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**CALIPPUS REGULUS (MAMMALIA: EQUIDAE) IN THE  
PENNY CREEK LOCAL FAUNA (CLARENDONIAN),  
WEBSTER COUNTY, NEBRASKA**

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Well-preserved teeth and jaw fragments of a very small but extremely hypsodont horse referable to *Calippus regulus* are described from the Penny Creek Local Fauna of Early Clarendonian age in south-central Nebraska. The species has previously been reported only from Texas, with possible occurrences in Oklahoma and Florida. Specimens from the Late Clarendonian of northern Nebraska previously referred to *Calippus placidus* appear to be similar to the Penny Creek specimens. *C. placidus* is probably confined to older, Late Barstovian, rocks.

† † †

**INTRODUCTION**

Among the numerous vertebrate fossils collected by J. L. Fitzgibbon and his students during the 1984 field season is a well-preserved upper premolar of a very hypsodont, very small horse. Additional specimens obtained in 1985, along with materials collected nearby more than a decade ago, constitute the first evidence of the diminutive equid *Calippus regulus* to be recognized in the Northern or Central Great Plains. Because of their paleobiogeographical significance, we are therefore placing the specimens on record.

The genus *Calippus* includes some of the least-known taxa of Late Neogene North American horses. Although the genotypic species, *C. placidus*, is based on specimens collected in northern Nebraska (Leidy, 1869) only a few additional isolated teeth have been described from Nebraska since Leidy's day (Webb, 1969). Most published information about *Calippus* deals with specimens collected in Texas. Well-preserved dentitions have been described and illustrated from localities in both the Gulf Coastal Plain (Quinn, 1955; Forstén, 1975) and the Texas Panhandle (Johnston, 1937; Webb, 1969).

The published record then, taken at face value, suggests that *Calippus* was primarily a "southern" mammal. A more complex picture emerges, however, when the mostly-undescribed fossil horse collections of the University of Nebraska State Museum (UNSM) are reviewed. *Calippus francisi*, the most primitive species of the genus, is fairly well represented in the Medial Barstovian assemblage from Norden Bridge Quarry (Voorhies, in press), and good samples of its probable descendant, *C. placidus*, have been obtained from two Late Barstovian sites, the Valentine Railway Quarry and Hazard Homestead Quarry (see below).

In contrast, Clarendonian-aged faunas in Nebraska have yielded very few recognizable *Calippus* remains. Besides the Penny Creek fossils reported here and the four teeth from the Minnechaduzza Fauna described by Webb (1969), the record appears to be totally blank.

**GEOGRAPHIC AND GEOLOGIC SETTING**

The fossils described in this report are part of a diverse assemblage of Clarendonian-aged mammalian remains collectively termed the Penny Creek Local Fauna (Turner, 1972). A succession of field parties from the University of Nebraska State Museum (UNSM) prospected the Tertiary sediments exposed in the drainage basin of Penny Creek in southern Webster County, Nebraska, especially in the 1960s and early 1970s. Collections were made at five principal sites which bear the following designations in the UNSM Vertebrate Paleontology locality catalog: Wt 11, Wt 12, Wt 13A, Wt 15B, and Wt 15A (Fig. 1). All except the latter site produce similar fossils and

## U.N.S.M. COLLECTING LOCALITIES NEAR RED CLOUD, WEBSTER COUNTY, NEBRASKA

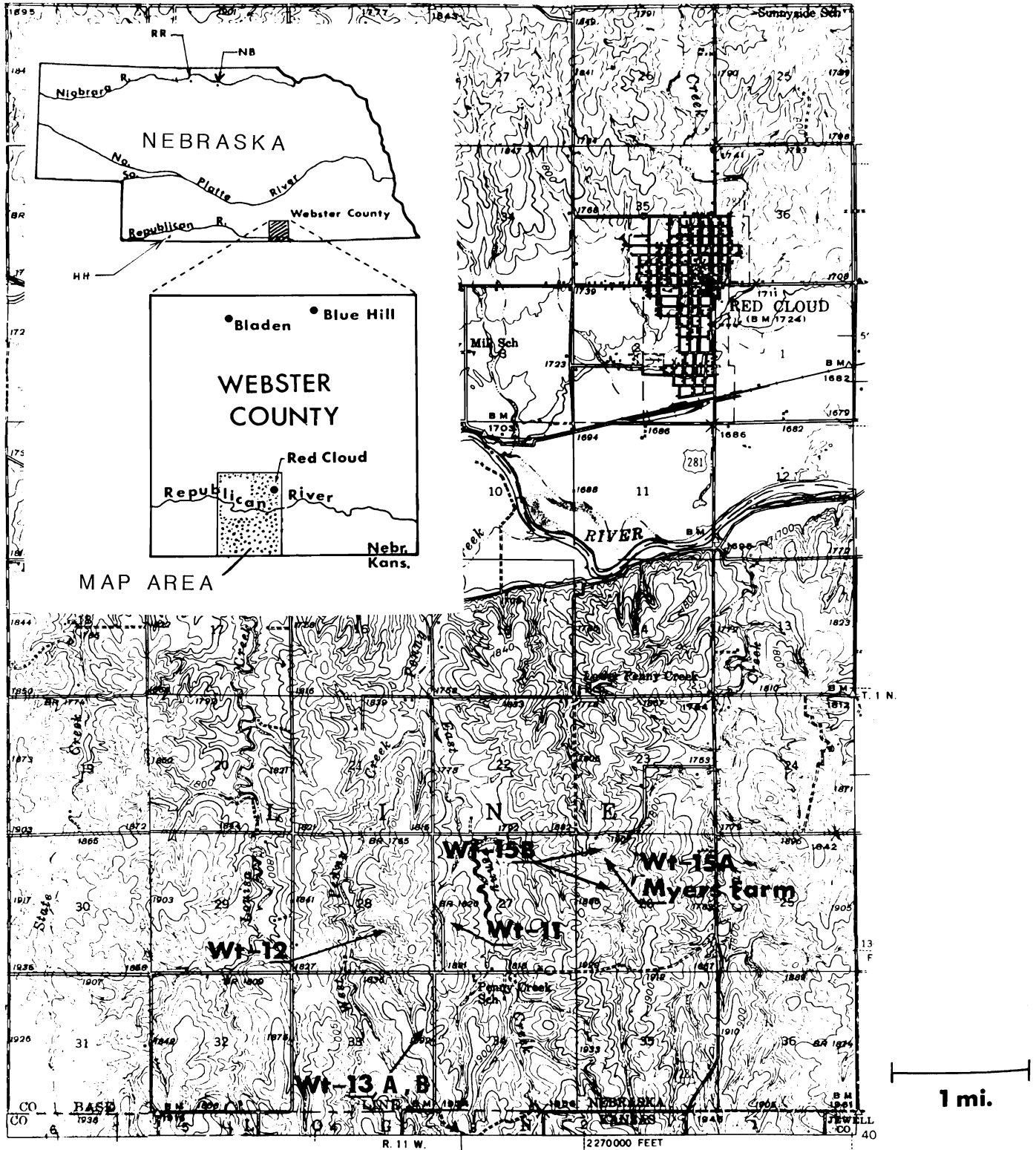


FIGURE 1. Map of a portion of southern Webster County, Nebraska, showing locations of fossil vertebrate sites in Ogallala Group sediments of the Penny Creek area. Horse remains referred to *Calippus regulus* in this paper were collected from Wt 11, Wt 12, Wt 13A and Wt 13B. The location of Valentine Railway Quarry (abbreviated RR), Norden Bridge Quarry (NB), and Hazard Homestead Quarry (HH), which produced the samples of earlier *Calippus* species compared with *C. regulus* in this report, are shown on the Nebraska index map (inset).

constitute the Penny Creek Local Fauna. Wt 15A lies stratigraphically below the Penny Creek localities and produces an older (Late Barstovian) faunal assemblage, the Myers Farm Local Fauna (Corner, 1976; Holman, 1977; Holman and Corner, 1985). A new site (Wt 13B) was discovered near Wt 13A in 1983 and has been excavated annually since then by students from the Red Cloud Community Schools under the supervision of J. L. Fitzgibbon.

The geology of Webster County has been investigated by the United States Geological Survey (Miller et al., 1964), who mapped, as Ogallala Formation, a sequence of unconsolidated deposits of sand, silt, and gravel that crop out south of the Republican River in southern Webster County. The Ogallala locally overlies Cretaceous bedrock and is in turn overlain by Pleistocene alluvium or loess. Ogallala sediments in the Penny Creek drainage are quite fine-grained compared with those seen in typical Ogallala exposures farther west. Miller et al. (1964) performed mechanical grain-size analyses to document a progressive decrease in clast size between Wray County, Colorado, and Webster County, Nebraska.

Corner (1976) studied the Tertiary geology of the Penny Creek area and determined that the lithologic succession within

the Ogallala in this area resembles that documented in the Niobrara River valley in northern Nebraska by Skinner et al. (1968), although the total thickness of the Ogallala (10 m or less) is much less in Webster County. Cross-bedded, fine, quartzose sand and green sandy silt characterizes the basal Ogallala at locality Wt 15A from which the Late Barstovian Myers Farm Fauna was collected. These lithologies are reminiscent of the Crookston Bridge Member of the Valentine Formation in northern Nebraska, which also yields vertebrate assemblages of Late Barstovian age.

Unconformably overlying the fine sand and silt unit exposed by quarrying at site Wt 15A is an Ogallala unit of sharply contrasting lithology. Coarse- to very coarse-grained feldspathic sand characterizes the latter unit which produces a sparse Clarendonian mammalian fauna at locality Wt 15B. Carbonate cement imparts a ledge-forming character to this stratigraphically-higher unit much as it does to the similar-aged Cap Rock Member of the Ash Hollow Formation which overlies the Valentine Formation in the Niobrara Valley (Skinner et al., 1968). Turner (1972) also reports granitic sand and gravel at the remaining Penny Creek localities (Wt 11, 12, and 13). Cross-bedding characteristic of fluvial environments (Fig. 2) is present at all localities.



**FIGURE 2.** Excavating fossils at Penny Creek locality Wt 13B. Isolated bones and teeth, occasionally jaws, of Early Clarendonian vertebrates occur as clasts in the unconsolidated, cross-bedded Ogallala sand and gravel exposed at this locality. Students from the Red Cloud (NE) Community Schools have been quarrying this site, under the supervision of J. L. Fitzgibbon and R. G. Corner, since 1983. View is toward the north.

The geographic position of the Penny Creek quarries makes them especially interesting paleontologically. They are the easternmost fossil excavations developed in the Ogallala in southern Nebraska or Kansas, and are among the easternmost Late Tertiary mammalian assemblages known from anywhere on the Great Plains.

### PALEONTOLOGY

Several specimens of *?Tapirus johnsoni* from the Penny Creek Local Fauna are listed by Schultz et al. (1975: 11), but the assemblage is otherwise unpublished. The following brief comments on the Fauna are therefore offered to place the present study in context. Mary Ann Turner described the suite of Penny Creek specimens then available, in a 1972 M.S. thesis at the University of Nebraska. She assigned a Clarendonian age to the Fauna, a conclusion with which we are in full agreement. Collections made since Turner completed her study only reinforce this age assessment.

During the current study we have examined the entire collection of equid fossils from Penny Creek (now numbering about 200 specimens, mostly isolated teeth and postcranial elements, but also including a few complete dentaries and associated tooththrows). The following taxa are present: *Hypohippus* cf. *affinis*, *Merychippus* sp., *Neohipparion* cf. *coloradense*, *Pseudhipparion retrusum*, *Calippus regulus*, and *Pliohippus supremus*.

The Penny Creek horses most closely resemble those in the Early Clarendonian Burge Fauna of northern Nebraska (McGrew, 1938; Webb, 1969). Although the Webster County specimens are much less complete than those available from the prolific Burge quarries, the identity of the horses is virtually complete at the generic level. Only *Calippus* has not been reported from the Burge Fauna. Most Penny Creek taxa also appear to be specifically identical with their Burge counterparts as well. The occurrence of characteristic *Pseudhipparion retrusum* jaws and teeth at Penny Creek is especially significant in correlation. This taxon is the most abundant horse in the Burge Quarry sample but is not known from earlier or later faunas. It is replaced by the smaller and more hypsodont *P. gratum* in later Clarendonian faunas (Webb, 1969).

Class MAMMALIA

Order PERISSODACTYLA

Family Equidae

Subfamily Equinae

*Calippus regulus* Johnston, 1937

**Diagnosis** (from Forstén, 1975: 44): "Very small, very hypsodont. Protocone connected from summit down, transversely oblique, not connecting to hypocone. Plication count low, incipient pli caballin in premolars disappears with wear, none in molars. Hypoconal lake [hypoglyph] closes early and soon obliterates completely. Lower cheek teeth with short metaconid-metastylid column; metaconid usually longer than metastylid. Premolars with shallow labial groove and long commissure, molars with deep labial groove."

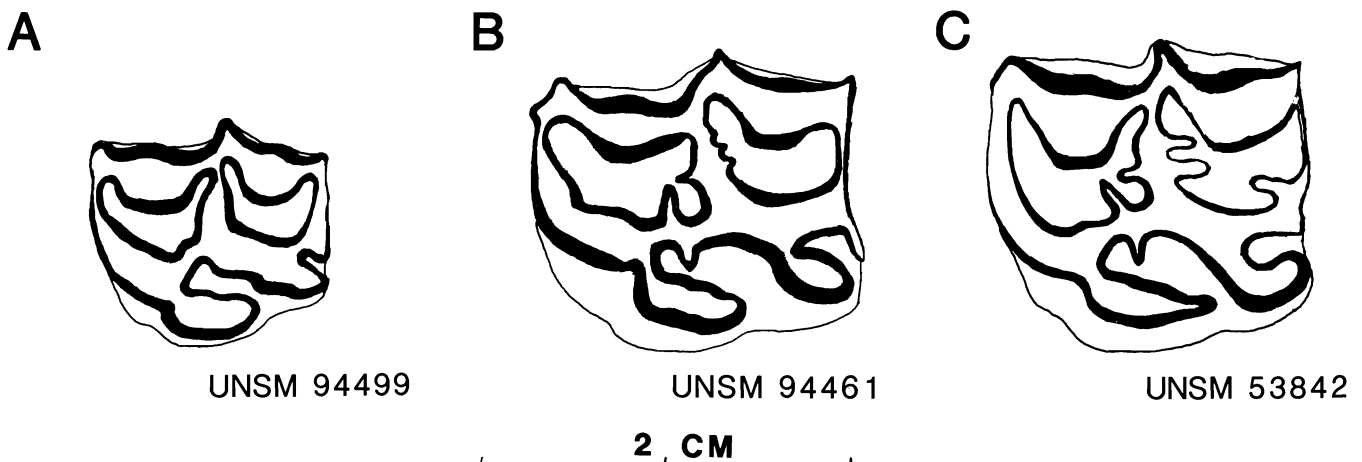


FIGURE 3. Upper premolars of three species of *Calippus* from Neogene deposits in Nebraska.

- A. Left P<sup>4</sup> referred to *Calippus regulus*, Penny Creek Local Fauna, Webster County, Nebraska, Early Clarendonian.  
 B. Left P<sup>3</sup> referred to *Calippus placidus*, Hazard Homestead Quarry, Driftwood Creek, Hitchcock County, Nebraska, Late Barstovian.

- C. Left P<sup>3</sup> referred to *Calippus francisi*, Norden Bridge Quarry, Brown County, Nebraska, Medial Barstovian. Crown height is similar in all specimens, mesostyle heights are: A = 33 mm, B = 35 mm, C = 34 mm. Small size and simplification of the enamel pattern are characteristic of the geologically younger species, *C. regulus*.

**Referred Specimens.** From locality Wt 13B: UNSM 94499, LP4/; UNSM 94498, LM2/; UNSM 94497, RM3/; UNSM 94643, L dentary fragment with P/3–M/2; UNSM 94496, LM/1; from locality Wt 13A: UNSM 21108, LP3/; from locality Wt 11: R dentary fragment with P/3–M/2, UNSM 21011, LM/1; from locality Wt 12: UNSM 21016 and 21074, LM/3's.

**Description.** The most informative specimen is UNSM 94499, a moderately worn upper premolar with a mesostyle height of 33.2 (see Table I for measurements). The occlusal pattern is extremely simple (Fig. 3A) with an elongate, obliquely-oriented protocone already broadly connected to the protoselene, a primary characteristic of *Calippus* upper cheek-teeth. The fossette borders lack any trace of plications, nor is there a pli caballin. An open hypoglyph (Webb, 1969) is present, but it would close with another 2 or 3 mm of wear. The styles are weak but increase in prominence toward the base of the tooth. Another upper premolar, UNSM 21108, is more worn than the preceding tooth and has the ectoloph sheared away. It likewise has a strongly connected protocone and lacks any trace of enamel plication. No hypoglyph or hypostylar fossette is present.

UNSM 94498, an upper molar, is also about half worn (mesostyle height 22 mm) and lacks any plications save a minute (0.5 mm long) remnant of a pli postfossette. A third upper molar, UNSM 94497, also has a very simple enamel pattern but bears minute traces of a pli caballin and pli pre-fossette. Its hypoglyph is about to be obliterated by wear.

The best-preserved lower dentition is a dentary fragment with moderately worn P/3–M/2 (UNSM 21030, see Fig. 4A). The occlusal patterns of P/3 and P/4 are very similar and are extremely simple; the metaconid and metastylid are both well rounded and closely appressed. The metastylid is only slightly smaller than the metaconid in P/3, more reduced in P/4. The metaconid–metastylid column connects to a narrow stalk or isthmus which is oriented anterolingually. Parastylids are present on both premolars. The molars are also very simple in pattern but differ from the premolars in lacking isthmuses and in having much-reduced metastylids. Another lower jaw fragment (UNSM 94643) also bears P/3–M/2 but in a much more advanced stage of wear. Reduced metastylids and the presence of parastylids characterize the teeth.

The least-worn lower cheektooth available in the Penny Creek sample is UNSM 21011, which has a metaconid height of 43 mm. The hypsodonty index (metaconid height divided by basal length) of this slightly worn tooth is 3.38, slightly exceeding the mean value calculated for Texas *Calippus regulus* by Forstén (1975: Table 23). The tooth bears a strong parastylid and lacks plications in the flexids. UNSM 94496 is a much more-worn example of a similar tooth; it shows a reduced and attenuated metastylid forming part of the enamel pattern to near the crown base.

Two lower third molars complete the sample. Like the anterior molars, they have reduced metastylids, prominent parastylids, deep ectoflexids and no trace of plications.

**Comparisons.** The small size, great hypsodonty, and unadorned enamel patterns of the specimens leave no doubt that the Penny Creek material is correctly referred to the genus *Calippus*. Identification of the species represented is more problematical. We are assigning our specimens to *C. regulus* because of their close resemblance in size (see Fig. 5 and 6) and morphology to the extensive samples of the latter species described by Forstén (1975) from Clarendonian deposits in Texas. The type specimen of *C. regulus* is from the Clarendon Fauna (Johnston, 1937). Topotypic specimens have been figured by Stirton (1940, Figs. 41 and 42) and Quinn (1955: Plate 5, Fig. 20). Webb (1969: 81) provided measurements of 30 upper molars from the type fauna (see Fig. 5, this paper).

A closely similar if not identical species of *Calippus* was described from the Lapara Creek Fauna by Quinn (1955) under the names *C. anatinus* and *C. optimus*. Webb (1969), quite properly in our opinion, synonymized these two "species" (and a third, *Astrohippus curvitalis*<sup>6</sup>Quinn, also from Lapara Creek). Webb regarded the Lapara Creek sample (called *C. anatinus*) as representing an important stage in the evolution of *Calippus*, namely an Early Clarendonian link between *C. francisi* of the Late Barstovian and the Late Clarendonian *C. regulus* (in Texas) and *C. placidus* (in Nebraska). Forstén (1975: 44–46), although she pointed out a small difference in size and

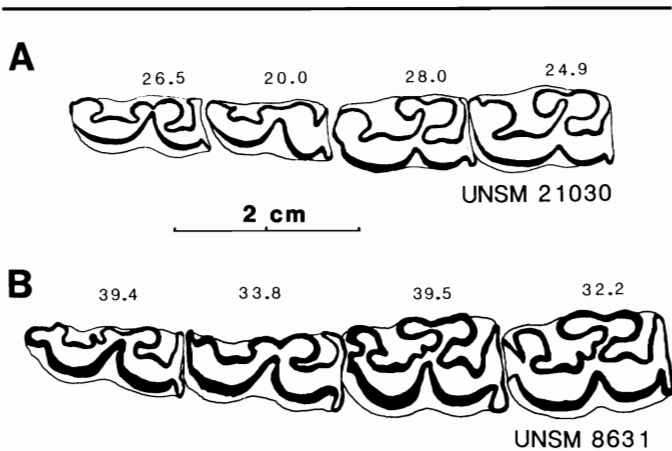


FIGURE 4. Lower tooththrows of two species of *Calippus* from Neogene deposits in Nebraska.  
 A. LP/3–M/2 referred to *C. regulus*, Penny Creek Local Fauna, Webster County, Nebraska, Early Clarendonian.  
 B. RP/3–M/2 (reversed in drawing) referred to *Calippus placidus* Valentine Railway Quarry A, Cherry County, Nebraska, Late Barstovian. Number above each tooth signifies height of metaconid in mm.

hypsodonty between the Lapara Creek and Clarendon samples, considered the overlap between them so great as to justify synonymizing *C. anatinus* under *C. regulus*. We tentatively follow her in this even though we suspect that it may eventually be possible to provide separate diagnoses for the Lapara Creek and Clarendon samples.

In contrast with the wealth of material from Texas, Clarendonian populations of *Calippus* in Nebraska are very poorly known. Webb (1969) referred four isolated cheekteeth from the Late Clarendonian Minnechaduzza Fauna to the genotypic species, *Calippus placidus* (Leidy). The teeth are somewhat larger than, but otherwise similar to, the Penny Creek specimens. As noted by Webb, previous authors (e.g. Stirton, 1940: 188) had postulated that Leidy's specimens came from the Valentine Formation and were of Late Barstovian age. Webb proposed, instead, that the type specimen was actually derived from a higher level (the Minnechaduzza Fauna) correlative with the Clarendon of Texas.

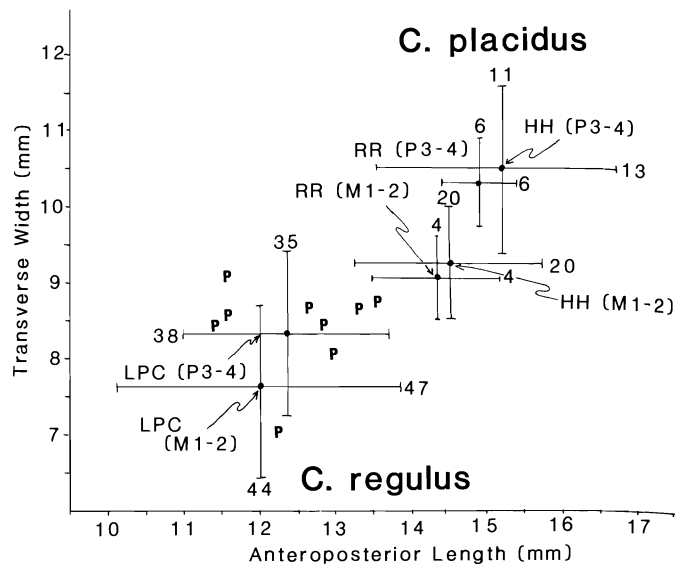


FIGURE 6. Dimensions of *Calippus* lower cheekteeth from Nebraska and Texas. See Figure 5 for further explanation.

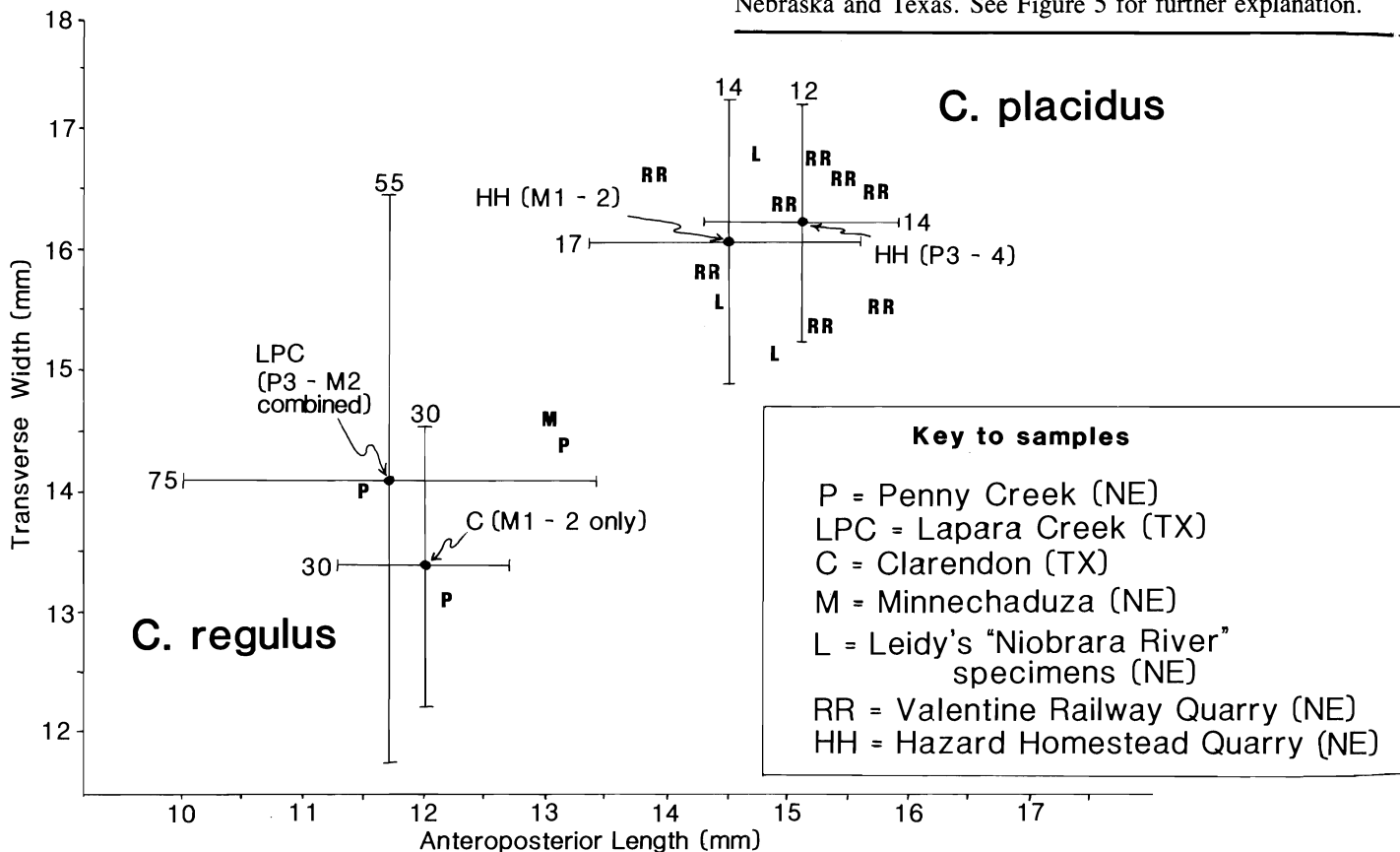


FIGURE 5. Dimensions of *Calippus* upper cheekteeth from Nebraska and Texas. Dots indicate sample means, bars extend 2 standard deviations on either side of mean, numbers beside bars give sample size, letters represent individual teeth. For standardization, measurements were taken 12 mm above base of tooth crowns as recommended by Webb (1969). Data on the Lapara Creek sample (Medial Clarendonian of Texas Gulf Coastal Plain) are from Forstén (1975); those for the Clarendon and Minnechaduzza samples are from Webb (1969). Measurements of Leidy specimens are from casts. Remaining measurements are original, for specimens in the UNSM collection. For discussion of Valentine Railway Quarry (UNSM locality Cr 12) see Skinner and Johnson (1984: 271–276 and references). Norden Bridge Quarry (UNSM locality Bw 106) is also discussed by Skinner and Johnson (1984: 261–268 and references). Hazard Homestead Quarry (UNSM locality Hk 104) is a basal Ogallala site on Driftwood Creek in southern Hitchcock County, Nebraska. It has yielded a large but still undescribed collection of Late Barstovian mammals (Voorhies and Xue, 1983).

While agreeing that such an interpretation is possible (the source of Leidy's specimens will probably never be known), we believe that better matches for the original *C. placidus* specimens occur in the Crookston Bridge Member of the Valentine Formation. Quarry samples from the Crookston Bridge Member studied by one of us (MRV) contain teeth that appear to precisely duplicate the Leidy specimens in size (see Fig. 5) and morphology. Webb (1969) has identified the Late Barstovian *Calippus* from the Valentine Formation as *C. francisi* (Hay) but we regard the Valentine *Calippus*, as represented for example, by the Valentine Railway Quarry sample mentioned

by Webb, as morphologically advanced beyond *C. francisi* in hypsodonty and in simplification of the enamel pattern (Fig. 3).

In our view, *C. francisi*, as described by Quinn (1955) and Forstén (1975) from Texas, is confined to Medial Barstovian faunas while the more hypsodont *C. placidus* occurs only in the Late Barstovian (Voorhies, in preparation). Our interpretation of the stratigraphic distribution of *Calippus* species is shown in Figure 7.

NORTH AMERICAN LAND MAMMAL AGE	WEBB 1969		FORSTÉN 1975	THIS PAPER	
	TEXAS	NEBRASKA	TEXAS	TEXAS	NEBRASKA
LATE CLARENDONIAN	<b>regulus</b>	<b>C. placidus</b>	<b>regulus</b>	<b>regulus</b>	<b>C. regulus</b>
EARLY	<b>anatinus</b>		<b>regulus</b>	<b>regulus</b>	<b>regulus</b>
LATE BARSTOVIAN	<b>francisi</b>	<b>C. francisi</b>	<b>francisi</b>	<b>francisi</b>	<b>placidus</b>
MEDIAL			<b>francisi</b>	<b>francisi</b>	<b>francisi</b>

FIGURE 7. Stratigraphic Distribution of *Calippus* species in the Great Plains. Webb (1969) recognized four species: *C. francisi* from the "Valentinian" (= Late Barstovian) of Texas (Cold Springs Fauna) and Nebraska (Valentine Railway Quarry), *C. regulus* from the type Clarendon in Texas, *C. anatinus* from Lapara Creek (regarded as a Burge equivalent, hence Early Clarendonian), and *C. placidus* from the Minnechaduzza Fauna (correlated with the Clarendon). Forstén (1975) synonymized *C. anatinus* with *C. regulus* and regarded the Lapara Creek Fauna as post-Burge but still pre-Clarendon. She recognized *C. francisi* in two biostratigraphically-distinct Barstovian faunas, Cold Spring and "Younger Burkeville." We follow Forstén's arrangement of the Texas samples and tentatively recognize *C. regulus* in three Clarendonian horizons in Nebraska: the Early Clarendonian Penny Creek local fauna (a Burge equivalent), the Medial Clarendonian Minnechaduzza Fauna (restricted to Webb's sites in the Cap Rock Member of the Ash Hollow Formation), and Late Clarendonian (represented by the upper molar described by Webb [1969, Fig. 20b] from Leptarctus Quarry). In the Barstovian of Nebraska we recognize *C. francisi* in the Medial Barstovian Norden Bridge Quarry local fauna and its equivalents and *C. placidus* in the Late Barstovian Valentine Railway Quarry and its equivalents.



TABLE I. Measurements of *Calippus regulus* cheekteeth, Penny Creek Local Fauna, taken 12 mm above base of tooth crown. Measurements in parentheses are approximate.

		UNSM 94499 P4/	UNSM 21108 P3/	UNSM 94498 M2/	UNSM 94497 M3/								
UPPERS	Mesostyle height	33.2	(20)	22.0	28.0								
	AP	11.50	12.15	13.20	14.95								
	TR	14.05	(13)	14.40	—								
		UNSM 21030				UNSM 94643				UNSM 21011 M/1	UNSM 94496 M/1	UNSM 21016 M/3	UN 21016 M
LOWERS	Metaconid height	P/3	P/4	M/1	M/2	P/3	P/4	M/1	M/2	43	6.5	32.9	28.
	AP	24.9	28.0	20.0	26.5	(5)	—	5.5	6.5	12.70	11.60	18.20	18.
	TR	13.70	13.35	13.0	12.95	—	11.55	11.50	12.35	8.65	8.55	7.25	7.
		8.80	8.70	8.20	8.30	8.95	9.20	8.40	7.10				

## ACKNOWLEDGMENTS

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