Equus complicatus* and our domestic horse unless it be the very narrow mandibular symphysis. Little is known regarding the form and proportion of the remains of the skeleton.

From Petite Anse, Louisiana, there is in the U. S. National Museum, No. 703, the distal end of a right humerus. It appears to differ in no way from that of the Arabian horse, except that it is slightly larger, measuring 85 mm. across the articular surface at the lower end, the Arabian measuring 81 mm. No other skeleton of *E. caballus* is at hand for comparison. It is observed that the outer ridge bounding the cavity for receiving the olecranon maintains an equal width, 23 mm., from the lower to the upper end; whereas, in the Arabian horse this ridge is 33 mm. wide below and only 18 mm. above. On the inner face of the bone, at the lower end, the greatest width, fore and aft, is 93 mm.

No. 702 includes the right radius, lacking a few inches of the middle of the shaft. The upper end fits the humerus, No. 703, so accurately that both bones were probably parts of the same individual. The extreme width of this upper end of the bone is 95 mm.; in the Arabian horse, 80 mm. The greatest diameter of the shaft, 125 mm. below the head, is 49 mm.; the shortest diameter, 32 mm. In the Arabian horse these dimensions are respectively, 41 mm. and 31 mm. The shaft of the fossil is thus seen to be somewhat flatter than in the Arabian horse. The surface for the outer condyle of the humerus is narrower fore and aft than in the Arabian horse, measuring, at the middle of the length in the fossil, 25 mm.; in the Arabian horse, 28 mm. The distal end of the radius has an extreme width of 83 mm.; in the Arabian horse, 79 mm. On the anterior surface of this lower end the external groove for a tendon is placed nearer the outer border of the bone than it is in the domestic

horse; and a prominence, which in the latter is near the middle of the anterior surface, is, in the fossil, much nearer the outer border.

No. 723, U. S. National Museum, from Petite Anse, presents the bone surrounding the acetabulum. The long diameter of this cavity is 72 mm. The bone does not permit a section being taken in front of the acetabulum, but the upper border of the bone is more rounded than in the Arabian horse. From the upper edge of the acetabulum to the upper border of the ilium is 54 mm., while in the Arabian horse, a smaller animal evidently, the distance is 57 mm. The pubic bone is much thinner in front of the obturator foramen than in the Arabian horse, being, in the former, 17 mm. wide, in the latter, 23 mm. Measured 25 mm. behind the acetabulum, the ischium is 43 mm. high, while in the Arabian horse, the bone is only 36 mm. high.

In the U. S. National Museum is the lower end of the left tibia from Petite Anse, No. 704. It measures from side to side 85 mm.; from front to back on the inner side 51 mm. In the Arabian horse these dimensions are respectively 81 mm. and 48 mm. No other differences are observed in this part of the tibia of the two animals.

TEETH OF *EQUUS COMPLICATUS* FOUND IN IOWA.

To this species I refer certain teeth that have been discovered in Iowa. One of these (No. 116) was described by Calvin (Bull. Geol. Soc. Amer., Vol. XX, p. 345, pl. xviii, figs. 1, 3). It was found in the Cox pit, near Missouri valley, Harrison county. Calvin's figures are here reproduced (Pl. X, figs. 1, 3) and a pen drawing (Fig. 57) is furnished which shows more distinctly the arrangement of the enamel. This is an upper left premolar, either the third or fourth, and has the following dimensions: Height of crown, 88 mm.; length, 31.5 mm.; width, 32 mm.; length of protocone, 17 mm. It is about as much curved as the type tooth (Fig. 50), probably just a little less. The anterior and posterior pillars are broken off near the summit of the tooth. In the drawing (Fig. 57) this is restored from a lower level of the tooth.

Figure 58 represents the grinding face of an upper left true molar (No. 122b), either the first or the second. It was found in an Aftonian gravel pit at Turin, Monona county. It has

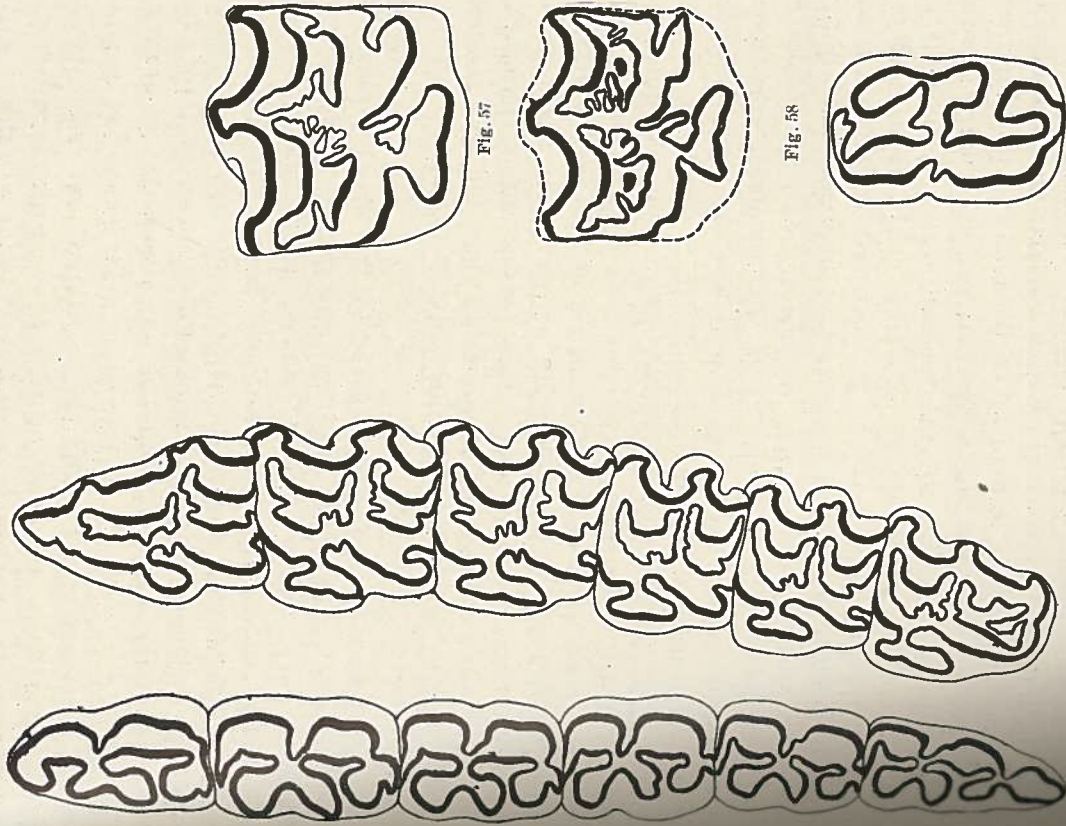


Fig. 57. *Equus complicatus*.
 Fig. 58. Grinding surface of left upper premolar. XI. No. 116 State University of Iowa.
 Fig. 59. Upper left molar. XI. No. 122b State University of Iowa.
 Fig. 60. Lower left molar or premolar. Slightly less than natural size. No. 261 State University of Iowa.
 Fig. 61. Upper left cheek-teeth. X. 726. No. 220 State University of Iowa.
 Fig. 62. Lower right cheek-teeth. X. 726. No. 219 State University of Iowa.

the following dimensions: Height, 83 mm.; length, 30.2 mm.; width, 28 mm.; protocone, 13 mm. The tooth appears to be slightly more curved than the type tooth. If the arrangement of the enamel of these two teeth be compared with that in the type tooth, it will be seen that no important differences exist. Nevertheless, the pattern in all three resembles closely that found in the upper teeth of *E. scotti*.

Figure 59 represents the grinding face of a left lower tooth (No. 261), probably a premolar. It was found in the Cox gravel pit at Missouri Valley, Harrison county. It is little worn down and shows the following dimensions: Height of crown, 80 mm.; length, 33 mm.; width, 17 mm. This tooth appears to agree closely with the lower teeth from Louisiana here represented (Figs. 52, 53, 54) and believed to belong to *E. complicatus*.

In the collection of the Iowa University, with the catalog numbers 219 and 220, is a specimen consisting of the left upper and right lower cheek-teeth. The number 219 is assigned to the lower teeth, 220 to the upper. These teeth were described in a part of the lower jaw. These teeth were described and figured by Professor Calvin in his paper entitled Aftonian Mammalian Fauna (Bull. Geol. Soc. Amer., Vol. XX, 1908, p. 344, pl. xvii, figs. 1, 2). The animal was identified by him as *Equus scotti*. We are told in that communication that these teeth were found by Mr. E. L. Gladwin while grading a road in section 35, Lyons township, Mills county. Prof. B. Shimek (Bull. Geol. Soc. Amer., Vol. XXI, p. 138) informs us that the locality is in the east one-half of section 35, township 71 north, range 43 west. It is stated by Calvin that a considerable part of the skeleton was present, but the bones were too soft for preservation. The matrix was a fine blue clay, a bed of silt; and this bed is regarded as belonging to the Aftonian. The presence of this skeleton with all these teeth and so many bones associated furnishes evidence that the animal was in its original place of burial and had not been redeposited from some older formation. Calvin speaks of this specimen as the "Gladwin horse."

The present writer prefers to refer this specimen to *Equus complicatus* rather than to *E. scotti*, because he knows of no means of distinguishing the teeth of the two forms and is inclined to believe that both belong to the same species. Later studies may show that they are distinct. Inasmuch as the present specimen presents some peculiarities it is described and figured with some detail (Pl. XI, figs. 1, 2; text figs. 60, 61).

The following measurements are taken from the teeth of this specimen. It must be stated that the horse was rather old and that the teeth are worn down to about one-half their original lengths.

MEASUREMENTS OF TEETH OF GLADWIN HORSE.

Upper Teeth.

Length of premolar-molar series	190 mm.
Length of premolar series	104 mm.
Length of molar series	86 mm.
Pm. ² , height	45 mm.
length	42.5 mm.
width	27 mm.
protocone	10 mm.
Pm. ³ , height	48 mm.
length	31 mm.
width	30.5 mm.
protocone	14 mm.
Pm. ⁴ , height	53 mm.
length	29.5 mm.
width	31.5 mm.
protocone	16.8 mm.
M. ¹ , height	39 mm.
length	26 mm.
width	30 mm.
protocone	14 mm.
M. ² , height	43 mm.
length	27 mm.
width	27.5 mm.
protocone	14 mm.
M. ³ , height	53 mm.
length	32 mm.
width	26 mm.
protocone	15.5 mm.

Lower Teeth.

Length of premolar-molar series	194 mm.
Length of premolar series	98 mm.
Length of molar series	96 mm.

Pm. ₃ , height	29 mm.
Pm. ₃ , length	37 mm.
Pm. ₃ , width	18 mm.
Pm. ₂ , height	39 mm.
Pm. ₂ , length	31 mm.
Pm. ₂ , width	18 mm.
Pm. ₁ , height	30 mm.
Pm. ₁ , length	20.5 mm.
Pm. ₁ , width	44 mm.
M. ₁ , height	28 mm.
M. ₁ , length	18 mm.
M. ₁ , width	18 mm.
M. ₂ , height	28 mm.
M. ₂ , length	16.5 mm.
M. ₂ , width	16.5 mm.
M. ₃ , height	37 mm.
M. ₃ , length	14 mm.
M. ₃ , width	14 mm.

The teeth of this horse are remarkable on account of the great thickness of the coat of cement. This is especially thick on the external columns of the upper teeth; and as a consequence the grooves between these cement-covered columns are deep and narrow. In the type of *Equus niobrarensis* the cement adds 2 mm. to the width of the last upper premolar, while in this specimen it adds 3 mm. The enamel, too, is very heavy, being thicker than in specimens of the domestic horse, nearly twice as thick as in the type of *E. excelsus*, and thicker than in other specimens of *E. complicatus* at hand.

As to the disposition of the enamel on the grinding face of the teeth, it may be said that the pattern is rather simple. There is an unusual difference in the arrangement of the enamel around the lakes of the premolars and those of the molars. In the premolars the arrangement is very similar to that seen in *E. niobrarensis*, but there is rather less folding of the enamel around the anterior lake. In both the lakes of each premolar there is a front and a hinder notch. In the molars the pattern of the lakes resembles a good deal that of *E. excelsus*. The anterior lake has no notch in its front border, and the posterior has only a minute notch in its hinder border.

Notwithstanding the great differences which these teeth present when compared with undoubted specimens of *Equus complicatus*, the writer proposes to refer it to that species. It may

be regarded as probably furnishing the extreme limit in variation in the direction of simplicity of arrangement of the enamel. This simplicity is due probably to some extent to the approach of the grinding surface to the bases of the teeth. On account of this simplicity in the enamel, its great thickness, and the great breadth and prominence of the styles of the upper teeth and the great thickness of the cement on all the teeth, there is a temptation to regard the specimen as belonging to an undescribed species. On the whole, however, this course does not seem to be advisable.

A tooth bearing the catalog number 262 is a large lower left premolar, probably the third (Fig. 62). It was discovered near Pisgah, Harrison county, in the Peyton gravel pit. The tooth is only moderately worn and is in good condition. The height is 80 mm.; the length, 34 mm.; the width, 19 mm. The size of the tooth and the arrangement of the enamel agree so closely with a corresponding premolar of *Equus complicatus* found at New Iberia, Louisiana, (Fig. 52) that there is nothing else to do than to refer it to the same species.

There is a second tooth in the collection which has the number 262 and which was found likewise in the Peyton pit. Not improbably it appertained to the same individual. It belonged to the left side of the lower jaw and seems to be either the first or second molar. The height is 56 mm.; the length, 29 mm.; the width, 16.5 mm. The arrangement of the enamel is essentially the same as in No. 127, but its thickness is not so great.

The tooth bearing the number 132 was found in the Cox gravel pit at Missouri Valley. It belonged to the left side of the lower jaw and is probably a second molar. It was mentioned by Calvin in his paper on Aftonian Mammals (Bull. Geol. Soc. Amer., Vol. XX, p. 348, pl. xix, figs. 1, 3). Calvin's figures are here reproduced (Pl. XII; figs. 1, 3) and a pen drawing is presented (Fig. 63). This author regarded it as belonging to the same species as the Gladwin horse, *E. scotti*. The present writer is disposed to refer both these specimens to *E. complicatus*. The tooth had only begun to wear. Its height, not including the roots, is 85 mm.; the length, 31 mm.; the width, 16 mm. However, the width would on further wear soon

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have been somewhat greater. The enamel is arranged very much like that of the tooth of our figure 52, and like the tooth numbered 262. It will be observed from Calvin's illustration that the tooth was diseased on the inner face.

The tooth which has the catalog number 134 is a lower left last molar. It was secured in the Cox pit, at Missouri Valley, Harrison county. It is only moderately worn and is in fine condition of preservation. The tooth is curved backward. The height is 75 mm.; the length, 36 mm.; the width, in front, 15 mm. The outer inlet is broad and furnished with a loop, the so-called protostylid, in its hinder border. The inlet does not push itself between the two longitudinal valleys. The heel is thin and prolonged backward. The tooth is referred to *Equus complicatus*. Figures are here presented showing both faces of the tooth. Some of the cement is still retained (Pl. XIII, figs. 1, 2).

A tooth which bears the catalog number 131 was found in the Cox gravel pit, at Missouri Valley. It was described and figured by Calvin (Bull. Geol. Soc. Amer., Vol. XX, p. 349, pl. xix, figs. 2, 4). He referred it to *Equus complicatus* and the present writer is content to agree with the determination. The tooth is a true molar, probably the second, of the left side of the lower jaw. It is only moderately worn down and is in good preservation, except that a portion of the hinder part of the base is split off. The height is 80 mm.; the length, 29 mm.; the width, 17.5 mm. The disposition of the enamel resembles much that of the second molar of No. 127 (Fig. 64), but the lines of enamel are not so heavy. As in No. 127 the outer inlet pushes in between the ends of the longitudinal valleys. Calvin's figures are here reproduced (Pl. XII, figs. 2, 4).

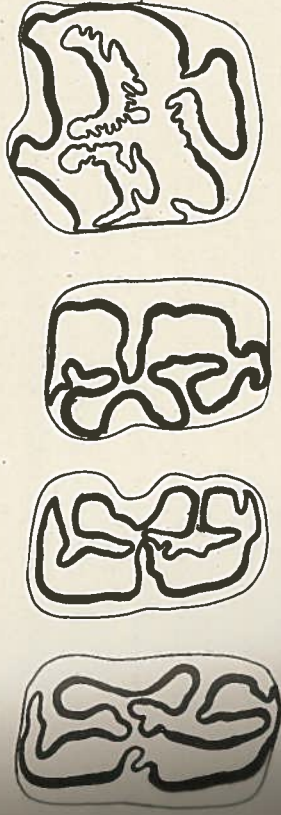
The number 127 has been given to a fragment of the right ramus of the lower jaw with the last two molars (Pl. XII, fig. 6). The specimen was discovered in the Cox gravel pit, at Missouri Valley, and was described by Professor Calvin (Bull. Geol. Soc. Amer., Vol. XX, pl. xix, fig. 6). He referred it to *Equus complicatus*, and the present writer believes that his assignment of it is correct. The animal was an old one and the teeth are worn down to half their original height.

The following are the measurements:

MEASUREMENTS OF TEETH OF SPECIMEN 127.

Tooth	Height mm.	Length mm.	Width mm.
M ₁	50	28	17
M ₂	40	37	15

These teeth, the second molar of which is here figured (Fig. 64), differ in one respect, perhaps important; this is, that the outer inlet of enamel pushes itself inward beyond the midline of the tooth and between the adjacent ends of the two longitudinal valleys. There are at hand six lower teeth that can be assigned with considerable certainty to *Equus complicatus*. These are from New Iberia, Louisiana, and one of them is here figured (Fig. 53). In none of these does the outer inlet reach so far inward. Whether it may have done so in some individuals cannot now be determined. In the length of this inlet, the specimen, No. 127, resembles the domestic horse, in the true molars of which the inlet in question is interposed between the longitudinal valleys. The second molar of a large gelding in the U. S. National Museum has the same length as that of the specimen here described, but the width is only 15 mm. Also the outer inlet is considerably nearer the middle of the length of the tooth than in No. 127.



FIGS. 62-65. *Equus complicatus*. XI.
 62. Lower left premolar. No. 262 State University of Iowa.
 63. Lower left tooth, probably second molar. No. 132 State University of Iowa.
 64. Lower right second molar. No. 127 State University of Iowa.
 65. Upper right tooth, fourth premolar? No. 118 State University of Iowa.