# VERTEBRATE FOSSILS FROM THE GREASEWOOD CREEK LOCALITY IN THE LATE CRETACEOUS LANCE FORMATION OF NIOBRARA COUNTY, WYOMING

Janet L. Whitmore and James E. Martin
Museum of Geology
South Dakota School of Mines and Technology
Rapid City, South Dakota 57701

## ABSTRACT

The Greasewood Creek locality in the Maestrichtian Lance Formation in eastern Wyoming contains vertebrate fossils which add to the knowledge of faunal distribution and morphologies of taxa present during the latest Cretaceous (Lancian). This locality is one of the most northerly reported vertebrate-bearing sites within the Lance Formation. Although faunal diversity is less than that described in the type area of the formation to the south (probably a function of collecting technique), the sample includes: one ray; four fish, including the sturgeon, *Acipenser*; three amphibians; *Champsosaurus*; four turtles; two crocodylids, *Brachychampsa* and *Leidyosuchus*; five dinosaur genera; and a single mammal. The most abundantly represented taxa are gars, trionychid turtles, and teeth from theropods and ceratopsians.

In conjunction with other Lancian faunas, the Greasewood Creek sample may be used to assess the similarity of environmentally sensitive lower vertebrates across the Mesozoic-Cenozoic boundary. Only four nondinosaurian taxa from Greasewood Creek have not been identified in Paleocene faunas, suggesting their resistance to the Late Cretaceous extinction, but most of the sample includes taxa with aquatic affinities. Further investigation is required to assess the significance of habitat preferences before species may be utilized in analysis of the extinction event.

## INTRODUCTION

The Lance Formation in eastern Wyoming has been classically known for a terrestrial fauna dominated by dinosaurs. Coupled with the fossils collected from equivalent units in North and South Dakota, Montana, and Canada, the dinosaurs from Wyoming have been considered as the typical faunal constituent before the Late Cretaceous extinction event. Relatively unnoticed in the discussions of this event are the smaller herpetofaunae from the Lance Formation and its equivalents. Although dinosaurs have been discussed extensively since J. B. Hatcher's collections made from the Lance Formation during 1889-1892, only scattered descriptions of the smaller taxa appeared until the work of Gilmore (1928). Gil-

more's review of the Late Cretaceous lizards was the standard reference until Estes (1964) published on the lower vertebrate fauna from the Lance Formation of eastern Wyoming. Subsequently, Estes, Archibald, Breithaupt, Carpenter, Sahni, and others have studied both Cretaceous and Paleocene faunas from the northern midcontinent.

With the exception of a few scattered sites to the north (Hatcher 1907, pl. LI), most vertebrate localities in the Lance Formation are near the town of Lance Creek in central Niobrara County. Two of Hatcher's northern sites are along the northern side of Greasewood Creek. Because it is not possible from the known records to determine precisely the position of Hatcher's localities, the S.D. School of Mines locality, Greasewood Creek (SDSM V685), described herein may coincide with one of those of Hatcher. SDSM V685 lies on the northern side of the South Fork of Greasewood Creek (Fig. 1) which flows easterly and empties into Lance Creek. Precise locality data is available at the Museum of Geology.

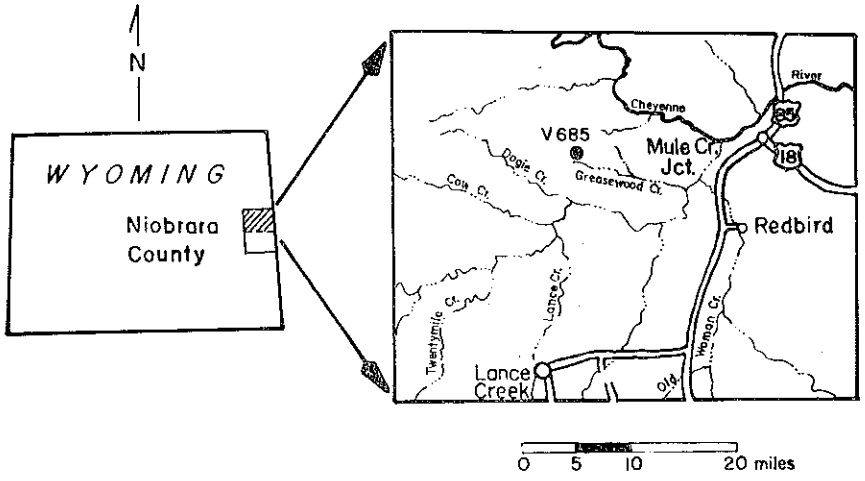


**Figure 1. Location of study area in eastern Wyoming.**

The fossils occur in a blowout, and most occur as isolated elements, many of which are water worn. The preservation and lithology indicate deposition in a relatively high-energy aqueous environment. When the original collection was made, surface prospecting was the method of collection.



The second author became involved in collecting from the Lance Formation of Niobrara County while still in high school. A couple of years later in 1968, Mr. William Zerbst, a friend and landowner in the area, took Martin to a locality which Zerbst described as at the source of Greasewood Creek. A small collection was made, including an unusual bone which was thought to be that of a fish. At that time, little interest was shown in the Lance Formation, and the collections from a number of localities remained at the Museum of Geology and in the possession of Martin until Whitmore undertook a study of the taxa collected as the subject of her Master's thesis. Except for the specimen described herein, she has already published (1985) on the fossil mammals from the area.

## ACKNOWLEDGEMENTS

We wish to thank the late Mr. William Zerbst for his encouragement and for his willingness to share many of his finds with the scientific community. Bill's son, Leonard, and his family have continued this tradition, and we thank them for their hospitality and help during these investigations. We also wish to thank Harold and Betty Honadel, who aided in the initial collections. Mr. Paul Stoddard kindly allowed us access to the locality during recent investigations. The specimen figure was prepared by Merton C. Bowman from the Museum of Geology, and Dr. E. M. White, South Dakota State University, provided helpful review.

## STRATIGRAPHY

The locality lies within the Lance Formation and is composed of yellowish-gray, well sorted and rounded, medium to coarse-grained quartz sandstone. The sandstone is usually friable except in ancient sand bars where it has ferruginous cement. Due to erosion, these resistant sand bars may now be isolated on pedestals. Numerous sedimentary structures within the sandstone, particularly cross-bedding and scour features, suggest a fluvial origin.

## SYSTEMATIC PALEONTOLOGY

Table 1. Faunal list

Chondrichthyes
- Dasyatidae
  - *Myledaphus bipartitus*

Osteichthyes
- Acipenseridae
  - *Acipenser eruciferus*

Amiidae
*Amia fragosa*
Aspidorhynchidae
*Belonostomus longirostris*
Lepisosteidae
*Atractosteus occidentalis*

Amphibia
Batrachosauroididae
*Opisthotriton kayi*
Scapherpetontidae
*Scapherpeton tectum*
Sirenidae
*Habrosaurus dilatus*

Reptilia
Champsosauridae
*Champsosaurus* sp. indet.
cf. Baenidae sp. indet.
Dermatemydidae
cf. *Helopanoplia distincta*
Trionychidae
Trionychidae sp. indet.
Testudinata *incertae sedis*
*Compsemys victa*
Crocodylidae
*Leidyosuchus sternbergi*
*Brachychampsa montana*
Crocodylidae sp. indet.
Tyrannosauridae
cf. *Albertosaurus* sp. indet.
Theropoda *incertae sedis*
*Paronychodon lacustris*
Hypsilophodontidae
cf. *Thescelosaurus* sp. indet.
Hadrosauridae
cf. *Edmontosaurus* sp. indet.
Ceratopsidae
cf. *Triceratops* sp. indet.

Mammalia
Pediomyidae
*Pediomys* sp. cf. *P. krejcii*



## CHONDRICHTHYES

### RAJIFORMES

Dasyatidae

*Myledaphus bipartitus*

*Referred specimens.*—SDSM 12741, 6 pavement teeth.

*Description.*—Dental remains of this ray are very common in the Late Cretaceous deposits of the midcontinent. The teeth are hexagonal, and the crowns are covered with vitrodentine that is heavily wrinkled on the lateral crown borders. The root is distinctly divided by a central root canal.

### RAJIFORMES

*Referred specimens.*—SDSM 12742, 2 vertebrae.

*Description.*—The calcified vertebrae are deeply amphicoelous with circular cotyles and medially constricted centra. The lateral border of the smaller vertebra is smooth, whereas the larger displays fine convolutions. The simple morphology is very similar to that of shark centra.

*Discussion.*—Four genera of Chondrichthyes are known from the Lance Formation, *Lonchidion, Squatirhina, Ischyrhiza,* and *Myledaphus* (Estes 1964). Tooth measurements of the first three representatives are small, ranging in length from 1.5 mm to 6 mm, whereas the larger vertebra in the SDSM collection is 11.7 mm long. *Myledaphus* teeth can reach relatively large size, and may more closely correspond with the size of the vertebra.

## OSTEICHTHYES

### ACIPENSERIFORMES

Acipenseridae

*Acipenser eruciferus*

*Referred specimen.*—SDSM 6839, partial body scute.

*Description.*—SDSM 6839 is a fish specimen discovered by Harold Honadel that initially brought attention to the site. The specimen is a strongly sculptured bone believed to be a lateral scute. The scute is characterized by a deep central keel which displays parallel ridges, trending perpendicular to the margin of the keel. These ridges display no ornamentation, whereas the remainder of the plate is greatly ornamented with jagged denticles. On associated plates, the denticles are arranged in subparallel rows approximately a millimeter apart.

*Discussion.*—The deep keel and jagged denticles are similar to the condition of the species described by Estes (1964) from the

Lance Formation. However, there is the possibility that the specimen may be referred to another sturgeon, *Protoscaphirhynchus*, which occurs in the equivalent Hell Creek Formation in Montana (Estes *et al.* 1969).

## AMIFORMES

### Amiidae

### *Amia fragosa*

*Referred specimens.*—SDSM 12718, coronoid fragment; SDSM 12739, 2 opercular fragments; SDSM 12719, 11 vertebrae.

*Description.*—A single fragment with teeth has been tentatively identified as a coronoid. The bone is subtriangular and bears five blunt teeth and nine alveoli. On the operculars the external surfaces are ornamented with fine sculpturing, whereas the internal surfaces are smooth. Both operculars are broken, and only one has the articular process intact. Eleven subcircular to oval amphicoelous amiid vertebrae are present. The vertebrae bear ossified chordal foramina, a condition recorded in the collection of Estes (1964). Vertebral morphology is very similar to that of the living amiid, *Amia calva.*

*Discussion.*—This taxon is abundantly represented in the deposits of the Lance Formation. Estes (1964) identified specimens from this unit as *Kindlei fragosa*, and in 1969 (Estes and Berberian) synonomized the species with *Amia.*

## ASPIDORHYNCHIFORMES

### Aspidorhynchidae

### *Belonostomus longirostris*

*Referred specimens.*—SDSM 12717, 2 predentary fragments.

*Description.*—Two dentulous predentary fragments correspond closely with the illustrations and descriptions of the species by Estes (1964). The elements are oval in cross-section and bear three parallel rows of teeth. The central row possesses high, sharp teeth, whereas the flanking rows possess much smaller teeth. The teeth are conical, very pointed, and capped with "vitrodentine." The proximal ventral surfaces of the predentaries are covered with a thick ganoine layer, and the lateral sides of the element display a faint striated pattern. Neither element bears a well developed anterior bifurcating ridge, indicating that the fragments are distal portions of the predentary.

*Discussion.*—This species is one of the taxa in the assemblage which has not yet been recorded from the Paleocene Epoch.



## LEPISOSTEIFORMES

### Lepisosteidae

### *Atractosteus occidentalis*

*Referred specimens.*—SDSM 12781, infraorbital; SDSM 12720, right dentary; SDSM 12782, jaw fragment; SDSM 12746, 8 vertebrae; SDSM 12721, 151 scales; SDSM 12740, miscellaneous broken elements.

*Description.*—The infraorbital closely resembles that of the modern gar. An external row of small crenulated alveoli is bordered internally by a row of larger crenulated alveoli. The edentulous dentary also exhibits two rows of alveoli, an internal row of seven large crenulated sockets, and a labial row of numerous, much smaller, crenulated sockets. The labial border of the dentary is distinctly sculptured, particularly anteriorly, whereas the lingual border is composed of relatively smooth bone. *Atractosteus* vertebrae are distinctly opisthocoelous. Transverse processes project posteriorly and neural arches are not preserved on any of the SDSM specimens. Anterior elements are shorter anteroposteriorly than the posterior vertebrae. The great number of diamond-shaped ganoid scales corresponds with the observations of all earlier workers who indicate their preponderance.

*Discussion.*—Wiley (1976) recorded two genera of gars in the Late Cretaceous deposits of North America: *Lepisosteus opertus* and *Atractosteus occidentalis.* As most of the material heretofore described from the Lance Formation is *A. occidentalis* and because no elements could be assuredly assigned to *L. opertus,* the sample from the Greasewood Creek locality is assigned to the former taxon.

## AMPHIBIA

## URODELA

### Batrachosauroididae

### *Opisthotriton kayi*

*Referred specimen.*—SDSM 12743, vertebra.

*Description.*—SDSM 12743 is an opisthocoelous vertebrae that displays the pseudocoelous type of opisthocoely of Soler (1950). The condyle is not completely ossified but rather exhibits a hollow notochordal canal that is covered anteriorly with an ossified or cartilaginous cap. The neural arch is low anteriorly and rises posteriorly displaying a low neural spine. Of the zygopophyses, only the oval left prezygopophysis is preserved. Distinct ventroposterior basapophyses are present on either side of the very well developed, thin hypapophysial keel.

*Discussion.*—*Opisthotriton* vertebrae are easily distinguished from those of contemporaneous *Prodesmodon,* a taxon which possesses a solid condyle (Estes 1981).

Scapherpetontidae

*Scapherpeton tectum*

*Referred specimen.*—SDSM 12744, vertebra.

*Description.*—The vertebra is amphicoelous, displays teardrop shaped cotyles, and is laterally compressed. The ventral margin of the centrum is fragmentary as are the ventral borders of both the anterior and posterior cotyles. Zygopophyses are oval and located close to the midpoint of the centrum, and the teardrop shaped cotyles of *Scapherpeton* are distinct from the circular cotyles of *Lisserpeton* (Estes 1981).

Sirenidae

*Habrosaurus dilatus*

*Referred specimen.*—SDSM 12697, vertebra.

*Description.*—The morphology of this fragmentary vertebra closely resembles that of *H. dilatus* provided by Estes (1964, 1981). The amphicoelous element is 11.2 mm along the centrum, possesses a fragmentary posterior cotyle, a circular anterior cotyle, and a triangular neural canal cross-section which smooths to a semicircle posteriorly. A distinct neural spine bifurcates at about the midpoint of the centrum into two posterior aliform processes. These processes trend posteriorly to the postzygopophyses (Estes 1964). Only the oval, horizontally oriented left postzygopophysis is preserved. Ventrally, remnants of a subcentral keel remain.

*Discussion.*—One of the most definitive features which may be used to differentiate the Sirenidae from other contemporary Lancian urodeles is the distinct bifurcation of the neural spine into two aliform processes (Estes 1981). *Habrosaurus dilatus* is known from the Late Cretaceous and Paleocene deposits of the midcontinent, and the two extant North American genera, *Siren and Pseudobranchus,* are confined to the southern coastal plains of the United States and Mexico (Estes 1981).

REPTILIA

EOSUCHIA

Champsosauridae

*Champsosaurus* sp. indet.

*Referred specimens.*—SDSM 12780, maxillary fragment; SDSM 12705, vertebra; SDSM 12706, 2 dorsal rib fragments.

*Description.*—SDSM 12780 is a worn edentulous maxillary fragment displaying four alveoli. The socket borders are highly crenulated, a characteristic of *Champsosaurus.* One socket bears broken remnants of a tooth. SDSM 12705 is a champsosaur vertebra which is typically preserved without neural arches. The amphiplatyan centrum has two ventral carinae and facets for articulation of the ribs. SDSM 12706 includes the proximal fragments of two dorsal ribs. The articular surfaces are hour-glass in shape, and the shafts possess prominent anterior and posterior ridges. The general morphology greatly resembles that illustrated by Erickson (1972, fig. 24). This material is too incomplete to warrant a specific designation.



TESTUDINATA

cf. Baenidae sp. indet.

*Referred specimens.*—SDSM 12700, neural fragment; SDSM 12701, 2 carapace or plastron fragments.

*Description.*—The fragments are tentatively referred to the Baenidae due to the lack of a distinct sculpture pattern. The partial neural displays five shallow sulci scars that are positioned anteroposteriorly.

*Discussion.*—In the systematic revision of the North American Baenidae, Gaffney (1972) utilized skull morphology for generic differentiation; therefore, these shell fragments appear to be of limited utility for precise taxonomic determinations.

Dermatemyidae

cf. *Helopanoplia distincta*

*Referred specimen.*—SDSM 12699, 2 plastron fragments.

*Description.*—The specimens bear a robust sculpture composed of tall pustulae, which along the border, join to form small ridges. The sculpture is similar to that illustrated by Hay (1908, figs. 4-5, pl. 88).

*Discussion.*—*Helopanoplia distincta* can be differentiated by its taller, better developed pustulae which are farther apart than those of the similarly constructed turtle, *Compsemys victa.* Unlike *Compsemys, Helopanoplia* does not survive into the Paleocene.

Trionychidae, sp. indet.

*Referred specimens.*—SDSM 12702, 2 neural fragments; SDSM 12703, 41 carapace and plastron fragments; SDSM 12704, 3 lateral spines.

*Description.*—The lateral spines are ventrally flattened and are ornamented with distinct longitudinal striations as is characteristic of both recognized Late Cretaceous trionychid genera, *Trionyx* and *Plastomenus.* The sculpture pattern of the elements is

composed of a coarse network of irregular pits and ridges similar to those illustrated by Hay (1908, figs. 6-9, pl. 88). Both fragments with vertical-sided, flat-bottomed pits and those with rounded pits (Breithaupt 1982) are present in the collection. Most workers generally accept the contention that the sculpture pattern is of questionable taxonomic significance within the Trionychidae, and most suggest that a taxonomic revision is needed.

*Discussion.*—The trionychids are probably the most abundant turtles in the Hell Creek Formation of Montana (Archibald 1977) and are the most abundant turtle family represented in the SDSM collections from the Lance Formation. Perhaps these specimens could be assigned to *Trionyx (Aspideretes)* as it is the most commonly recognized Late Cretaceous genus; however, the possibility exists that the fragments may be assigned to another trionychid.

### Testudinata *incertae sedis*

### *Compsemys victa*

*Referred specimen.*—SDSM 12698, carapace fragment.

*Description.*—The specimen displays the characteristic densely packed small pustulae of the carapace of *Compsemys victa* as illustrated by Hay (1908, figs. 2-3, pl. 34). One shallow sulcus scar transects the carapace fragment.

*Discussion.*—Both Archibald (1977) and Gaffney (1972) believed the sculpture pattern of *Compsemys victa* to be diagnostic of this taxon. However, the familial assignment of this species is disputed. Based on the morphology of the mesoplastra, Gaffney placed *Compsemys* within the Baenidae, but admitted that this characteristic is a weak taxonomic trait. Archibald (1977) believed that until skulls and postcranial material are obtained, the taxonomic affinities will remain questionable and placed the species *incertae sedis* at a familial level.

## TESTUDINATA

*Referred specimens.*—SDSM 12748, vertebra; SDSM 12749, distal phalange.

*Description.*—SDSM 12748 is a vertebral centrum from the trunk region. The centrum is amphicoelous and greatly constricted medially resulting in an hour-glass outline. Characteristic of chelonian trunk vertebrae, SDSM 12748 lacks zygopophyses. The distal phalange is composed of slightly porous bone and bears distinct lateral grooves, which extend from the tip posteriorly approximately two-thirds the distance of the phalange. SDSM 12749 is laterally compressed, sharply pointed, and concave on the ventral surface.



## CROCODILIA

## EUSUCHIA

### Crocodylidae

### Crocodylinae

### *Leidyosuchus sternbergi*

*Referred specimens.*—SDSM 12711, 15 teeth.

*Description.*—The teeth are conical to slightly curved. All display distinct carinae directed from the tip to the crown base.

*Discussion.*—Although these specimens have been assigned to the most common Late Cretaceous crocodile, *Leidyosuchus sternbergi,* other authors including Armstrong-Ziegler (1980) working in the Campanian Fruitland Formation in New Mexico and Breithraupt (1982) working in the Lance Formation in southwestern Wyoming have identified an additional genus, *Thoracosaurus.* It is therefore recognized that it is possible that *Thoracosaurus* may be present at Greasewood Creek.

### Alligatorinae

### *Brachychampsa montana*

*Referred specimens.*—SDSM 12710, 5 teeth.

*Description.*—The low crowned, laterally compressed teeth with crenulated enamel resemble those of *Brachychampsa* illustrated by Gilmore (1911). Distinct radiating carinae trend from the apex to the constricted tooth base. Smooth enamel surrounds the base.

*Discussion.*—*Brachychampsa* is a broad-snouted alligatorine interpreted, on the basis of its massive, low teeth and heavy jaws, to be chelonivorous by Carpenter and Lindsey (1980). It is not found in Paleocene deposits, and its absence may be correlated with a decrease in the diversity of turtles across the Cretaceous-Tertiary boundary.

### Crocodylidae sp. indet.

*Referred specimens.*—SDSM 12715, right squamosal; SDSM 12712, 2 caudal vertebrae; SDSM 12713, 2 nuchal scutes; SDSM 12716, 11 dorsal scutes.

*Description.*—The squamosal is thin, and like the scutes (osteoderms), exhibits the pitted sculpture characteristic of crocodilians. Sutures for parietal contact are preserved, whereas the postorbital sutures are broken away. The anterior medial border is curved and excavated concavely where the squamosal contributes to the formation of the supratemporal fenestra. Along the right lateral margin, a distinct groove is bounded by nutrient foramina. A por-

tion of the posterolateral process that contacts the exoccipital is preserved.

The elongate, laterally compressed vertebrae are caudals. Distinct, paired ventral ridges on one vertebra are indicative of an anterior caudal (Erickson 1976).

SAURISCHIA

THEROPODA

Tyrannosauridae

cf. *Albertosaurus* sp. indet.

*Referred specimens.*—SDSM 12736, premaxillary tooth fragment; SDSM 12737, 5 maxillary or dentary teeth.

*Description.*—The premaxillary tooth fragment consists only of the crown tip. Serration rows are positioned posteromedially on the lingual face of the tooth, whereas those of the posterior teeth are anteroposteriorly directed. The serration count of the premaxillary tooth totals three serrations per two millimeters, whereas the serrations of the posterior teeth average seven anteriorly and 6.5 mm posteriorly. The anterior row of serrations of the posterior teeth terminates at approximately two-thirds the crown height, whereas posterior serrations extend down the crown almost to the base.

*Discussion.*—The teeth of *Albertosaurus* are very similar to those of *Tyrannosaurus* and are tenuously differentiated primarily by their smaller size.

THEROPODA *incertae sedis*

*Paronychodon lacustris*

*Referred specimen.*—SDSM 12707, tooth.

*Description.*—The tooth is laterally compressed, recurved, and in contrast to the rounded labial surface, the lingual side is flat. Both faces bear the characteristic prominent ridges that arise from the tip and radiate three-fourths down the crown height. This specimen displays neither anterior nor posterior serrations, although other known specimens may possess these serrations.

*Discussion.*—The infraordinal and familial affinites of *Paronychodon* are questionable; the genus has been placed in numerous families (Armstrong-Ziegler 1980, Breithaupt 1982, Carpenter 1982). We have followed Steel (1970) with placement in the suborder Theropoda *incertae sedis*; however, Steel noted that *Paronychodon* teeth resemble those of *Saurornithoides* and thus may represent a coelurosaur.



ORNITHISCHIA

ORNITHOPODA

Hypsilophodontidae

cf. *Thescelosaurus* sp. indet.

*Referred specimens.*—SDSM 12751, premaxillary tooth; SDSM 12745, maxillary tooth; SDSM 12738, distal phalange of the pes.

*Description.*—The premaxillary tooth resembles illustrations of Sternberg (1940) and Galton (1974). Unlike the maxillary and dentary teeth, premaxillary teeth lack distinct denticles. Fine grooves are present from the tip to the base and the thickest portion of the tooth occurs along the midline. The maxillary tooth is also similar to the descriptions and illustrations of Sternberg (1940) in being asymmetrical with the anterior border longer than the posterior. SDSM 12745 displays 14 denticles that continue down the crown as subparallel flutings which lose their definition near the base. In accordance with Sternberg's description, principal wear occurs on the anterior margin of the internal face. The distal phalange is triangular and displays well developed, deep lateral grooves. The dorsal surface is moderately convex, whereas the ventral surface is only slightly concave. The bone is porous, rugose, and the articular surface is poorly preserved. The anteroposterior length is 38 mm, and the maximum transverse width is 20.4 mm. SDSM 12738 resembles figures of the pes of this taxon by Morris (1976).

Hadrosauridae

cf. *Edmontosaurus* sp. indet.

*Referred specimens.*—SDSM 12709, 7 teeth.

*Description.*—The diamond shaped crowns of these fragmentary hadrosaur teeth have enamel only on one face. A distinct central carina divides the enamel face. The enamel along this ridge and that near the crown tip is slightly crenulated like that illustrated by Leidy (1865, pl. 13).

*Discussion.*—Lull and Wright (1942) reported that individual teeth are not diagnostic for lower taxonomic determinations. Later, Brett-Surman (1979) synonomized all species of *Anatosaurus* except *A. copei* with *Edmontosaurus regalis* and *E. edmontoni*. The greater number of species of *Edmontosaurus* suggests that these specimens are likely referable to that genus, but the possibility of reference to *Anatosaurus copei* exists.

Ceratopsidae

cf. *Triceratops* sp. indet.

*Referred specimens.*—SDSM 12708, 21 teeth.

*Description.*—A variety of wear stages are represented by these teeth. Overall morphology is triangular with spatulate enamel surfaces that display a single vertical carina on the lingual and labial faces. Rugose convoluted enamel exists along the lateral margins of one tooth. On only one of the specimens is preserved the characteristic bifurcated root system.

*Discussion.*—As ceratopsian teeth are not accepted as valid generic indicators, the teeth have been provisionally referred to *Triceratops*. This is the most commonly occurring taxon in the Lance Formation, but it is possible that the contemporary Lancian ceratopsian, *Torosaurus* may be represented.

MAMMALIA

MARSUPIALIA

Pediomyidae

*Pediomys* sp. cf. *P. krejcii*

*Referred specimen.*—SDSM 12752, partial left dentary with $M_1$ and $M_2$.

*Description.*—The dentary greatly resembles those described by Clemens (1966). The slender dentary (Fig. 2) possesses an anterior mental foramen below the alveoli for $P_2$, a posterior foramen below $M_1$, and the symphyseal scar extends posteriorly to below the posterior root of $P_2$. The dentary possesses a slightly worn $M_1$ and $M_2$ and alveoli for the posterior root of $P_1$, $P_2$, $P_3$, and the anterior root of $M_3$. On the trigonid of $M_1$, the protoconid is the highest cusp, and the more anteriorly positioned paraconid is the lowest cusp. As is typical of most Cretaceous marsupials, the talonid exhibits closely appressed entoconid and hypoconulid. In contrast to the subequal height recorded by Clemens (1966), the entoconid of SDSM 12752 is higher than the hypoconulid; however, this difference may be a function of wear. The trigonid of the $M_2$ differs from that of the $M_1$ in the closer position of the paraconid and metaconid. Dental measurements are: $M_1$, length 1.54, width-trigonid 0.82, width-talonid 0.91; $M_2$, length 1.58, width-trigonid 0.95, width-talonid 1.2 mm.

*Discussion.*—SDSM 12752 is very similar to illustrations of *P. krejcii* from the southern localities in the Lance Formation (Clemens 1966, fig. 65) and from the Scollard Formation of Alberta (Lillegraven 1969, fig. 23). The diminutive measurements corroborate



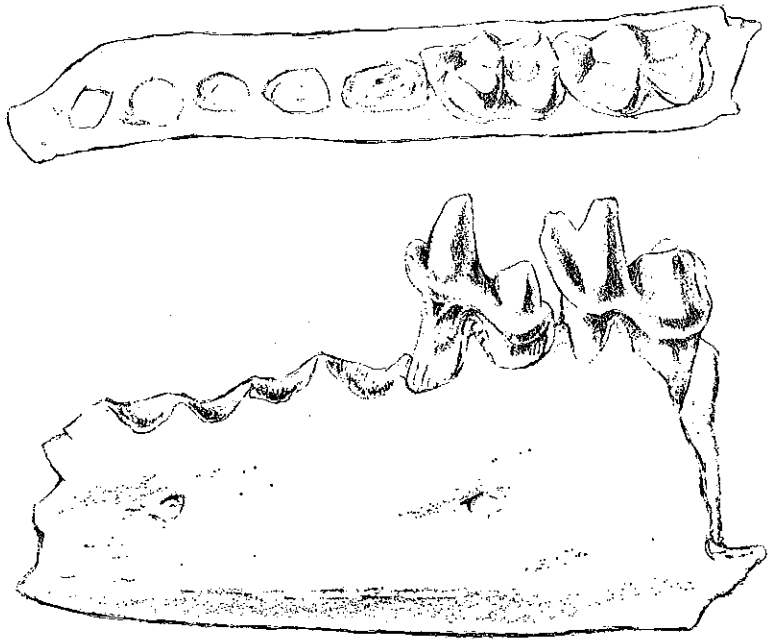

Figure 2. *Pediomys* sp. cf. *P. krejcii*, occlusal and lateral views. The scale equals one millimeter.

this assignment. As documented by Clemens (1966), species of *Pediomys*, like most other Cretaceous marsupials, did not survive into the Paleocene, and the disjunct distribution of the genus has been tenuously suggested as an ecological bias (Lillegraven and McKenna 1986).

## TAXONOMIC COMPARISONS

When one reviews the literature or undertakes a study of the Quaternary, it becomes apparent that lower vertebrates are very useful environmental indicators. These sensitive creatures were probably also greatly affected by changing conditions in the Cretaceous, perhaps more so than their larger faunal counterparts. Because similar sedimentological conditions appear to have existed at latest Cretaceous and earliest Paleocene localities, comparison of the lower vertebrate components may test the severity of climatic effects, particularly during the Late Cretaceous extinction.

Although we cannot resolve climatic effects with the small

sample from the Greasewood Creek locality, preliminary analysis may be initiated with the taxa present. With the exception of the dinosaurs, only *Belonostomus, Helopanoplia, Brachychampsa,* and *Pediomys* have not been reported in Paleocene faunas. Of these, *Helopanoplia* is a rare element in all faunas. *Brachychampsa* has been considered a very specialized alligator which might not be expected to survive for extended geologic time. With these exceptions, this small assemblage shows great similarity with taxa surviving into the Paleocene. However, most constituents have aquatic affinites, and Estes (1976) indicated a closer relationship among aquatic taxa between the two time intervals than those taxa with terrestrial affinities. Therefore, additional lower vertebrates must be recovered, particularly those representing the terrestrial component, before significant comparisons can be interpreted.

## SUMMARY

The fossil collection from the Greasewood Creek locality is very similar to collections from other Late Cretaceous sites in Wyoming (Estes 1964, Breithaupt 1982), Colorado (Carpenter 1979), Montana (Estes *et al.* 1969), and northwestern South Dakota (Greenwald 1971). Although collections from similar formations are known from more northerly latitudes, this site has produced the most northerly heretofore described assemblage from the Lance Formation. Generally, the Greasewood Creek collection is representative of other assemblages except for the absence of lizard remains. This faunal discrepency appears to be a function of collection method. Screen washing techniques will probably produce these small, fragile faunal remains. Otherwise, the Greasewood Creek sample is diverse and is represented by a chondrichthyan, a chondrostean and three holostean fishes, three salamanders, *Champsosaurus,* four turtles, two crocodilians, five dinosaurs, and a mammal.

The taxa from the Greasewood Creek locality, like those from contemporaneous sites, indicate that the paleoenvironment of the midcontinent was much like that of the present Gulf Coast of the United States (Estes 1964). The bony fishes, *Acipenser, Amia,* and *Lepisosteus,* currently coexist in that region. The distribution of extant Sirenidae, *Siren* and *Pseudobranchus,* includes the southeastern and central regions of the United States and northeastern Mexico (Estes 1981). *Opisthotriton* and *Scapherpeton* have been regarded (Estes 1964) to have had fresh water affinities, and the turtles, specifically trionychids, indicate permanent, large, fresh water ponds or streams with sandy or muddy bottom (Estes and Berberian 1970). *Champsosaurus,* a gavial-like predator, was fully adapted to an aquatic lifestyle (Erickson 1985). It is assumed that the Crocodylidae of the Cretaceous occupied a similar subtropical niche as their living relatives. Overall, the herpetofauna is similar to that of other Late Cretaceous sites and greatly resembles that present in the southeastern United States.

The nondinosaurian taxa from this locality are very similar to those from other Late Cretaceous and Paleocene sites. Although the comparisons are based upon taxa with aquatic affinities, only four taxa are not found higher in Paleocene deposits. Further collecting and analysis of lower vertebrates from the latest Cretaceous and earliest Paleocene may indicate the severity of the Late Cretaceous extinction on these environmentally sensitive creatures.



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