BUREAU OF ECONOMIC GEOLOGY
The University of Texas
Austin 12, Texas

JOHN T. LONSDALE, Director

Report of Investigations—No. 33

Pleistocene Equidae of Texas

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Contents

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ABSTRACT

Pleistocene-age fossil horses of Texas belong to at least three faunal assemblages. The oldest contains *Hippotigris* (= *Plesippus)* which disappeared before Yarmouthian time. The second contains *Equus scotti* and *Onager semiplicatus* (= *Equus (Asinus) calobatus)* which disappeared before Sangamon time. Both these groups are found on the High Plains but not on the Coastal Plain or along the central Texas rivers, where a later fauna, probably of Sangamon age, is found which contains remains of *Equus,. Asinus,* and *Onager* but no *Hippotigris.* The Texas *Onager* material is referable to the Asiatic group and in addition to *O. semiplicatus* contains *O. lambei, O. littoralis, O. fraternus, O. complicatus,* and others; one new form is described herein.

It is necessary to reject *Hemionus* F. Cuvier (1823) in favor of *Onager* Brisson (1762) because of priority.

Post-Pleistocene horses of the Texas High Plains region contain *Equus caballus,* both the draft and pony-horse types. These are treated as subspecies, *Equus c. caballus* for the larger and *Equus c. laurentius* for the smaller form. *E. laurentius* was described by Hay (1913a) and the type has subsequently been considered a "feral" horse that somehow became fossilized. It seems doubtful that fossilization could have taken place in less than 400 years, the maximum time available for a "feral" horse. Also, *E. laurentius* is inseparable from *E. niobrarensis alaskae* and the Texas materials.

Two new species are described, five species are transferred to *Onager,* and additional species are reconsidered.

INTRODUCTION

Teeth and bones of horses of Pleistocene age (fig. 1) have been found in fluvial and basin deposits of the Texas Gulf Coastal Plain and the southern High Plains. Some of these are associated with human artifacts, some with the remains of fossil bison, and others with forms long extinct. Three and possibly four separate faunal assemblages ranging from earliest to latest Pleistocene are distinguishable and appear relatable to Quaternary glacial chronology (Quinn, 1957a).

The oldest of these assemblages is typified by presence of *Hippotigris* (= *Plesippus*) and is related to Nebraskan glacial, Aftonian interglacial, or early Kansan glacial time. In Nebraska, *Hippotigris* remains are found in coarse gravel deposits probably related to Aftonian interglacial phenomena (McGrew, 1944).

Deposits in Texas, probably of early Illinoian age, called the Rock Creek beds contain bones of *Equus scotti* Gidley and *Onager semiplicatus* (Cope) (p. 12). Bison remains have not been found in these deposits (Hibbard, 1955b, p. 221).

A large collection of Texas fossils belonging to the Bureau of Economic Geology, of The University of Texas, and the Texas Memorial Museum contains an assemblage of horses distinct from those of the Blancan and Rock Creek faunas. These are associated with a species of large bison and possibly with human artifacts. The fossils are found throughout surficial deposits extending from near the present strand of the Gulf of Mexico, inland to the southern High Plains. Near the edge of the Coastal Plain the sediments are fine silt and clay. Farther inland they coarsen

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to gravel and sand deposits which also extend far to the northwest along the major river channels. Gravels resting on the high divides coastward of the Balcones escarpment and between the river valleys probably also belong to this sequence (Quinn, 1957a). Along the Brazos, Colorado, and other rivers the gravels appear to be terraced, and these have been correlated (Weeks, 1945; Quinn, 1957a) with various Pleistocene glacial events. Study of the fossil horse remains from Ingleside quarry, San Patricio County, Texas (Sellards, 1940), terraces on the Colorado River in the vicinity of Austin, on the Brazos River in Stonewall County, on the Trinity River in Henderson County, and in several minor localities indicates all are of the same age, and that they do not include species of horses belonging to earlier assemblages.

Since these horses are found in association with species of large *Bison,* but not with the small forms which are thought to have appeared in late Wisconsin time, it follows that the horses are of earlier age.

Quinn (1957a) on geological evidence has postulated that the sediments containing the horse remains described herein were deposited during an interglacial stage and not a glacial stage and that since the sediments do not contain horse remains belonging to the earlier stages of the Pleistocene, they may have been deposited during the Sangamon interglacial stage. In the descriptions and discussions which follow, assignment of Sangamon age or reference to a Sangamon fauna is provisionally based on the conclusions presented in that paper.

In recent years dissatisfaction has been expressed by workers concerning the taxonomy of Pleistocene horses. There seems to be a general feeling that too many species have been described on too little evidence (Savage, 1951, pp. 241–252), and that most characters based on tooth differences are invalid because these exhibit a high degree of variability.

Three factors seemingly have contributed much of the difficulty experienced by investigators. One of these is the question of variability and the morphologic limits of a paleontological species. The second has to do with the distribution of Pleistocene species of horses in time and space. The third stems from marked parallelism in many of the genera (p. 8).

Paleontological species can be identified only on the basis of morphologic characters. The problem is not so much one of placing identical materials in a taxonomic category as one of deciding how much dissimilarity specimens may exhibit and still belong in a common category. The principle that closely related genetic units will not occupy a common ecological niche at the same time has been applied to quarry assemblages and even to materials from a common locality and has been used to demonstrate degrees of variability in species of horses. That such procedures are not always advisable has already been discussed (Quinn, 1955a) and is borne out by examination of the Texas Pleistocene-age fossils. One of the species found in the quarry assemblages is *Onager littoralis* (Hay), smallest of the Equini. Another is *Equus pacificus* Leidy (of Gidley), one of the largest of the Pleistocene horses. Besides these, there are materials of horses of intermediate size, so that teeth grade from smallest to largest with no appreciable breaks. Few investigators would place *E. littoralis* and *E. pacificus* in the same species, yet the practice outlined above, if strictly adhered to, would lead to just this.

The second factor contributing to the difficulty of equine taxonomy, namely, distribution in time and space, results from peculiarities introduced by successive occupation and elimination of populations in Pleistocene time, in connection with climatic fluctuations and the probability that the horses inhabited several separate ecologic areas. *Onager complicatus* and *Onager fraternus* are found in deposits of the Trinity River terraces and along the Gulf of Mexico to San Patricio County, Texas. Farther north they are absent in the Brazos River terraces and seemingly

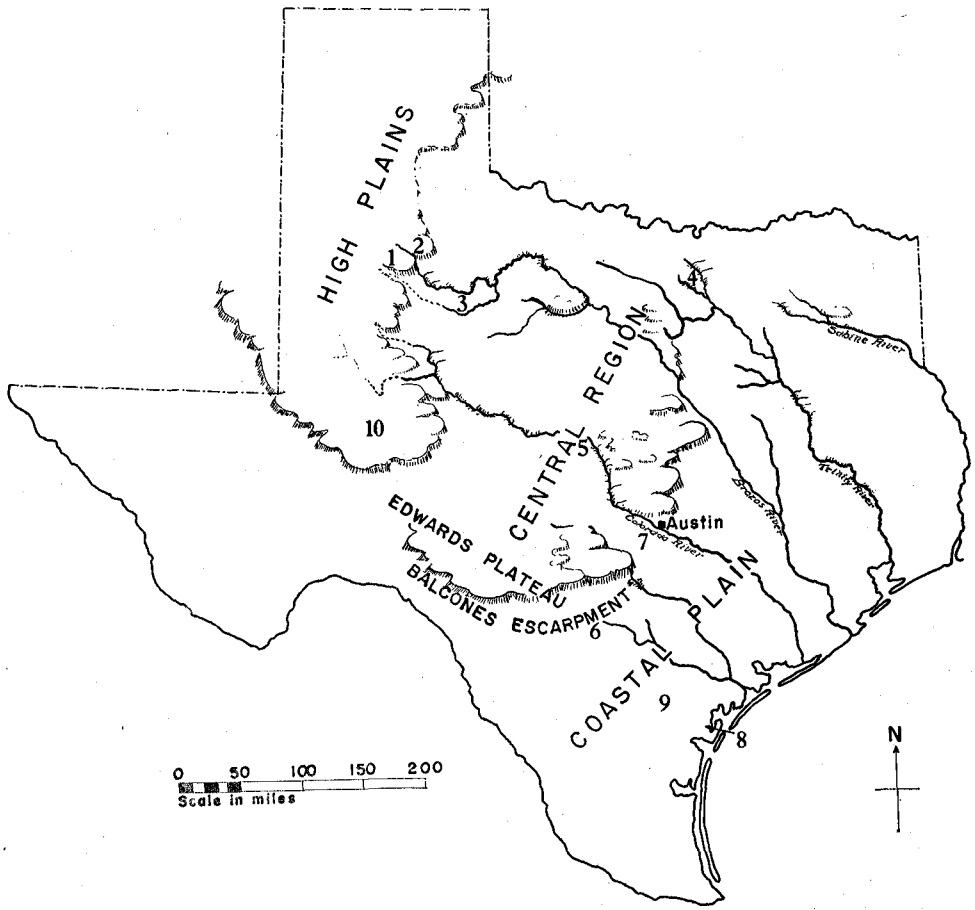

FIG. 1. Locality map of Texas showing principal Pleistocene vertebrate fossil localities. (1) Blanco beds. (2) Rock Creek beds. (3) Stonewall County terrace deposits. (4) Trinity River terraces, Henderson County. (5) San Saba River terraces. (6) Kincaid Shelter (4 miles north of Sabinal, Uvalde County). (7) Colorado River terraces, Austin. (8) Ingleside pit, San Patricio County. (9) Berclair terrace. (10) Scharbauer site, Midland County.

from those west of the Brazos. The type localities of these horses are in Mississippi and South Carolina, respectively. They are typical of southeastern North America. Likewise, *Asinus conversidens* (Owen) has been found only in the southwestern United States and Mexico. Although these indicate it may be possible to establish precise ranges and provinces for the horses of Pleistocene age, such a study is beyond present resources, since it would require re-examination of all preserved material.

Considerable evidence has been accumulated in recent years indicating extinction and replacement of the large mammal components of Pleistocene faunas in relation to glacial stages. This condition is not as clearly reflected in small mammal components of the faunas (Skinner, 1942, p. 153). Rodents especially, and other burrowing animals, are less subject to rigorous climatic conditions than animals such as horses, which must remain in the open. The point of maximum extinction in a glacial-interglacial cycle is not known, but it seems logically to relate with glacial maxima. It is now generally accepted that glacial stages were periods of intense pluviation and undoubtedly of low temperatures—induced by refrigeration from

the ice mass, if nothing else—and it is understandable that horses especially are most susceptible to wet-cold conditions.

Interglacial stages appear clearly to have been as arid as the glacial stages were pluvial (Quinn, 1957a). The major problem during the interglacial stages would have been supplies of food and water, but shortages of these would not necessarily have produced extinction of species of large mammals.

Destruction and replacement of species of horses in response to climatic fluctuations during Pleistocene time thus seems to be a well-supported concept. It may be supposed, however, that populations were not affected, or were less affected, in southeastern North America, extreme southwestern North America, and possibly along the West Coast. Replacement species for the central region may have originated from these areas as well as from the Old World. Little has previously been done to compare Old and New World species, perhaps because the current idea of a late Pliocene or Pleistocene age for origin of the genus *Equus* has made great diversification of the group seem unlikely. That the Equini actually developed much earlier has recently been indicated (Quinn, 1955a). Species belonging to *Asinus* of Africa and *Onager* of Asia have been found in the faunas in Texas, and elsewhere, and are reported here. These may indicate greater correspondence between the New and Old World species than has been supposed.

Recognition of *Onager* (= *Hemionus*) as well as *Asinus* and *Equus* in the New World raises a question of the validity of referring New World forms to the Old World groups. The resemblances are undeniable perhaps but these might be ascribed to parallelism. There are four Old World groups of late Pleistocene and Recent horses; there are four New World groups, all distinguished on the same characters as the Old World groups. *Equus* undeniably occurs in both areas. That *Hippotigris* occupied North America in early Pleistocene time was proposed by McGrew (1944). This proposition, although not fully accepted by other workers, has not been rejected. Old World *Asinus* originated and remained in the New World until late Pleistocene (Quinn, 1955a). The evidence seems to be conclusive that materials here referred to *Onager* can belong to no other group. Hibbard (1955a) suggested that the New World horses must eventually be recognized as belonging to the Old World genera.

The third factor, parallelism, or independent development of similar characters in some species of the genera (p. 11), is perhaps most clearly exemplified by the trend toward loss of the infundibulum in the lower incisors. This loss has occurred in species of *Hippotigris, Onager,* and probably *Equus.* It may well be that similar trends have also functioned in connection with secondary or less obvious characters. In effect, the range of morphologic characters of each genus is to a greater or lesser extent repeated in all the others.

This trend or tendency in the horses increases the difficulty of evaluating criteria of specific and/or generic magnitude. Likewise, it becomes nearly impossible to establish a list of generic or specific characters calculated to simplify the task of distinguishing taxonomic categories.

The phylogeny and taxonomy of the Pleistocene horses thus may be highly complex rather than simple. It is not surprising that materials of a given area and of undetermined age may not easily be correlated with named species. Once it is recognized that several local (ecological) faunas of at least three different ages are concerned, it is obvious that an attempt to restrict the number of species for the sake of "simplicity" is lumping of the worst sort. Only when the various components of these faunas are identified and described will it be possible to develop fully the usefulness of the horses in estimating Pleistocene chronology and correlations.

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ABBREVIATIONS

The following abbreviations are used in the text and in the tables of measurements.

B.E.G.....Bureau of Economic Geology, The University of Texas, Austin, Texas.
Inst. de Geol. Instituto de Geologica, Universidad Nacional Autonoma de Mexico, Mexico City, Mexico
C.M.N.H. Colorado Museum of Natural History, Denver, Colorado.
C.N.H.M. Chicago Natural History Museum, Chicago, Illinois.
T.M.....Texas Memorial Museum, Austin, Texas.
U.K.....University of Kansas, Lawrence, Kansas.
U.S.N.M...United States National Museum.
W.F.I.S. Wagner Free Institute of Science, Philadelphia, Pennsylvania.
P.2,3,4.....Premolar two, three, four.
M.1,2,3..... Molar one, two, three.
AP.....Antero-posterior diameter in millimeters.
Tr.....Transverse,
CL.....Crown length.
PL.....Protocone length.
PW.....Protocone width.
MM.....Metaconid-metastylid combined diameter. Measurements taken at the occlusal surface and exclusive of the cement.
s.s.....*Sensu stricto,* in the strict sense.

SYSTEMATIC DESCRIPTION

Order PERISSODACTYLA Owen, 1841
Family EQUIDAE Gray, 1821
Tribe EQUINI Quinn, 1955

Genus ONAGER Brisson, 1762

Onager Brisson, 1762, Regnum Animale, etc., Leiden.
Hemionus F. Cuvier, 1823, not seen.[2]
Tomolabis Cope, 1892, Amer. Phil. Soc. Proc., vol. 30, p. 125.
Equus (Hemionus) Stehlin and Graziosi, 1935, Abh. Schweiz. Pal. Ges., vol. 66.
Asinus (in part) Hopwood, 1942, Ann. Mag. Nat. Hist., vol. 11, no. 9.

Type species.—*Onager onager* Brisson, 1762; Kaslin, NW Persia.

Range.—Pleistocene (New World and Old World) to Recent (Old World).

Distribution.—North America and Eurasia.

Diagnosis.—Size range equal to *Equus;* pattern of upper cheek teeth more complex, protocones elongated, hypoconal groove of premolars tends to be partly closed, third molar less modified than in *Equus* or *Asinus;* lower molars with median valley shorter than in most species of *Equus;* upper and lower teeth equalling or surpassing *Equus* in hypsodonty and appreciably more hypsodont than *Asinus;* metapodials long and more slender than in *Equus,* longer and more slender than in *Asinus.*

Discussion.—The oldest valid generic name applicable to the Asiatic wild asses is *Onager* Brisson, 1762, according to Dr. G. G. Simpson (personal communication), who supplied the following information:

The reference to Brisson (1756) [Simpson, 1945] is of course invalid because it antedates the tenth edition of Linnaeus. However, Brisson repeated the generic use of the name *Onager* in 1762 in Regnum Animale, p. 72. We have confirmed this reference in the original publication and it seems certainly to be valid. That date is of course four years after Linnaeus' tenth edition and therefore the name is available in scientific nomenclature.

Smith (1842) referred the kiang and onager to the species *Asinus hemionus* and considered the asses, horses, and zebras to belong in separate genera.

Flower (1892, p. 86) treated the Asiatic forms as species of *Equus,* stating: "The true *E. hemionus* Pall., the kiang or dzeggetae, is the largest and darkest in color. . . . *E. onager* Pall, is smaller and paler in color. . . ."

Stehlin and Graziosi (1935) placed the Asiatic asses in the genus *Equus* but considered them as a separate subgenus, *Hemionus.* They also considered the African asses as members of the genus *Equus,* subgenus *Asinus.*

Hopwood (1942) considered onager and kiang as species of *Asinus,* stating: "I have included the Kiang and Onager in the genus *Asinus* rather than *Equus,* because their limbs and teeth show a series of characters which, in the sum, are much nearer to those of the Ass than they are either to the Horse or to the Zebras."

Bourdelle and Frechkop (1950) considered the Asiatic asses, horses, and zebras to belong to separate genera. They proposed that the expanded classification would be more nearly equivalent to that accepted for other groups of ungulates and would be more in keeping with the present state of knowledge concerning the horses. They also suggested that the characters used to distinguish fossil horses are of less magnitude than those of the species of living horses. This view is opposed to that expressed by Stirton (1940, p. 194): "It is generally understood by most investigators that fossil genera and species of vertebrates cannot be divided so closely as living animals. . . . Hence it seems that many paleontologists have been justified in retaining a rather wide definition of the genus *Equus,* thus expressing a rank more or less equivalent to the other genera of Equidae which are not so well known." Also, Savage (1951, p. 219) stated: "It seems tenable that if various proposed genera for later equids—*Asinus, Plesippus, Hemionus*—are recognized, a much

[2] Examination of the literature has failed to disclose a published reference to *Hemionus* F. Cuvier, 1823.

greater 'splitting' of the Tertiary genera would be necessitated as a corollary. Stirton (1948, oral communication) has pointed out that such a classification is in keeping with the presently accepted categorical distinction between subgenera and genera of equids."

Bourdelle and Frechkop included the Asiatic asses in the genus *Hemionus,* pointing out that the reference *Onager* Brisson 1756 is invalid but not mentioning the 1762 reference.

Although the above list is far from complete, it illustrates the diversity of opinion among authors concerning the affinities of the Asiatic wild asses. How many Old World species exist and the taxonomy properly applicable to these is a problem beyond the present work.

Morphological differences, such as greater hypsodonty, more elongated protocones, more complex enamel patterns, tendency for the hypoconal groove of the premolars to close, and longer metapodials, distinguish the Asiatic from the African asses. Likewise, differences in enamel patterns, flatness and elongation of the protocones, closure of the premolar-hypoconal grooves, and greater slenderness of the metapodials distinguish the Asiatic asses from *Equus.* The elongated, flattened protocones, shortened median valleys of the lower molars, and slender metapodials also distinguish the Asiatic asses from the zebras. It appears that the four groups are about equally distinct or, for that matter, about equally related.

If *Asinus, Equus,* and *Hippotigris* are to be accorded generic rank, and this appears acceptable due to their long history as distinct groups (Quinn, 1955a), the Asiatic asses should be accorded generic rank also.

The American Pleistocene species of horses previously referred to *Equus* which have the characters of the Asiatic asses and, therefore, appear referable to that group make it more than ever necessary to give them separate recognition. For this reason the prior generic designation *Onager* Brisson, 1762, is re-established and the American and Old World species with the proper morphological characteristics are referred to that genus. *Hemionus,* therefore, becomes a synonym.

Reference of *E. fraternus* Leidy, 1860, to *Onager* (p. 20) introduces consideration of *Tomolabis* Cope, 1892. Cope named the genus on the basis of a lower dentition referred by himself, and separately by Leidy, to *E. fraternus,* which lacks the infundibuli (cusps) of the lower incisors, thus making *E. fraternus* the type of the genus *Tomolabis.* Cope later abandoned the genus because he noticed a tendency toward loss of the infundibuli in other horses. Inclusion of *E. fraternus* in *Onager* places *Tomolabis* in synonymy.

Hoffstetter (1950a) proposed the genus *Amerhippus* principally to receive *E. andium* and related South American horses which lack the infundibuli of the lower incisors. Hoffstetter added *E. occidentalis* Leidy, the North American Tar Beds horse, to the group and considered *E. occidentalis* as the possible ancestor of the South American horses. (The reverse might be equally true.)

Cooke (1950) called attention to the fact that *Hippotigris burchelli* customarily lacks the infundibuli. Hoffstetter (1950a) proposed *Pseudoquagga* for zebras lacking the infundibulum.

It appears that loss of the infundibuli, like the appearance of monodactyly, shortening of the median valley of the lower molars, loss of the parastylid and other similar characters, has appeared separately in several genera of horses and is due to long-range genetic trends (Quinn, 1955a) or evolutionary response to environmental factors and may not in itself be useful as a generic criterion. The South American horses may represent a separate genus, but *E. occidentalis,* except for loss of the infundibuli, seems closely related to *Equus.* The species does not appear to belong in *Onager* or with the American species referable to *Onager.*

ONAGER SEMIPLICATUS (Cope) 1893

Pl. II, fig. 5

Equus semiplicatus Cope, 1893, Texas Geol. Surv., 4th Ann. Rept.

Equus (Asinus) calobatus Troxell, 1915, Amer. Jour. Sci., 4th ser., vol. 39, no. 234.

Type.—Second upper molar, from Tule Canyon (Rock Creek), Briscoe County, Texas; coll. The University of Texas.

Range.—Late Kansan to early Illinoian, Pleistocene.

Distribution.—Texas (southern High Plains), Oklahoma (Holloman gravel pit, Frederick, Oklahoma), Kansas (Arkalon gravel pit, Seward County), Nebraska (Hay Springs, Frick, 1930).

Referred material.—Maxillary, ramus, isolated teeth, second phalanx, T.M. no. 276, Rock Creek, Briscoe County, Texas; metatarsal, Holloman gravel pit, Frederick, Oklahoma.

Diagnosis.—(*Cope,* 1893, p. 80) "Teeth indicate a species of about the dimensions of the *E. tau,*. but characterized by a greater complexity of the enamel foldings.... the anteroposterior diameter of the protocone is more than half that of the grinding face of the crown."

Description.—A maxillary, T. M. no. 276, Rock Creek beds, Briscoe County, Texas (Pl. II, fig. 5) retains the cheek tooth series. The second molar is closely similar to the type, described by Cope. The dimensions of the teeth, although slightly more worn, almost exactly equal those of *Onager lambei* (Hay) (p. 14), B.E.G. no. 31058–2. The styles of the premolars are not as prominent as those of *O. lambei* and the fossette borders are less folded. The protocones are considerably shorter anteroposteriorly but are otherwise similar in shape. The hypoconal grooves are open on all but the third molar.

The metatarsal from Holloman gravel pit is of approximately the same length and proportion as the type material described by Troxell (1915) as *E. (Asinus) calobatus.* Metatarsals from Texas and Kansas differ somewhat in length and diameter but all are larger and longer than those of *Onager* from the Sangamon-age deposits.

Discussion.—Although the type of *E. semiplicatus* is a molar tooth and the type of *E. (Asinus) calobatus* is a metatarsal, comparison of these materials with the maxillary T.M. no. 276 and materials of *Onager* from the Sangamon-age deposits indicates they belong to closely related forms. Since *E. semiplicatus* Cope, 1893, is the prior name, *E. (Asinus) calobatus* becomes a synonym. In recognition of the affinities of the species it is referred to *Onager.*

In Texas, Oklahoma, and Kansas *O. semiplicatus* is found in association with bones of *Equus scotti* Gidley. Reported but undescribed materials from Nebraska are found with *E. niobrarensis* Hay. Bones of *Bison* have not been found in association with these species. Authors agree in general that the faunas are of late Kansan to early Illinoian age. The metatarsals of *O. semiplicatus* are sufficiently striking in their length and slenderness to be useful for index purposes.

Table 1. Measurements of Onager semiplicatus *(Cope).*

Upper dentition, T.M. no. 276–2, Rock Creek, Briscoe County, Texas

Pl. II, fig. 5

	AP	TR	CL	PL	PW
P. 2	37.5	25.8	33.0	8.5	5.3
P. 3	29	..	..	14.0	6.0
P. 4	26.3	27.3	55	14.6	5.3
M. 1	23.5	26.0	.....	12.5	5.1
M. 2	24.6	25.5	.....	14.0	5.0
M. 3	25	.....	.....	14.0	3.5

Lower deciduous dentition, T.M. no. 276–1, Rock Creek, Briscoe County, Texas

(not figured)

	AP	TR	CL	MM
D.P. 2	36.5	12.0	.....	17.0
D.P. 3	33.7	12.0	.....	17.0
D.P. 4	35.4	11.3	.....	16.6
M. 1*	31.0	12.1	.....	16.7

*Sectioned 16 mm below top of crown

Depth of ramus anterior of M.I: 80 mm

Metatarsal III, T.M. no. 934–6, Holloman gravel pit, Frederick, Oklahoma

Length: 330 mm
Proximal width: 49.5 mm
Distal width: 44 mm

ONAGER LITTORALIS (Hay) 1913

Pl. III, fig. 13

Equus littoralis Hay, 1913a, U. S. Nat. Mus. Proc., vol. 44, no. 1969, pp. 575–576.

Equus achates Hay and Cook, 1930, Colorado Mus. Nat. Hist. Proc., vol. 9, no. 2, p. 15.

Type.—Upper left molar, W.F.I.S. no. 4086, Pleistocene, Peace Creek, Florida.

Range.—Sangamon interglacial, Pleistocene.

Distribution.—Texas (Coastal Plain, southern High Plains), Oklahoma (Holloman gravel pit, Frederick, Oklahoma), Florida (Peace Creek).

Referred material.—Upper right premolar, B.E.G. no. 31168–13 (Pl. III, fig. 13), Powers ranch, left bank of Medio Creek, Berclair terrace, Bee County, Texas; first or second lower molar, B.E.G. no. 30965–11, right bluff of Blanco Creek, 1,700 feet upstream from bridge on Beeville-Goliad road, Bee County, Texas; third or fourth lower premolar, B.E.G. no. 31034–75, right bluff of Blanco Creek, 3 miles downstream from bridge on Beeville-Goliad road, J. J. O'Brian ranch, Bee County, Texas.

Diagnosis.—Smallest of the Equini, teeth slightly larger than those of *Nannippus phlegon.* (From Hay, 1913a, p. 575) "Characterized by teeth of small size . . . enamel surrounding the lakes rather strongely folded. The crown somewhat more curved than in *E. leidyi.*"

Description. — An upper premolar, B.E.G. no. 31186–13 (Pl. III, fig. 13), has a crown height of 74.5 mm, measured on the mesostyle. The parastyle and mesostyle are low and broad. The interstylar valleys are shallow and without ribs. The prefossette has, in addition to the pli protoloph, three small antero-external plications. Internally, the border is flattened and diagonally oriented. Posteriorly there is a broad V-shaped pli protoconule and double pli prefossette. The postfossette has a bifurcated pli postfossette, is broadly rounded on its internal border, and has a doubly inflected pli hypoloph. The protocone is long and oriented in a slightly diagonal direction. It has a flattened, sharply pointed anterior heel, flattened and slightly grooved internal border, and is connected to the protoselene by a narrow, transversely directed commissure. The postprotoconal valley has a small pli caballin and extends transversely into the V of the pli protoconule, indicating an early stage of wear for the tooth. The hypocone is small, restricted anteriorly by a weak groove and posteriorly by a shallow hypoconal groove which extends to the base of the crown.

A lower first or second molar, B.E.G. no. 30965–11 (not figured), has a crown height of about 50 mm. The paralophid is thin, directed posterointernally and has a small posteriorly directed inflection. There is a very short metaflexid. The metaconid is large, rounded, and deflected; the metastylid is small leaf-shaped, strongly deflected, and the intervening valley is broadly V-shaped. The entoconid is broken but the tip approaches closely to the metastylid. There is no parastylid. The protoconid is flattened but transversely broader anteriorly than posteriorly. The median valley is short and does not penetrate between the flexids but approaches them more closely than in the premolars.

A third or fourth lower premolar, B.E.G. no. 31034–75 (not figured), does not differ markedly from the molar. It is larger and the median valley is shorter and has a trace of the pli caballinid.

These teeth are closely akin to those of *Asinus somaliensis* Noak and the burro but differ in their smaller size, longer protocones, and greater hypsodonty.

Discussion.—Hay and Cook (1930, pp. 13–14) referred to *Equus littoralis* a lower jaw fragment, C.M.N.H. no. 616, and an upper left second molar, C.M.N.H. no. 623A, from a bison quarry on Lone Wolf Creek, near Colorado, Texas. They compared the material with that of *Equus francisi* Hay and concluded it represented a distinct species, on the basis of smaller size and some differences in the enamel pattern of the teeth. The upper molar was referred to *E. littorallis* as was the lower jaw because it was found at the same locality.

In the same paper (p. 15) Hay and Cook described an upper left second molar, C.M.N.H. no. 1085, from the Holloman gravel pit, Frederick, Oklahoma, as *Equus achates,* new species. They gave as diagnostic characters its extreme hypsodonty and curvature.

Savage (1951, p. 244) regarded both *Equus achates* and *Equus littoralis* as nomina vana.

These materials are distinguishable as belonging to the smallest of the Pleistocene Equini. The extreme hypsodonty and elongation and flattening of the protocones indicate they belong to *Onager* rather than *Asinus.* The Texas materials occur in beds of Sangamon interglacial age. No materials of *O. littoralis* have been found in the Rock Creek beds. The Holloman gravel pit specimen is probably of the same age as the Texas materials. Its occurrence in the same locality with *Equus scotti* and *O. semiplicatus* indicates mixing, or strata of different ages in the gravel pit.

Table 2. Measurements of Onager littoralis *(Hay).*

B.E.G. NO.		AP	TR	CL	MM	PR
31186–13	P.3?	22.6	20.6	74.0	.....	13.7
30965–11	M. 1	.....	11.5	30	11.0	.....
31034–75	P. 3?	20.0	12.0	39	13	.....

ONAGER LAMBEI (Hay) 1917

Pl. II, fig. 4

Equus lambei Hay, 1917, U. S. Nat. Mus. Proc., vol. 53, no. 2212.

Equus cf. *caballus* Savage, 1951, California Univ. Pub., Dept. Geol. Sci., Bull., vol. 28, no. 10.

Type.—Skull and lower jaw, U.S.N.M. no. 8226, from Gold Run Creek, Klondike Region, Yukon Territory, Alaska, late Pleistocene.

Range.—Sangamon interglacial.

Distribution.—Alaska, southern High Plains, Gulf Coastal Plain.

Diagnosis.—(From Hay) Small, broad-skulled horse; teeth unusually broad; their enamel little plicated; the protocones unusually long.

Referred material.—Skull, B.E.G. no. 31058–2 (Pl. II, fig. 4), previously referred to *E. fraternus* (Sellards, 1940, pp. 1633–1635, pl. 2, fig. 2) from left bank of Blanco Creek, 3 mile downstream from bridge on Beeville-Goliad road, Bee County, Texas; deciduous and permanent teeth from Kincaid Shelter (Sellards, 1952, pp. 94, 143), 4 miles north of Sabinal, Uvalde County; teeth from Brazos River terraces, Stonewall County, Texas; teeth from Colorado River (Asylum terrace), Travis County, Texas.

Description.—*Onager lambei* (Hay) is distinguished from other species of Pleistocene horses by its moderately small size, intermediate between *Asinus somaliensis* and *Hippotigris burchelli,* short skull and jaw, moderately complex cheek teeth and excessively elongated, flattened protocones. Hay (1917, p. 440) considered the plications of the fossettes to be very simple, a condition not altogether due to excessively worn teeth. The Texas materials indicate that the teeth are a little less complex than those of *Onager fraternus.*

Upper dentition.—The upper dentition of the skull, B.E.G. no. 31058–2 (Pl. II, fig. 4) indicates an age of 5 to 6 years for the animal.

The first incisor has a shallow anterior groove and a deep, oval infundibulum, without an anterior inflection. The canines are broken at the alveoli and appear to have been small. There are no first premolars.

The second premolar is short anteroposteriorly like those of *Onager altidens* (p. 16) but is more compressed transversely. The fossettes are more elongated and the protocone less divergent. The hypoconal groove is closed and the fossette lost. The closed hypoconal groove of the premolars is not found in *Equus* but appears in *Onager* and the zebras.

The third premolar is smaller and shorter than that of *O. altidens.* The mesostyle is much heavier, the borders of the fossettes are much more complex, and the protocone far longer. The pli protoloph is deep and narrow. The pli protoconule consists of a series of four loops. The pli prefossette is small but nearly touches the posterior loop of the pli protoconule. Externally there is a series of small inflections. The postfossette is rectangular and has a very long cornua.

The protocone has a long broad heel and toe, is slightly inflected internally, and oriented parallel with the long axis of the tooth row. The postprotoconal valley is shallow. The pli caballin arises from the posterior border of the valley. The hypoconal groove is closed.

The fourth premolar is smaller than the third; the plications of the fossettes are deeper and the protocone is considerably longer, equalling 67 percent of the anteroposterior length of the tooth.

The plications are less pronounced on the first molar, the protocone is shorter than on the fourth premolar, and the hypoconal groove is closed. There is no pli caballin, which probably is the result of greater wear.

The second molar retains the plications of the premolars and is much like them except it is smaller and has less pronounced styles of the ectoloph. The hypoconal groove is open.

The third molar, as Owen (1869, p. 542) suggested concerning the kiang, is less modified than in *Equus* and *Asinus*. The posterior border has two minor inflections but is nearly straight. The hypoconal groove is closed, remaining as a large nearly round fossette.

The cheek teeth are oriented in a nearly straight line with less divergence from the axial plane of the skull than in *Hippotigris* or *Asinus* and less curvature than in *Equus*. In this as well as the great length of the protocones the Texas horse agrees nearly exactly with the type from Alaska.

Deciduous upper dentition.—A maxillary, B.E.G. no. 31186–23 (not figured), with the first and second molars in place and from the same locality as the type of *O. altidens* appears to belong to *O. lambei*. The protocones of the molars are of the same length as those of the skull described above, whereas those of *O. altidens* are much shorter. Likewise, the protocones of the deciduous upper cheek teeth are oriented more nearly parallel with the axis of the skull and are longer than those of *O. altidens*. Materials from Kincaid Shelter include a number of permanent upper, deciduous upper, and lower cheek teeth, and deciduous incisors. The permanent and deciduous uppers belong to *O. lambei* as presumably do the deciduous lowers.

Lower dentition.—Lower teeth of the permanent series belonging to *O. lambei* were not recognized in the collections. A lower jaw associated with the type skull is figured (Hay, 1917, pl. 53, fig. 2).

A number of deciduous incisors from Kincaid Shelter lack the infundibulum and are considered to be lowers of *O. lambei*. According to Hay (1917, p. 438) the lower incisors of the type are so worn that the cusps (infundibuli) have disappeared but they are still all present in the upper incisors. It seems more probable that like *O. altidens* the lower incisors of *O. lambei* did not possess infundibuli. (Wear would obliterate those of the upper teeth as well as those of the lower teeth.)

Lower deciduous premolars from Kincaid Shelter are slightly smaller than those of *O. altidens*. The metaconid and metastylid are less deflected and the valley between them is broadly V-shaped rather than sharply so.

Skeletal material.—A metacarpal, B.E.G. no. 31058–3, from the same site as the skull described above agrees in length and slenderness with that of *O. kiang* (Stehlin and Graziosi, 1935, pl. 2, fig. 3) and differs from that of *O. altidens* in being 32 mm. shorter.

Table 3. Measurements of Onager lambei *(Hay).*

Upper dentition, B.E.G. no. 31058–2, Berclair terrace, Bee County, Texas

Pl. II, fig. 4

	AP	TR	CL	PL	PW
I. 1	6.0	19.0	.....	.....	.....
P. 2	36.0	25.8	50.0	12.4	5.0
P. 3	27.5	27.5	51.0	15.9	5.2
P. 4	27.1	28.6	60.5	18.5	6.0
M. 1	24.0	26.0	.....	15.1	5.0
M. 2	24.0	25.0	.....	16.0	5.2
M. 3	27.0	22.5	.....	16.0	4.5

Deciduous upper dentition, T.M. no. 908–2297, –2372, –2369, Kincaid Shelter, Uvalde County, Texas

D.P. 2	38.0	24.0	25.0	10.5	5.0
D.P. 3	29.1	23.0	27.6	10.5	4.8
D.P. 4	30.0	22.0	31.2	13.9	4.8

Deciduous lower dentition, T.M. no. 908–2362, Kincaid Shelter

				MM
D.P. 2	31.5	13.5	.....	16.0
D.P. 3	29.5	14.0	.....	15.0
D.P. 4	33.7	12.4	.....	15.2

Metacarpal, B.E.G. no. 31058–3, Berclair terrace

Length: 215 mm
Proximal width: 44 mm
Middle of shaft: 28.5 mm

ONAGER ALTIDENS[3] Quinn, new species

Pl. I; Pl. V, fig 3; Pl. VII, figs. 1, 2

Type.—Right maxillary, with worn D.P. 2–4, unerupted P.2–4, M.1–2 (B.E.G. no. 31186–35); right and left lower jaws with I.1, D.I.2, D.P.2–4, M.1–2, P.2–4 unerupted (B.E.G. no. 31186–36); cranium lacking occiput (B.E.G. no. 31146–37) ; right Mc.3 (B.E.G. no. 31186–3) ; right and left femora (B.E.G. nos. 31186–2, 34) ; right and left tibiae (B.E.G. nos. 31186–1, 10); right and left Mt.3 (B.E.G. nos. 31186–4, 7) ; phalanx, first (B.E.G. no. 31186–24)—all believed to belong to one individual, approximately three years old. In addition to the type material a pair of maxilla (B.E.G. no. 31186–23) and a right lower jaw (B.E.G. no. 31186–22) of an animal about one year old and 24 deciduous and permanent upper and lower teeth, all apparently belonging to the same species, were recovered from the site. It is situated on the bank of Blanco Creek, Powers ranch, 1 mile south, 1 mile east, 4.3 miles southeast, 0.7 mile southwest of Berclair, Bee County, Texas, on the Berclair terrace, of late Pleistocene age.

Range.—Sangamon, Pleistocene.

Distribution.—Gulf Coastal Plain, terrace deposits.

Diagnosis.—Size slightly larger than *Onager kiang,* teeth extremely hypsodont exceeding *E. caballus* somewhat and *Asinus* considerably; upper teeth curved both transversely and anteroposteriorly; protocones elongated, especially anteriorly; metaconid-metastylid valley V-shaped on premolars; upper and lower third molars greatly reduced anteroposteriorly; limbs longer and more slender than those of *Onager kiang* or *Onager onager.*

Referred material.—Third upper premolar, B.E.G. no. 31278–2, Fort Sam Houston, San Antonio, Texas; third or fourth lower premolar, B.E.G. no. 18608, Onion Creek, near Austin, 1½ miles east of junction of Burleson road and Lockhart highway, found 40 feet below surface in a well, and 3 feet above contact of gravels with Taylor marl.

Owen (1869, p. 542) described the dentition of a male kiang as *Equus hemionus* Pallas, stating it probably came from Tibet and that it is specifically identical with a second specimen from Tibet and probably the same species as the *Equus hemionus* Pallas from the Mongolian plains. He characterized the species as having relatively longer premolars, anteroposteriorly, than *Equus* s.s., second premolar more obtusely terminated, third molar shorter anteroposteriorly, mesostyle narrower, protocone of P.2 more elongated, M.3 more like M.2, lower teeth relatively narrow transversely; the upper molars curved about as in *Equus* and straighter than in the ass.

Description.—The upper incisors are not preserved in any of the materials at hand. The cheek teeth are moderately curved, transversely, about as in *E. caballus* but the molars are more curved anteroposteriorly and equalling or slightly exceeding those of *E. caballus* in hypsodonty.

Upper permanent dentition. — The second premolar is unerupted but was removed from the maxillary and sectioned 20 mm below the top of the mesostyle. The tooth is short anteroposteriorly with wide angular styles and moderately complex fossettes. The protocones are not longer but more concave internally than in *E. caballus.* The pli caballin is prominent; there is a closed hypoconal groove forming a small fossette that terminates 5 mm lower on the crown.

The unerupted third premolar was also sectioned. This tooth has the greatest crown diameter of any in the series and appears so much larger than the succeeding teeth that it might be supposed to belong to a

[3] Latin, *altus* — high and *dens* = tooth.

different animal had it not been found in place. The styles are heavy and the interstylar valleys deep and moderately concave. The fossettes are large and their borders little folded except for a deep pli protoloph and pli protoconule of the prefossette. The protocone has a long anterior heel, is deeply concave internally, and turned inward at the tip. The pli caballin is large as in *Equus*. The hypoconal groove is closed and represented by a small fossette as on P.2. This is seen in some premolars of *Asinus* and *Hippotigris* but not in *Equus* insofar as can be determined.

The fourth premolar is 2.3 mm shorter anteroposteriorly than is the third and 2 mm narrower transversely, which is about the limit of variation found by Gidley (1901, p. 102) for teeth of *E. caballus*.[4] The styles are weaker than on P.3 and the fossettes smaller but with similar plications. The protocone is slightly longer, less concave, and less inwardly deflected. The postprotoconal valley is continued outward nearly reaching the pli protoconule and has a series of small inflections, the outermost of which represents the pli caballin. There is no prehypoconal groove. The hypoconal groove is compressed so that the borders are parallel but remains open to the base of the crown.

The first molar is slightly worn and was not sectioned. The occlusal surface is smaller than that of P.4. The crown is curved anteroposteriorly and tapered so that there is about 6 mm difference in the anteroposterior diameter between the top of the crown and a point 20 mm above the base. The styles are considerably narrower than on the premolars. The enamel pattern is otherwise similar to that of P.4. The hypoconal groove remains open to the base of the crown.

The second molar is smaller and appreciably (1.5 mm) narrower transversely than is the first.

The third molar is missing in the type. As isolated half-worn tooth from the type locality indicates that the third molar is reduced in size, has an elongated protocone, and no sign of the hypoconal groove. Posteriorly there is a ridge opposite the postfossette so that the tooth is bilobed as on *O. complicatus* (Leidy, 1869, p. 563, pl. LXI, fig.l).

Lower permanent dentition.—The first incisors are present on the lower jaw of the type. They are but slightly worn and are unique in that they are initially slightly concave anteriorly and so compressed posteriorly that they are very thin, chisel-like, and lack the infundibuli (Pl. I, fig. 5).

The second incisors are unerupted but are in place behind the second deciduous incisors. These too are chisel-like, and there is no cusp or infundibulum, but the enamel of the anterior face of the teeth meets that of the posterior face, forming a blade-edge as in the Artiodactyla.

The third incisors and canines if present are not sufficiently developed to be exposed.

The premolars are in place but unerupted; consequently, the left ramus was sectioned to expose these teeth (Pl. I, fig.3).

The second premolar is short anteroposteriorly, as is the second upper premolar. The anterior process of the paralophid is very reduced. The groove between the metaconid and metastylid is shallow V-shaped. The entoconid is large and rounded. There is a small pli hypoconid (Quinn, 1955a). There is a parastylid anteriorly, on the protoconid. The median valley is shallow and has no pli caballinid. The hypoconid is very much flattened.

The third premolar is broad, transversely, at its anterior end as in *O. kiang*. The metaconid and metastylid are elongated, strongly divergent, and have a V-shaped valley much as in *Hippotigris*. There is a prominent pli hypoconid. The anterointernal border of the protoconid has a weak parastylid and is directed strongly inward, as in *O. kiang*. The internal face of the protoconid is concave. The median valley is shallow and has a

[4] The idea that large individuals of a species have larger teeth than small individuals is erroneous, according to Gidley (1901).

small pli caballinid. The hypoconid is flattened but not concave.

The fourth premolar differs from the third in that the metastylid is directed posteriorly and is not divergent. There is a large pli hypostylid and a similar opposed process projecting into the metaflexid. This process is rudimentary on the third premolar. As on the third premolar there is a weak parastylid and pli caballinid.

The second premolar is sectioned approximately 25 mm below the tip of the metastylid, which is exposed. The third premolar is sectioned 20 mm below the tip of the metastylid, and the fourth premolar about 15 mm below the tip of the entoconid.

The first molar is in place and somewhat worn, probably about 10 mm (Pl. I, fig. 4), and is not sectioned. The metaconid and matasylid are divergent and have a broadly V-shaped valley. The metastylid is sharply truncated posteriorly, which imparts to it a triangular configuration. The entoconid is flattened internally and is elongated. There is no parastylid, but a well-developed pli caballinid is present. The external faces of the protoconid and hypoconid are concave. The median valley is very short and does not reach the re-entrants of the flexids.

The second molar has a shorter metaconid-metastylid column than the first, is narrower transversely at its posterior end, and has the shortened median valley.

The third molar is unerupted and possibly has not yet developed. Material from the type locality indicates the third molar is reduced anteroposteriorly, with the hypoconulid nearly eliminated.

Deciduous upper dentition.—The deciduous upper incisors of the type are missing.

The deciduous cheek teeth (Pl. I, fig. 2) of the type are deeply worn and have lost most of the plications of the fossettes. The styles are heavy as in the permanent premolars. The protocones are smaller than those of the permanent teeth but like them are concave internally and tend to diverge inward at the tip. Although the deciduous premolars of the type do not exhibit a complex enamel pattern, two little-worn sets of deciduous premolars from the type locality are complex. Both the anterior and posterior borders of the fossettes are considerably plicated. The postprotoconal valleys tend to be deep. Pli caballinids are present on the second and third but absent on the fourth premolars. The hypoconal grooves of the second and third premolars tend to be closed high on the crowns, as on the second and third permanent premolars.

Deciduous lower dentition,—The second deciduous incisors of the type are preserved. Like the permanent lower incisors they lack the infundibuli.

The deciduous lower cheek teeth (Pl. I, fig. 4) of the type are badly broken except for D.P. 4 on either side. Additional material from the type locality includes a lower jaw with little worn milk teeth and isolated material. The metaconids and metastylids of all three deciduous milk teeth are divergent and have a V-shaped valley. The entoconids have an anterior spur. The D.P. 2's have prominent parastylids. Most of the D.P. 3's and D.P. 4's have parastylids on the lower half of the crowns. All have prominent pli caballinids. Some have weak hypostylids on the lower part of the crowns.

Skeletal material. — The fragment of cranium, B.E.G. no. 31186—37, is distorted but *is* of a skull a little larger than that of *Asinus somaliensis.* The zygomatic process of the temporal bone is present and is considerably broader than that of *A. somaliensis,* about equalling that of *Hippotigris grevyi.*

The lower jaw is intermediate in size between those of *A. somaliensis* and *H. grevyi* in the length and height of the ascending ramus. The symphysis is short as in *A. somaliensis.* The horizontal ramus is deep dorsoventrally, equalling that of *H. grevyi,* although the zebra is a considerably larger animal.

Of the fore limbs only the third metacarpal (Pl. VII, fig. 1) of the right side is preserved. This bone differs from those of

Recent *Equus* chiefly in its greater slenderness. It is much longer than the metacarpals of the burro and exceeds slightly the length of metacarpals of *O. onager* but equals them in slenderness.

The femora of both sides are preserved. That of the left side is uncrushed and lacks only the great trochanter. It is proportionately more slender than that of *E. caballus;* otherwise there is very little difference between the two bones, except for size.

The tibiae (Pl. VII, fig. 2) of both sides are present. Part of the proximal ends are missing. These bones are proportionately more slender than those of *E. caballus,* approximately equalling the femur in length where the tibia of *Equus is* considerably shorter than the femur. Hay (1915, pp. 546–547) indicated the length of the femur equals the length of the tibia in the Arabian horse. The material used for comparison here is that of a "Texas pony."

Both third metatarsals (Pl. V, fig. 3) are preserved. Of these the left is complete and seems to be undamaged. The proximal articulations differ considerably from those of *E. caballus.* The anterior articulation for the ectocuneiform is narrow, providing a relatively large nonarticular depression. The articulation for the cuboid is very small and not prominent. The facet for the meso- and ectocuneiform bones is proportionately about the same as in *E. caballus.* The facets for Mt. 2 and 4 are very much reduced. The transverse diameter of the proximal end of Mt. 3 is relatively less than in *E. caballus,* while the anteroposterior diameter is relatively greater. The shaft of the bone is slender and more nearly rounded. The distal end is transversely narrow compared with that of *Equus.*

The first phalanx, like the third metatarsal, is long and slender. In size and proportions the phalanx agrees precisely with that of *O. onager* (Stehlin and Graziosi, 1935, pl. 3, fig. 4). The metatarsal, however, is 18 mm longer than that of *O. onager* (ibid., pl. 2, fig. 4).

Table 4. Measurements of Onager altidens *Quinn, new species.*

Permanent dentition, B.E.G. no. 31186–36, right maxillary, type

Pl. I, figs. 1, 2

	AP	TR	CL	PL	PW
P. 2	35.0	25.4	.....	10.0	5.4
	sectioned 20 mm below top				
P. 3	31.2	27.0	.....	13.5	5.0
	sectioned 20 mm below top				
P. 4	29.0	26.0	.....	13.2	5.0
	sectioned 20 mm below top				
M. 1	28.0	25.0	93.0	13.5	5.5
M. 2	28.0	.....	78	14	....
	occlusal surface partly developed				
M. 3	.....	.....	.....	.....	....

B.E.G. no. 31186–35, lower jaw, type

Pl. I, figs. 3, 4

P. 2	32.0	13.8	.....	14.5
	sectioned 25 mm below Ms. tip			
P. 3	30.0	16.5	.....	16.5
	sectioned 20 mm below Ms. tip			
P. 4	30.5	14.0	.....	17.0
	sectioned 15 mm below Ms. tip approximately			
M. 1	28.5	14.0	91.5	15.0
M. 2	28.0	11.0	82	13.3
	roots not formed			
M. 3	.....	.....	.....	.....

Deciduous dentition, B.E.G. no. 31186–36, right maxillary, type

D.P. 2	.....	22.0	9.0	9.0	5.0
D.P. 3	27.0	23.5	11.0	9.7	5.9
D.P. 4	27.8	23.5	15.5	11.6	5.0

Deciduous dentition, B.E.G. no. 31186–35, lower jaw, type

D.P. 2	32	.....	.....	.....	....
D.P. 3	28	.....	8	.....	....
D.P. 4	28.7	15.0	9.0	16.0	....

Length of upper premolars: 95 mm at point of section
Length of lower premolars: 100 mm at point of section
Depth of ramus at anterior border of M. 1: 83 mm
Length of jaw, incisor 1 to angle: 416 mm
Length of symphysis, including I.1: 81 mm

B.E.G. no. 31186–3, type

Length of Mc. 3: 247 mm
Width of proximal end: 47 mm
Width of distal end: 43 mm

B.E.G. no. 31186–2, type

Head to distal extremity: 327 mm
Width of proximal end: 103 mm (damaged)
Width of distal end: 86.5 (slightly abraded)

B.E.G. no. 31186–10, type

Length of tibia: 330 mm (proximal end damaged)
Width of proximal end: 90 mm (damaged)
Width of distal end: 63 mm

B.E.G. no. 31186–7, type

Length of Mt. 3: 283 mm
Width of proximal end: 45.5 mm
Width of distal end: 42 mm, approximately (damaged)

B.E.G. no. 31186–24, type

Length of first phalanx: 82 mm
Width of proximal end: 41 mm
Width of distal end: 36 mm

Deciduous upper dentition, B.E.G. no. 31186—23

	AP	TR	CL	PL	PW
D.P. 2	41.0	23.0	.....	8.0	5.0
D.P. 3	30.5	24.8	.....	10.0	5.0
D.P. 4	31.0	24.5	.....	12.0	5.0

Deciduous lower dentition, B.E.G. no. 31186–22 (same individual as B.E.G. no. 31186–23)

				MM
D.P. 2	35.0	12.5	.....	15.5
D.P. 3	30.0	12.2	.....	14.7
D.P. 4	33.0	11.5	.....	15.3

ONAGER FRATERNUS (Leidy) 1858

Pl. III, fig. 10; Pl. V, fig. 4

Type.—Upper P. 3[5] (according to Cope, 1896, p. 467; and Hay, 1913a, pp. 569–570) from Charleston, South Carolina.

Range.—Post-Illinoian to post-Wisconsin?

Referred material.—Upper and lower teeth (B.E.G. no. 30907), Trinity River terrace; and metatarsal (B.E.G. no. 30967), Ingleside pit.

Discussion.—Teeth of *O. fraternus* are distinguished from those of *O. complicatus* by their smaller size. Otherwise, there seems to be little difference, but since materials of the two sizes are consistently found, both species seem to be valid.

The metatarsal, B.E.G. no. 30907–6 (Pl. V, fig. 4), agrees closely in slenderness with that of *Onager* (Stehlin and Graziosi, 1935, pl. 9, fig. 4) but is about 7 mm longer. It is much smaller and more slender than the corresponding material attributed to *O. complicatus*, and even though the enamel patterns are closely similar the two forms may belong in separate subgenera, as indicated below (p. 21). The metatarsal figured and measured is from the Trinity River terraces and is identical in all respects with those from Ingleside pit.

Table 5. Measurements of Onager fraternus *(Leidy).*

Left lower jaw, B.E.G. no. 31041–26 (not figured)

	AP	TR	CL	MM
P. 2	29.8	14.2	.....	16.0
P. 3	27.1	15.0	.....	15.7
P. 4	27.7	14.0	97	14.4
M. 1	24.5	12.2	89	14.5
M. 2	25.2	12.0	95	13.1
M. 3	24	10.0	62.5	11.7

Right upper M. 2, B.E.G. no. 30907–46B

Pl. III, fig. 10

				PL	PW
M. 2	26.9	24.5	77.5	15.0	3.6

Left metatarsal, B.E.G. no. 30907–6

Pl. V, fig. 4

Length: 267 mm
Width of proximal end: 43.4 mm
Width of distal end: 41.6 mm

ONAGER (HESPERHIPPUS) COMPLICATUS (Leidy) 1858

Pl. III, figs. 11,12

Type.—Upper M.2, from near Natchez, Mississippi.

Range.—Post-Illinoian to post-Wisconsin?

Distribution. — Southeastern North America.

Referred material.—Upper and lower teeth (B.E.G. no. 30907), Boatwright gravel pit, 2.5 miles northwest of Trinidad, Henderson County, Texas, compare closely with Leidy's type. The crown height, curvature, and dimensions of the occlusal surface are the same at about the same point on the crowns. The referred upper tooth (Pl. III, fig. 11) has a more complex enamel pattern than does the type, and the anteroposterior diameter of the postfossette is considerably greater.

[6] Gidley (1901, p. 111) rejected Cope's choice of the P.3, on the grounds that Leidy did not figure the specimen. Hay (1913a) pointed out Gidley's error in not recognizing Leidy's figure. Gidley selected a new type, a P.2 (1901, p. 112, fig. 8A). This tooth belongs to a small horse, about equalling *A. conversidans* in size. Leidy (1858) stated "Its remains are undislinguishable from the corresponding parts of the recent horse. . . " Gidley's choice of type, therefore, does not correspond with Leidy's characterization.

Lower cheek teeth from the same quarry are of a size to equal that of the uppers. They are distinguished, principally, by reduction in length of the molar series and relatively short anteroposterior dimension of the premolars as well. In detail the enamel pattern is more plicated than in *E. caballus* and remains so in well-worn teeth. The metaconid of the lower tooth (Pl. III, fig. 12) is expanded both externally and internally at its end as in *E. midlandensis*. The metastylid is more regularly oval, and the valley between metaconid and metastylid is narrow and V-shaped. The entoconid of the premolars is larger than in *E. midlandensis* and has a more pronounced spur; the hypoconulid is short and narrow and has a noticeable hypostylid. There is a faint but persistent parastylid on the premolars. The protoconid and hypoconid are flattened and concave. The median valley is broad and short with the pli caballinid occupying a central position, producing an M-shape termination.

Teeth of both *O. complicatus* and *O. fraternus* were found in the Henderson County quarries, with metapodials and foot bones which probably belonged to them, since no teeth of other species of horses were found there. The smaller metatarsals are of a size to belong with *O. fraternus* and of the type possessed by *Onager*. The larger ones, possibly belonging to *O. complicatus*, do not resemble those of *Equus*, although they are larger and stouter than those of *Onager*. There is a strong resemblance in the tooth pattern of *O. complicatus* to that of *Onager*. It may be that *O. complicatus* belongs with the subgenus *E. (Hesperhippus) mexicanus* Hibbard (1955a) which undoubtedly is more closely related to *Onager* than *Equus* and it is here tentatively placed in that group.

Table 6. Measurements of Onager (Hesperhippus) complicatus *(Leidy).*

Left upper M. 2, B.E.G. no. 30907–24D
Pl. III, figs. 11, 12

	AP	TR	CL	PL	PW
M. 2 (slightly worn)	31.3	25.2	90	14.8	4.8

Right lower P. 4?, B.E.G. no. 30907–8G

	MM			
P.4?	29.9	17.0	51	18.0

Genus EQUUS Linnaeus, 1758

Type species. — *Equus caballus* Linnaeus.

Range.—Late Miocene to Recent.

Distribution. — Eurasia, North and South America.

Diagnosis.—Large horses with complex permanent upper cheek teeth; styles of ectoloph high, thick, bifurcated; valleys deep and concave; fossettes small; protocones less elongated and compressed than in *Onager*, internally concave but not as markedly so as in *Asinus;* hypoconal groove open on all but M.3, lower permanent teeth with long, crescentic metaconids and metastylids, intervening valleys U-shaped; lower molars with shortened median valleys; lower incisors with infundibuli except intermittently on I.3; lower milk dentition without parastylids and hypostylids; skull elongated; metapodials stout.

Referred species. — *Equus excelsus* Leidy, 1858; *Equus occidentalis* Leidy, 1865; *Equus scotti* Gidley, 1900; *Equus pacificus* Leidy (of Gidley, 1901); *Equus niobrarensis* Hay, 1913a; *Equus bautistensis* Frick, 1921. (Only the better known species are included in this listing.)

EQUUS CABALLUS CABALLUS Linnaeus, 1758
Pl. IV; Pl. V, fig. 1

Type.—Draft horse.

Range.—Wisconsin to Recent.

Distribution.—Southern High Plains (for American fossil form).

Diagnosis. — Large horse, metaconid strongly produced internally, valley between metaconid and metastylid wide and deep, limbs heavy with shaft of metatarsal thick and rounded.

Referred material.—Left upper P.3–M.2, T.M. no. 937–170–4 (Pl. IV, figs. 1–4), lower cheek tooth (Pl. IV, fig. 5), astragalus, ulna, T.M. no. 937, from Blackwater Draw, 7 miles north of Portales, Roosevelt County, New Mexico. Metatarsal, T.M. no. 892–11 (Pl. V, fig. 1), Lubbock, Lubbock County, Texas.

Description.—Associated upper cheek teeth (T.M. no. 937–170–4) are of a young animal; the premolars are unworn and the molars are only slightly so. The teeth are moderately curved both anteroposteriorly and transversely but not more than in some individuals of the living domestic horse. The teeth and limb bones equal those of the draft horse in size and proportions.

Incisors.—Two incisors (T.M. nos. 937–210 and 937–197) are little worn and represent the first and second of the right lower dentition. The anterior surfaces of the incisors are indented by a V-shaped groove situated about 7.5 mm externally of the median borders of the teeth. The posterior borders of the infundibuli are broadly inflected lingually, indicating that the teeth belong in the lower dentition. Those of the upper dentition in *E. caballus* have an anterior inflection of the anterior border of the infundibulum.

Upper cheek teeth.—The second premolar is missing from the group of associated teeth, and there are no isolated specimens in the collection.

The third premolar (Pl. IV, fig. 1) is unworn and was sectioned 20 mm below the top of the mesostyle. Nearly all the cement has been dissolved away and the external details of the tooth clearly exposed. The parastyle is rounded, protrudes anteriorly, and meets the anterior valley of the ectoloph in a faint ridge. The anterior valley is broadly, asymmetrically concave. The mesostyle is prominent, broad, anteriorly deflected and slightly ridged on either side of its rounded outer border. The posterior valley is less broadly concave and meets the metastyle without interruption. The inner portion of the prefossette is sharply restricted by the strongly developed pli protoloph and pli protoconule. The pli prefossette is double. The postfossette has a deep pli postfossette and a small pli hypoloph. The protocone is rounded anteriorly and pointed posteriorly and is deeply grooved internally. The postprotoconal valley extends nearly to the center of the tooth and has a very prominent pli caballin. The hypocone is restricted by a shallow groove anteriorly and a deep posterior hypoconal groove which remains open to the base of the crown.

The fourth premolar (Pl. IV, fig. 2) is smaller than the third and has a slightly longer protocone. The hypoconal groove remains open to the base of the crown.

The first molar (Pl. IV, fig. 3) has less prominent styles than the premolars but the valleys of the ectoloph are similar. None of the cheek teeth has ribs. The pli protoloph and pli protoconule are prominent and are the only inflections of the prefossette. The pli postfossette is broad and shallow; the pli hypoloph is deeper than on the premolars. The protocone is narrower than on the third premolar but otherwise similar in shape. The postprotoconal valley has the pli caballin on the posterior border instead of on the anterior border as in the premolars. The hypocone is not restricted anteriorly and the hypoconal groove is open to the base of the crown.

The second molar (Pl. IV, fig. 4) is smaller and narrower posteriorly than the first and lacks the pli caballin. The hypocone is directed more posteriorly. The hypoconal groove remains open.

An isolated third molar (T.M. no. 937–247) is worn to within 20 mm of the base. The anterior part of the protocone is missing. It appears to have been much longer posteriorly than in the first and second molars. The hypoconal groove is closed and represented by a roughly oval fossette. The posterior border of the tooth is broadly bilobed.

Lower cheek teeth.—The second premolar is represented by a worn tooth, T.M. no. 937–192 (Pl. IV, fig. 6), which agrees in detail with that of the living draft horse. The metaconid is triangular and directed forward, approaching closely to the paralophid. The commissure appears as belonging entirely to the metaconid with the metastylid attached posteriorly. The valley between is shallow and V-shaped. The metastylid is elongated, flattened, moderately rounded internally, and nearly touches the entoconid. The entoflexid is

long and transversely compressed. The entoconid is large, roughly rounded, but slightly angular on its anterointernal border. There is a weak parastylid. The median valley is shallow and there is no pli caballinid. The hypoconid is flattened and concave. The hypoconulid becomes broad toward the base of the crown.

A third or fourth premolar, T.M. no. 937–169 (Pl. IV, fig. 5), is slightly worn and nearly perfectly preserved. The paralophid is short and thin and has two minute inflections on its posterior face. The metaconid is rounded anteriorly, greatly produced internally, and separated from the metastylid by a broad, flat valley. The metastylid is elongated but is more obliquely deflected than is the metaconid. The metaflexid approaches closely to the entoflexid, providing a very narrow commissure between them. The entoconid is flattened internally and has a rudimentary spur on its anteroexternal border. The hypoconulid is narrow transversely and remains so to the base of the crown. The anteroexternal border of the protoconid projects outward so that its concave external face is oblique to the long axis of the tooth. The median valley is shallow but broad and has a well-developed pli caballinid. The hypocone is slightly concave.

Skeletal material.—A radius-ulna (T.M. no. 937-240) compares closely with that of the draft horse in length. The shaft is slightly more slender and the ends are damaged so that no accurate width measurements of the articulations can be made. It is larger and longer than a radius (B.E.G. no. 30722, Pl. VI, fig. 2) found with teeth of *E. midlandensis* but not greatly so.

A metatarsal (T.M. no. 892–11, Pl. V, fig. 1) found at Lubbock, Texas, agrees closely in size and proportions with that of the draft horse and is referred to *E. caballus caballus.*

Discussion. — The upper cheek teeth, lower P.3 or 4, and the limb bone material from Portales and Lubbock agree so closely with those of the draft horse as to leave little doubt of relationship.

It has been stated repeatedly that the domestic horse is a product of interbreeding of many races and forms, and that it is unlikely that the ancestry of *E. caballus* can be traced to any fossil form. This does not seem to be the case. Recognition of *E. caballus caballus* and *E. caballus laurentius (p.* 24) indicates simply that the large and small forms have been kept separate by man and that however many varieties or forms of small horses have been combined in the pony horse, these cannot have differed sufficiently, insofar as tooth morphology is concerned, to have appreciably altered the phenotypic expression of tooth characters.

An exhaustive survey of the literature to determine if valid subspecific categories are available for *Equus caballus* is beyond the resources of the present investigation. Nonetheless, it is inconvenient to distinguish the two groups, as Gidley did (1901). Furthermore, one of the primary functions of a classification is to provide a terminology for the designation of such groups. Since Linnaeus (1758) did not designate a type for *E. caballus* but characterized the species as "strongest in running, in carrying, in pulling, best for riding . . ." it may be assumed he had both the draft horse and the riding horse or pony in mind. The heavy-limbed members may be recognized as belonging to the subspecies *Equus caballus caballus* Linnaeus. The subspecies *Equus caballus laurentius* (Hay) possibly includes the recent as well as the fossil-pony type members of the species.

Table 7. Measurements of Equus caballus caballus *Linnaeus.*

Left upper P. 3-M. 2, T.M. no. 937–170—173

No.		AP	TR	CL	PL	PW
170	P. 3	31.9	28.5	94.0	13.9	4.1
	sectioned 20 mm below tip of mesostyle					
171	P. 4	30.5	28.5	.....	15.0	5.0
	sectioned 20 mm below tip of mesostyle					
172	M. 1	32.0	26.7	99.5	14.0	5.1
173	M. 2	30.0	25.0	97.5	14.8	5.0

Left upper M. 3, T.M. no. 937-247

	M. 3	32.2	.....	21.4	.....	....

Right lower P. *2,* T.M. no. 937–192, and P. 3 or 4, T.M. no. 937–169

					MM
192	P. 2	37.5	18.0	44.5	18.5
169	P. 3/4	33.0	193	94.0	20.4

Radius, T.M. no. 937–240

Greatest length: 359 mm

Metatarsal, T.M. no. 892–11

Length: 283 mm
Proximal width: 62.2 mm
Mid-shaft width: 42.0 mm
Distal width: 57.0 mm

EQUUS CABALLUS LAURENTIUS (Hay) 1913

Pl. III, figs. 1, 2

Equus laurentius Hay, April 30, 1913a, U.S. Nat. Mus. Proc., vol. 44, no. 1969.
Equus niobrarensis alaskae Hay, June 4, 1913b, Smithsonian Misc. Coll., vol. 61, no. 2.
Equus cf. *caballus* Savage, 1951, California Univ. Pub., Dept. Geol. Sci., Bull., vol. 28, no. 10.

Type.—Skull and lower jaws, U.K. no. 347, from upper Pleistocene deposits near Lawrence, Kansas.

Range.—Sangamon to post-Wisconsin.

Distribution.—Alaska, Kansas, southern High Plains.

Diagnosis.—Smaller than *E. caballus caballus,* metaconid less produced internally, valley betwen metaconid and metastylid shallower and narrower.

Referred material.—Upper and lower cheek teeth (T.M. no. 937, Pl. III, figs. 1, 2) from Blackwater Draw, Portales, Roosevelt County, New Mexico.

Discussion.—*Equus laurentius* Hay was described at an earlier date than was *Equus niobrarensis alaskae* Hay and therefore is recognized as the prior name. Workers have consistently recognized *E. laurentius* as *E. caballus* but have insisted it belongs to a recent pony that somehow became fossilized (Savage, 1951, p. 252). Comparison of the dentitions of *E. laurentius* with those of *E. niobrarensis alaskae* indicates the following differences: The protocones of the former are slightly shorter and directed a little more inward, and the skull is somewhat smaller than that of the latter. Both specimens compare closely with materials of the "Texas pony," as Gidley (1901) referred to small forms of the domestic horse.

Recognition of *E. n. alaskae* as *E. caballus* requires reconsideration of the status of *E. laurentius.* It is more reasonable to consider the validity of *E. laurentius* as a fossil than to assume the skull, which according to Hay is "fossilized," belongs to a recent or modern horse (less than 400 years old, requiring investigation of the speed of bone fossilization). Bison bones found by the author on the San Saba River in McCulloch County, Texas, were buried in silt about 4 feet below the surface. There is a well-developed soil profile, with live-oaks more than a foot in diameter growing on the surface. The exact age of the bones cannot be estimated but must be several hundred years. On ignition these gave a burned-bone odor. Subsequent to the preparation of this manuscript, investigation has shown that the skull of *E. laurentius* also releases the burned-bone odor. Bones recovered from the Mississippi River and vicinity in Arkanas that are dated by means of archeological artifacts at more than 1,200 years are closely similar to the skull of *E. laurentius* in color and preservation. These also release the odor (Quinn, 1957b). Therefore, *E. laurentius* is recognized as a fossil representative of *E. caballus. E. n. alaskae* is considered indistinguishable from *E. laurentius* and the name is reduced to synonymy. The Kansas horse appears to belong with the domestic pony (Texas pony of Gidley).

Materials from Portales, New Mexico (T.M. no. 937–191, Pl. III, figs. 2, 2a), agree perfectly with Hay's Alaskan material. The lower teeth of size comparable to that of the uppers (Pl. III, figs. 1, 1a) agree with those of a lower jaw from **Alaska referred by Hay (1917, pl. 56, fig.** 2) to *E. lambei.* It seems probable all these belong to *E. caballus laurentius.*

EQUUS MIDLANDENSIS Quinn, new species

Pl. II, fig. 3; Pl. V, fig. 2; Pl. VI; Pl. VII, fig. 3

Type.—Right and left lower jaws, lacking M.2–3 on the right, M.3 on the left and the ascending rami; upper left P.2, right

P.3–M.1; right metatarsal III and navicular; phalanges of fore and hind foot; all believed to belong to one individual, T.M. no. 998, from gray sand strata, Scharbauer site (Wendorf et al., 1955), Scharbauer ranch, 8 miles southwest of Midland, Midland County, Texas, late Pleistocene (post-Sangamon).

Range.—Wisconsin glacial?

Distribution.—Southern High Plains.

Diagnosis.—Size and proportions of skeletal elements preserved, indistinguishable from *E. caballus laurentius;* teeth slightly larger, valley of metaconid-metastylid shallower and broader than *E. caballus;* median valley of lower molars shorter; upper cheek teeth with wider styles, less complex enamel pattern, and more elongated protocones.

Referred material.—Teeth and bones (B.E.G. no. 30722, Pl. VI, figs. 2–4; Pl. VII, fig. 3), J. O. Baggett ranch, Odessa, Texas; lower cheek teeth (T.M. no. 937), Clovis site, 7 miles north of Portales, New Mexico.

Description.—Upper teeth of *E. midlandensis* are slightly larger than those of *E. caballus* and differ in minor ways.

The second premolar (Pl. II, fig. 3) is short anteroposteriorly and broad transversely. The mesostyle is slightly bifurcated. Plications of the pre- and postfossettes are simple and much as in *E. caballus.* The protocone has a faint anterior heel, is concave internally, and separated from the hypocone by a short, broad postprotoconal valley. The pli caballin is large. The hypocone is restricted by a shallow prehypoconal groove and a hypoconal groove that does not extend to the base of the crown as in most second premolars of *Equus.*

The third premolar (Pl. II, fig. 3) is slightly curved anteroposteriorly and transversely. The parastyle is angular but not grooved, There is a broad nonbifurcated mesostyle. The valleys of the ectoloph are shallow and concave. The prefossette has a pronounced pli protoloph, short, blunt cornua, broadly angular pli protoconule, and a double pli prefossette. The postfossette is large and angular with a deep pli postfossette and pli hypoloph. The protocone is elongated, grooved internally, and oriented with the anteroposterior axis of the tooth. There is a large, transversely directed pli caballin. The hypoconal groove is shallow but remains open to the base of the crown.

The fourth premolar (Pl. II, fig. 3) does not differ materially from the third.

The first molar (Pl. II, fig. 3) lacks the ectoloph. The tooth is slightly smaller than the fourth premolar and has less pronounced plications, probably due to greater wear. The pli caballin is very small.

There are no second or third molars belonging to the type.

Lower dentition.—Incisors (Pl. VI, fig. 1) are present on the right half of the symphysis. The third is partly erupted, indicating the animal was about five years old at the time of death. The incisors are larger than those of *E. caballus* and the third lacks the infundibulum.

A large, partly erupted canine indicates the animal was a male.

The second premolar (Pl. VI, fig. 1) is short and blunt. The metaconid and metastylid are nearly equal in size and are connected with the protoconid by means of a narrow, deflected commissure that originates from the metaconid. The entoconid is large, sub-oval, and closely approaches the metastylid. There is a small pli caballinid and opposing pli hypoconid but no parastylid.

The third premolar nearly equals the second in length. There is a short, blunt paralophid. The metaconid is directed anteriorly, is initially narrow, and enlarged internally near the end, the external border remaining nearly straight. The metastylid is enlarged both internally and externally near its end and extends farther inward than does the metaconid. The intervening valley is shallow and broad anteroposteriorly. The entoconid is nearly square with a suggestion of a spur anteroexternally. The external borders of the protoconid and hypoconid are concave. There is a short median valley with a small

pli caballinid and an opposed pli hypoconid.

The fourth premolar is smaller than the third and has a small inflection on the anterior border of the commissure; the ectoloph is narrower transversely. Otherwise, the two teeth are similar.

The molars in *E. midlandensis* have the metaconid and metastylid attached by means of a long narrow commissure and a shortened median valley just as in the premolars. In most species of the Equini it is possible to distinguish premolars from molars by means of the longer commissure and shorter median valley of the premolars. Here the molars and premolars are strikingly alike, differing principally in size alone. In this respect *E. midlandensis* has progressed farthest, or is most advanced of all the species of *Equus,* in what might be termed premolarization of the molars.

Skeletal material.—A metatarsal, T.M. no. 998–3 (Pl. V, fig. 2), found with the type jaws and upper teeth may belong to the same animal. Is is a little longer and considerably more slender than that of *E. caballus caballus,* T.M. no. 892–11.

Skeletal material from the J. O. Baggett ranch, Odessa, Texas, appears to belong to *E. midlandensis.* There were several upper and lower teeth with probably associated skeletal elements in the assemblage. The bones may have belonged to a single individual for several of them are paired and there are no duplicates. There also are three deeply worn cheek teeth, probably of *E. caballus laurentius,* in the collection. Thus, it is possible the limb bones could belong to that species. They compare closely in size and proportion with those of the pony horse, but since both upper and lower teeth of *E. midlandensis* are represented, along with the paired limb bones, it seems more probable that the material belonged to a single individual of that species, and the teeth of *E. c. laurentius* are accidentally included.

The radius, B.E.G. no. 30722 (Pl. VI, fig. 2), from the Baggett ranch site agrees closely with that of *E. c. laurentius* in size and proportion.

It is considerably smaller and shorter than that of *E. c. caballus* and has a nearly straight shaft, whereas those of both *E. c. caballus* and the Texas pony are inwardly curved in the lateral plane. The median part of the frontal surface of the distal end of the radius is occupied by a broad, shallow valley in *E. midlandensis,* whereas in the other the innermost of two rugosities occupies this position.

The metacarpal, B.E.G. no. 30722 (Pl. VI, fig. 3), agrees closely with that of the Texas pony. Only the distal two-thirds of the metatarsal is preserved (Pl. VII, fig. 3). It does not differ from that of T.M. no. 998–3.

The astragalus (Pl. VI, fig. 4) is considerably smaller than that of *E. c. caballus.* The phalanges of the hind foot likewise are smaller, shorter, and more slender.

Table 8. Measurements of Equus midlandensis *Quinn, new species.*

Upper dentition, T.M. no. 998–

No.		AP	TR	CL	PL	PW
998–	P. 2	38	29	60	10.3	5.7
998–25	P. 3	32.3	29.0	87–	15.8	5.0
998–24	P. 4	31	30.0	87.0	16.0	5.5
998–26	M. 1	29	.....	82	15.5	5.0

Lower dentition, T.M. no. 998–1

				MM
I. 1	6.0	19.8	.....	.....
I. 2	10.0	19.8	.....	.....
I. 3	11.2	20	.....	.....
P. 2	35.4	15.6	69*	17.0
*measurement from opposite jaw				
P. 3	31.4	18.4	91*	19.0
*measurement from opposite jaw				
P. 4	31.0	17.4	102	17.0
M. 1	30.4	15.5	92	16.5
M. 2*	30.3	15.9	83	14.6
*measurements from opposite jaw				

Depth of ramus, middle of P. 4: 101.5 mm

Metatarsal, T.M. no. 998–3

Length: 287 mm
Proximal width: 55.5 mm
Mid-shaft width: 37mm
Distal width: 52 mm

B.E.G. no. 30722

Radius—length: 340 mm
mid-shaft width: 43 mm
distal width: 66 mm
Metacarpal—length: 234 mm
proximal width: 52 mm
mid-shaft width: 36 mm
distal width: 49 mm
metatarsal—mid-shaft width: 39 mm
distal width: 51.5 mm
Phalanx one—length: 92 mm
proximal width: 55 mm
mid-shaft width: 34 mm
(distal end damaged)
Phalanx two—length: 49 mm
proximal width: 54 mm
distal width: 48 mm
Ungual phalanx—width: 77 mm
length on anterior surface from articulation to tip: 55 mm; width: 74 mm

EQUUS PACIFICUS Leidy, 1868

Equus pacificus Leidy, of Gidley, 1901, Bull., Amer. Mus. Nat. Hist., vol. 14, pp. 116–118, fig. 11.

The type of *E. pacificus* was never figured, and Gidley's referred teeth may or may not belong to the species. Material from the terraces of the Brazos River, an upper third or fourth premolar (B.E.G. no. 31041–139) and a lower first or second molar (B.E.G. no. 45133–6), represents the same form as the Oregon material. This horse, insofar as the upper teeth are concerned, is not greatly different from *E. caballus* except possibly in size.

Table 9. Measurements of Equus pacificus *Leidy*

B.E.G. no. 31041–139

	AP	TR	CL	PL	PW
P. 3 or 4	35.0	30.3	82	16.5	5.2

B.E.G. no. 35133–6

				MM
M. 1 or 2	30.5	19.0	67.0	18.0

Genus ASINUS Frisch, 1775

Pl. II, figs. 1, 2; Pl. III, figs. 3–9

Type.—*Asinus domesticus* (Linnaeus).

Range.—Late Miocene? to Recent.

Distribution. — North America, Old World, Recent in Africa.

Diagnosis. — Upper permanent teeth with square outline, small fossettes, protocones shorter than in *Onager* and teeth less hypsodont; lower permanent dentition, metaconid tends to be deflected inward, then forward, metastylid deflected and short tending to be nearly rounded; intervening valley V-shaped as in *Hippotigris* but less deeply so, no parastylid, pli caballinid present, hypoconulid prominent and with a hypostylid, median valley of molars not protruding between re-entrants of the flexids (except in very early stage of wear) ; lower milk dentition with parastylids and hypostylids weak or absent; metatarsals short and stout but less so than in *Equus.*

ASINUS CONVERSIDENS (Owen) 1869

Pl. III, figs. 3–9

Equus conversidens Owen, 1869, Phil. Trans. Royal Soc. London, vol. 159, p. 563, pl. 61, fig. 1.

Asinus conversidens (Owen), Quinn, 1955b, *in* The Midland discovery, pp. 117–118.

Type.—Maxillaries and part of palate (Inst. de Geol. no. 403), from the Valley of Mexico; late Pleistocene, exact stratigraphic position unknown.

Range.—Sangamon interglacial? to late Wisconsin.

Distribution.—Texas to Arizona and Mexico.

Description.—An upper left M.2 (T.M. no. 998–8, Pl. III, fig. 7) agrees closely in size and configuration with that of the type of *A. conversidens* figured by Hibbard (1955a, p. 58, fig. 3).

Two lower teeth—P.4 (T.M. no. 998–9) and M.2 (T.M. no. 998–10), Scharbauer site, Midland, Texas (Pl. III, figs. 9 and 8 respectively)—are considerably smaller than materials[6] referred to *A. conversidens* by Hibbard (1955a, p. 53, fig. 2B). The teeth (T.M. no. 998) have rounded metaconids as in *A. africanus* (Stehlin and Graziosi, 1935, p. 8, fig. 6A), but the metastylids are more like those of *Onager* than those of *A. africanus* or *A. somaliensis.*

An anterior first phalanx (T.M. no. 937–227), a posterior first phalanx (T.M. no. 937–228), and a second phalanx (T.M no. 937–229) (Pl. III, figs. 3–5) agree closely with those of Recent *Asinus,* as does astragalus T. M. no. 937–185 (Pl. III, fig.

[6] Referred teeth do not agree in size with the uppers figured and seem loo long to belong to *A. conversidens* (p. 17, footnote).

6), Blackwater Draw, Portales, New Mexico. There are no metacarpals or metatarsals referable to *Asinus* in the Texas collections. Skinner (1942, p. 170) referred material to *A. conversidens.* This material includes a metacarpal (not figured), length 212.7 mm. A third metacarpal, figured by Stehlin and Graziosi (1935, table 2, fig. 2), of *A. somaliensis* measures approximately 205 mm. The metacarpal of *O. altidens* (Pl. VII, fig. 1) has a length of 247 mm. A metacarpal referred to *O. lambei* (p. 14) has a length of 215 mm. A metacarpal of *Onager* (= *E. (H.) hemionus*) (Stehlin and Graziosi, 1935, table 2, fig. 3) has a length of approximately 222 mm. Figures for height of crown of M.1 of *A. conversidens* (Hibbard, 1955a, p. 56, table 1) are approximately 62.3 mm and indicate pronounced hypsodonty. By the time M.3 has begun to receive wear, M.1 is shortened by about 20 mm. M.3 of the type is not greatly worn, as indicated by the open posterior border of the postfossettes. M.1 was therefore initially approximately 80 mm long. A first molar of *A. a. somalicus,* Laperung, Br. Somaliland (C.N.H.M. no. 1429), unerupted, has crown height 65.0 mm, enamel deposition not ended. A domestic ass (C.N.H.M. no. 42715) has both M.1 and M.2 in use but roots not fully formed, with heights 73.6 and 75.0 mm, respectively. *A. conversidens* seems to exceed Recent *Asinus* both in length of metapodials and hypsodonty but on the whole appears more closely related to *Asinus* than to *Onager.*

Discussion.—The available evidence concerning the relationship of *A. conversidens* is not conclusive. *A. conversidens* was referred to *Asinus* (Quinn, 1955b) under the assumption that the Asiatic asses belonged with *Asinus.* Subsequently it became necessary to consider the Asiatic asses as generically distinct from *Asinus* **(pp. 10–11).**

Materials of *A. conversidens* from Portales, New Mexico, and Midland, Texas, appear identical with those of *A. conversidens* from Arizona (Skinner, 1942) and are of later than Sangamon age. Materials from the Valley of Mexico, according to Hibbard (1955a), belong in the Upper Becerra formation and represent "the closing phase of the Sangamon and [beginning of?] Wisconsin subages." Materials from the terraces and Coastal Plain of Texas are from deposits seemingly of Sangamon age. These contain specimens which appear referable to *A. conversidens,* but they also contain teeth of larger and smaller species of *Asinus.* The smaller species may belong to *A. francisi* (Hay) but none of the specimens was sufficiently complete or unworn to be certainly assigned to *A. francisi.*

It will be necessary to make a much more exhaustive study of the available materials of *Asinus* before it can be certainly demonstrated that the terrace and Coastal Plain deposits contain remains of *A. conversidens.*

FAUNAS

Sangamon fauna.—The faunas of the terraces and Coastal Plain have not been studied in detail. Stovall and McAnulty (1950) described a new species, *Megalonyx brachycephalus,* from Trinity River terraces and presented the following list of fauna from the Boatwright gravel pit, Henderson County (B.E.G. no. 30907; nos. 30726 and 30787 also used for this locality).

Mammut americanum
Mammutus columbi
Onager complicatus
**Onager fraternus*
Bison sp.
Odocoileus cf. *virginianus*
Camelops sp.
Tanupoloma sp.
Platygonus sp.
Canis sp.
Holmesina sp.
Megalonyx brachycephalus
Didelphis
Spilogale sp.
Castor sp.
Graptemys sp.
Terrapene sp.
Bird
**Homo,* femur and stone images (Sellards, 1944, pp. 23–29; 1952, pp. 99–105)

* Added by present author.

In addition, Stovall and McAnulty listed *Bison occidentalis* as an isolated find. It probably does not belong with the above fauna but with later sub-Wisconsin deposits (Quinn, 1957a). They also listed (ibid.) from Ingleside pit, San Patricio County, Texas, 21 genera not found in the Trinity River terraces. These are:

Cervus
Capromeryx
Canis
Smilodon
Felis
Ursus
Cynomys
Geomys
Lepus
Reithodontomys
Mylodon
Nothotherium
Dasypus
Boreostracon
Testudo
Cistudo
Trionyx
Amphisbina
Alligator
Lepisosteus
Amiurus
**Homo,* artifacts (Sellards, 1940, pp. 1651–1653; *added by present author)

Sellards (1940, p. 1652, table 3) listed 12 genera from the Ingleside site and 20 genera from Berclair terrace.

Stovall and McAnulty suggested that discrepancy in the faunal lists indicates difference in age between the Trinity River terraces and the Ingleside pit. It seems more likely that the difference is a reflection of the differing nature of the two deposits. The terrace materials are fluvial gravel and sand. Ingleside pit is a pond or basin deposit and may have been a watering place.

Post-Sangamon fauna.—The Tahoka formation, according to Evans and Meade (1945, pp. 495–498), is the oldest deposit definitely recognized within the modern playa basins. The deposit occupies basins presumably similar to those of the Blanco and Tule formations (Evans and Meade, 1945). The materials in a number of basins are similar and represent deposition during a humid stage. Subsequent events included two arid and two humid substages, according to Evans and Meade (1945, p. 449). They concluded that the Tahoka formation is of Wisconsin age. Seemingly it is of early Wisconsin age. This is indicated by the subsequent history cited by Evans and Meade.

Evans and Meade considered the Tahoka clay formation to be correlative of the Portales, New Mexico, deposits (pp. 21, 24) containing artifacts described by Sellards (1940) and others. Horses found in association with human remains near Midland (Quinn, 1955b) indicate unity with the Portales fauna, but there is not adequate evidence, faunal or otherwise, to definitely establish contemporaneity of the Portales and Tahoka deposits (table 10).

Table 10. Tahoka, Portales, and Midland faunas.

TAHOKA	PORTALES	MIDLAND
Bison antiquus	*Bison antiquus?*	*Bison*
		Canis dirus
		Camelops
		Odocoileus
		Capromeryx?
		Platygonus alemonii
		Sylvolagus
		Lepus
Equus?	*Asinus conversidens*	*Asinus conversidens*
	Equus caballus caballus	*Equus caballus caballus*
	Equus caballus laurentius	*Equus caballus laurentius*
	Equus midlandensis	*Equus midlandensis*
Mammoth	*Mammutus columbi*	*Cynomys ludovicianus*
		Neotoma
		Citellus

SUMMARY AND CONCLUSIONS

Teeth and bones of horses from Texas substantiate the concept of distinct, large-mammal assemblages belonging to different stages of the Pleistocene. It is suggested that large mammals, for example, horses, were unable to live through the climaxes of the glacial stages. They did not retreat before oncoming glaciers but were decimated by inclement conditions over nearly the whole of continental North America with the possible exception of extreme southeastern and western North America, Mexico, and Central America, which, together with the Old World, may have furnished replacement species after glacial climaxes had passed.

Horses of the genus *Hippotigris* (= *Plesippus*) appear to be restricted between the Nebraskan-Kansan climaxes; *Onager semiplicatus* **and** *Equus scotti–Equus niobrarensis,* between the Kansan-Illinoian climaxes; *Equus pacificus* (and others), *Asinus conversidens?* (and others), *Onager fraternus, O. complicatus, O. lambei, O. altidens, O. littoralis,* and *Bison,* post-Illinoian climax. *Equus c. laurentius* is found in post-Illinoian sediments and seemingly survived through the Wisconsin stage, where it is found with remains of *Equus caballus caballus, Equus midlandensis,* and *Asinus conversidens.*

The horses of the Sangamon-age fauna represent three genera: *Equus, Asinus,* and *Onager.* The latter has formerly been treated as *Equus (Hemionus)* but *Hemionus* is antedated by *Onager* Brisson, 1762. Therefore, the earlier name is applied.

Equus caballus is recognized. There are two subspecies—*E. caballus caballus,* in no way different from the modern draft horse insofar as the materials preserved are concerned, and *E. caballus laurentius,* a pony-type caballine horse very much like the "Texas pony" of Gidley.

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Plates I–VII

PLATE I

Onager altidens Quinn, new species, type
(p. 16)

All figures approximately natural size

FIGURES—

1. Upper right P.2–4, section of unerupted premolars. B.E.G. no. 31186–36.
2. Upper right D.P.2–M.2, occlusal view. B.E.G. no. 31186–36.
3. Lower right P.2–P.4, section of unerupted premolars. B.E.G. no. 31186–35, type.
4. Lower right D.P.3–M.2, occlusal view. B.E.G. no. 31186–35, type (figs. 3 and 4 of same specimen).
5. Symphysis of lower jaw with I.1 and 2 (unerupted), D.I.2, occlusal view. B.E.G. no. 31186–35, type. (Figs. 3–5 of same specimen. The alveolus of D.P.2 has been filled with plaster but its anterior border can be seen on figs. 4 and 5.)

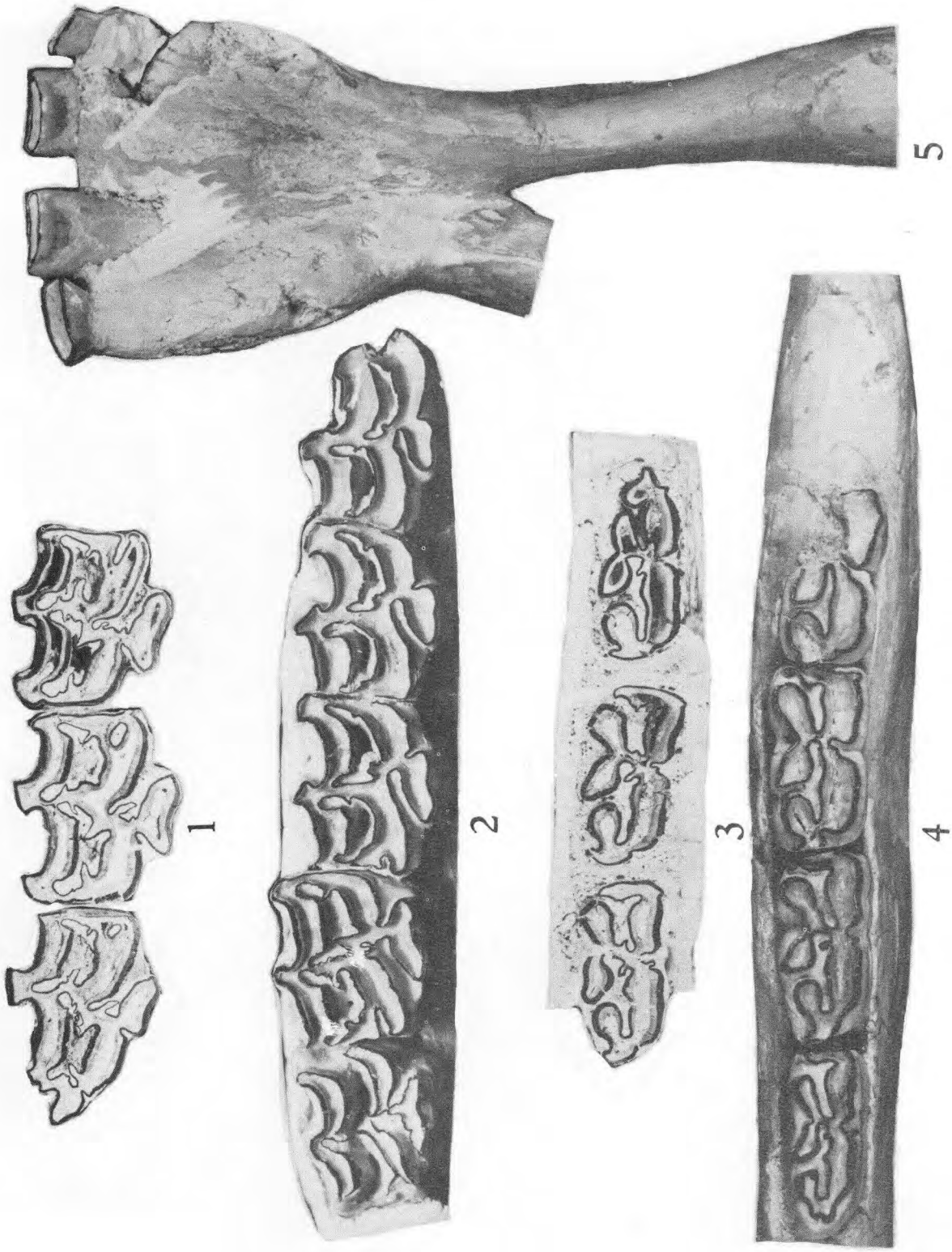
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PLATE II

All figures approximately natural size

FIGURES— PAGE

1,2. *Asinus somaliensis* Frisch 27
1. Upper left P.2–M.3, occlusal view. C.M.N.H. no. 1427.
2. Lower right P.2–M.3, occlusal view (same individual as fig. 1.)

3. *Equus midlandensis* Quinn, new species 24
Upper right P.2 (reversed), upper left P.3–M.1, occlusal view. T.M. nos. 998–, 998–25, 998–24, 998–26, respectively, type.

4. *Onager lambei* (Hay) 14
Upper left P.2–M.3, occlusal view. B.E.G. no. 31058–2 (skull figured in Sellards, 1940, pl. 2, fig. 2).

5. *Onager semiplicatus* (Cope) 12
Upper right P.2–M.3, occlusal view. T.M. no. 276.

PLATE III

All figures natural size

FIGURES— PAGE

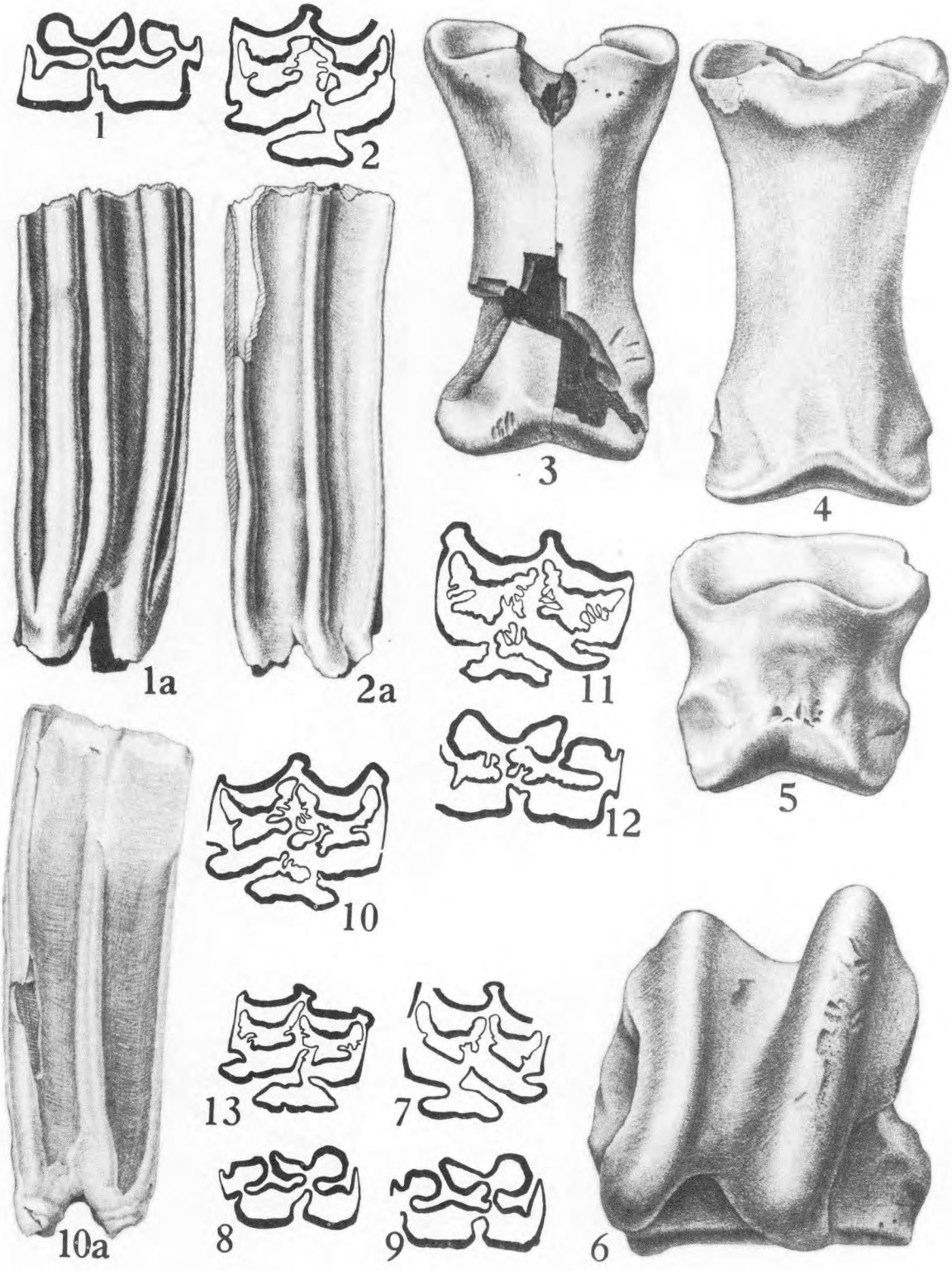
1,2. *Equus caballus laurentius* (Hay) 24
1, la. Lower left M.1, occlusal and external views. T.M. no, 937–252.
2,2a. Upper right M.1, occlusal and external views. T.M. no. 937–191.

3–9. *Asinus conversidens* (Owen) 27
3. Phalanx I, manus, anterior view. T.M. no. 937–227.
4. Phalanx I, pes, anterior view. T.M. no. 937–228.
5. Phalanx II, pes, anterior view. T.M. no. 937–229.
6. Astragalus, proximal view. T.M. no. 937–185.
7. Upper left M.2, occlusal view. T.M. no. 998–8.
8. Lower right M.2, occlusal view. T.M. no. 998–10.
9. Lower right P.4, occlusal view. T.M. no. 998–9.

10, l0a. *Onager fraternus* (Leidy) 20
M.I, occlusal and external views. B.E.G. no. 30907–46.

11, 12. *Onager (Hesperhippus) complicates* (Leidy) 20
11. Upper left M.2, occlusal view. B.E.G. no. 30907–24.
12. Lower right P.4?, occlusal view. B.E.G. no. 30907–8.

13. *Onager littoralis* (Hay) 13
Upper right P.3?, occlusal view. B.E.G. no. 31186–13.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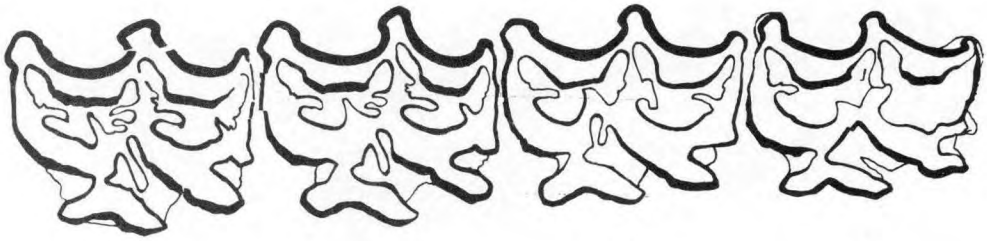

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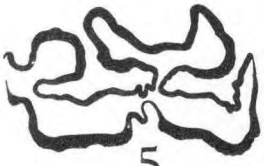

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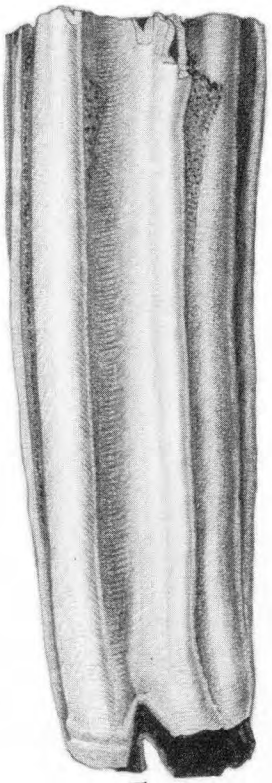

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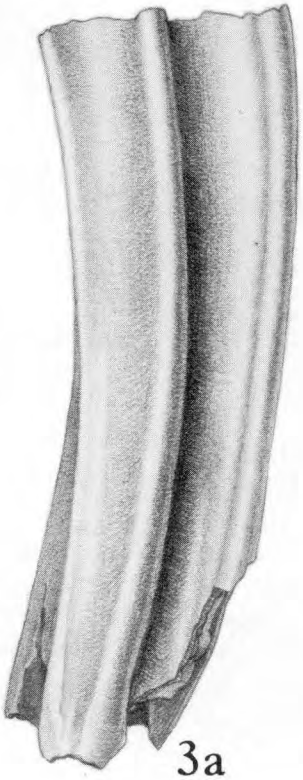

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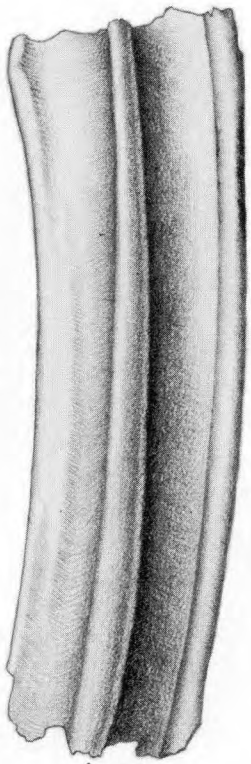

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PLATE IV

Equus caballus caballus Linnaeus
(p. 21)

All figures natural size

FIGURES—

1. Upper left P.3, sectioned 20 mm below tip of mesostyle. T.M. no. 937–170.
2. Upper left P.4, sectioned 20 mm below tip of mesostyle. T.M. no. 937–171.
3, 3a. Upper left M.1, occlusal and external views. T.M. no. 937–172,
4, 4a. Upper left M.2, occlusal and external views. T.M. no. 937–173 (believed to belong to one individual).
5, 5a. Right lower P.3 or 4, occlusal and internal views. T.M. no. 937–169.
6. Right lower P.2, occlusal view. T.M. no. 937–192.

PLATE V

All figures two-thirds natural size

FIGURES— PAGE

1. *Equus caballus caballus* Linnaeus 21
   Left metatarsal. T.M. no. 892–11.
2. *Equus midlandensis* Quinn, new species 24
   Right metatarsal. T.M. no. 998–3.
3. *Onager altidens* Quinn, new species 16
   Right metatarsal. B.E.G. no. 31186–7.
4. *Onager fraternus* (Leidy) 20
   Right metatarsal. B.E.G. no. 30907–6.


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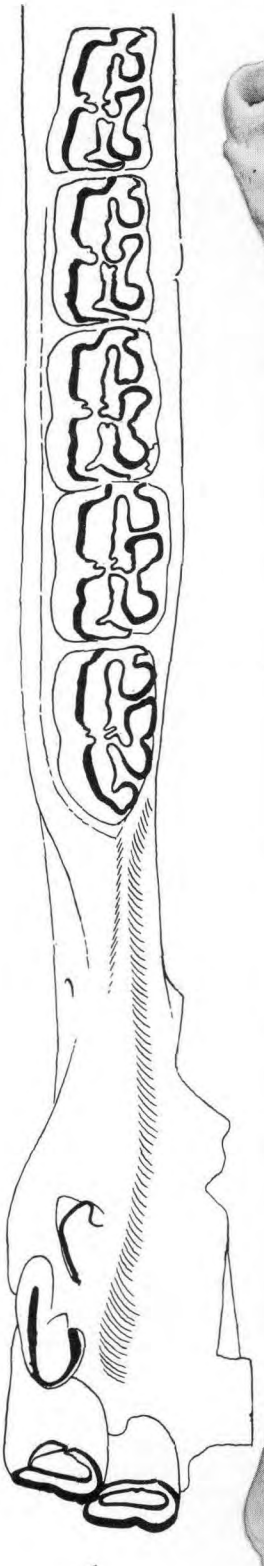

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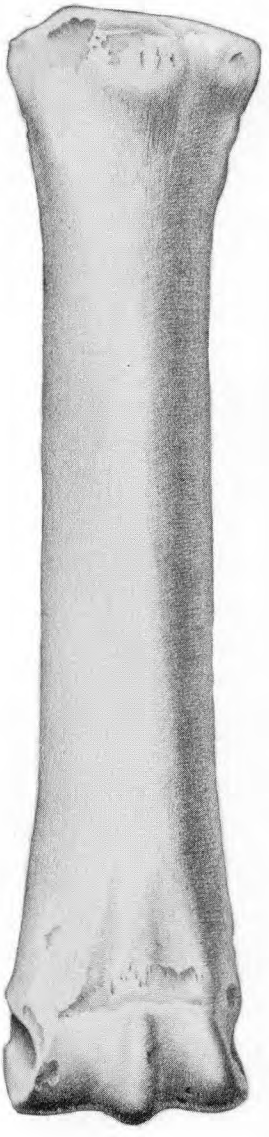

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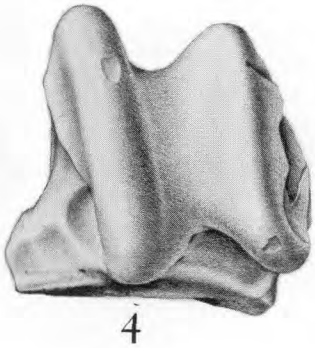

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PLATE VI

Equus midlandensis Quinn, new species
(p. 24)

All figures two-thirds natural size

FIGURES—

1. Lower left jaw, occlusal view, M.2 drawn from right jaw. T.M. no. 998–1, type.
2. Right radius. B.E.G. no. 30722.
3. Right metacarpal. B.E.G. no. 30722.
4. Right astragalus. B.E.G. no. 30722.

PLATE VII

All figures two-thirds natural size

FIGURES— PAGE

1, 2. *Onager altidens* Quinn, new species 16
1. Right metacarpal. B.E.G. no. 31186–3, type?
2. Right tibia. B.E.G. no. 31186–10, type? (proximal end restored from left tibia).

3. *Equus midlandensis* Quinn, new species 24
Right? pes. B.E.G. no. 30722.

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Index