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BY

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Abstract — Paleontological field work conducted during the past eight years in the southern Green River Basin of southwestern Wyoming has enabled recovery of over 800 mammalian specimens from the previously poorly-represented lower Bridger Formation lithostratigraphic interval A. Systematic analysis of these new collections reveals the presence of 43 genera and 54 species of fossil mammals, including one new species of miacid carnivore, *Vulpavus farsonensis*. Dominant elements of the Bridger A fauna in terms of numbers of specimens are primates (205), rodents (188), and perissodactyls (109). Most mammals from this interval belong to genera found in the succeeding Bridger B lithostratigraphic interval, but there are substantial differences between Bridger A and Bridger B samples at the specific level. Several species from Bridger A are more commonly found in the preceding Gardnerbuttean biostratigraphic zone (earliest middle Eocene), and several represent transitional taxa between Gardnerbuttean and later Bridgerian species. Evidence presented here supports an earlier suggestion that the mammalian fauna derived from Bridger lithostratigraphic interval A is distinct enough to be recognized as a separate biostratigraphic zone, Bridgerian zone Br-1b.

INTRODUCTION

In 1909 Matthew proposed a five part division of the Bridger Formation in the southern Green River (Bridger) Basin, designating these intervals A through E. The lowest 200 feet (65 meters) of the Bridger Formation represents interval A (this is actually closer to 200 meters in thickness, see Gunnell and Bartels, 1994). The Bridger A interval was viewed by Matthew (1909) as poorly fossiliferous, at least in terms of mammals. Interval B represents the succeeding 450 feet (148 meters) of the Bridger Formation and is abundantly fossiliferous with many thousands of mammalian specimens having been collected from these classic Bridger B beds. There is a thin, yet persistent, ostracodal limestone layer (the Lyman limestone of Evanoff *et al*, in press; marker bed G of McGrew and Sullivan, 1970) separating the Bridger A and B intervals, best seen west of Church Butte (Fig. 1). Bridger B is separated from the C interval by the laterally extensive and relatively thick Sage Creek White Layer (calcareous limestone), while interval D is separated from Bridger C by the laterally extensive, calcareous Lone Tree White Layer. Bridger intervals C and D together represent approximately 900 feet (296 meters) of section. Interval E, originally viewed as essentially non-fossiliferous by Matthew but now known to have a relatively extensive, though poorly distributed, mammalian fauna (West and Hutchison, 1981; Robinson, pers. comm.), represents approximately the top 150 feet (50 meters) of the Bridger Formation in the Bridger Basin.

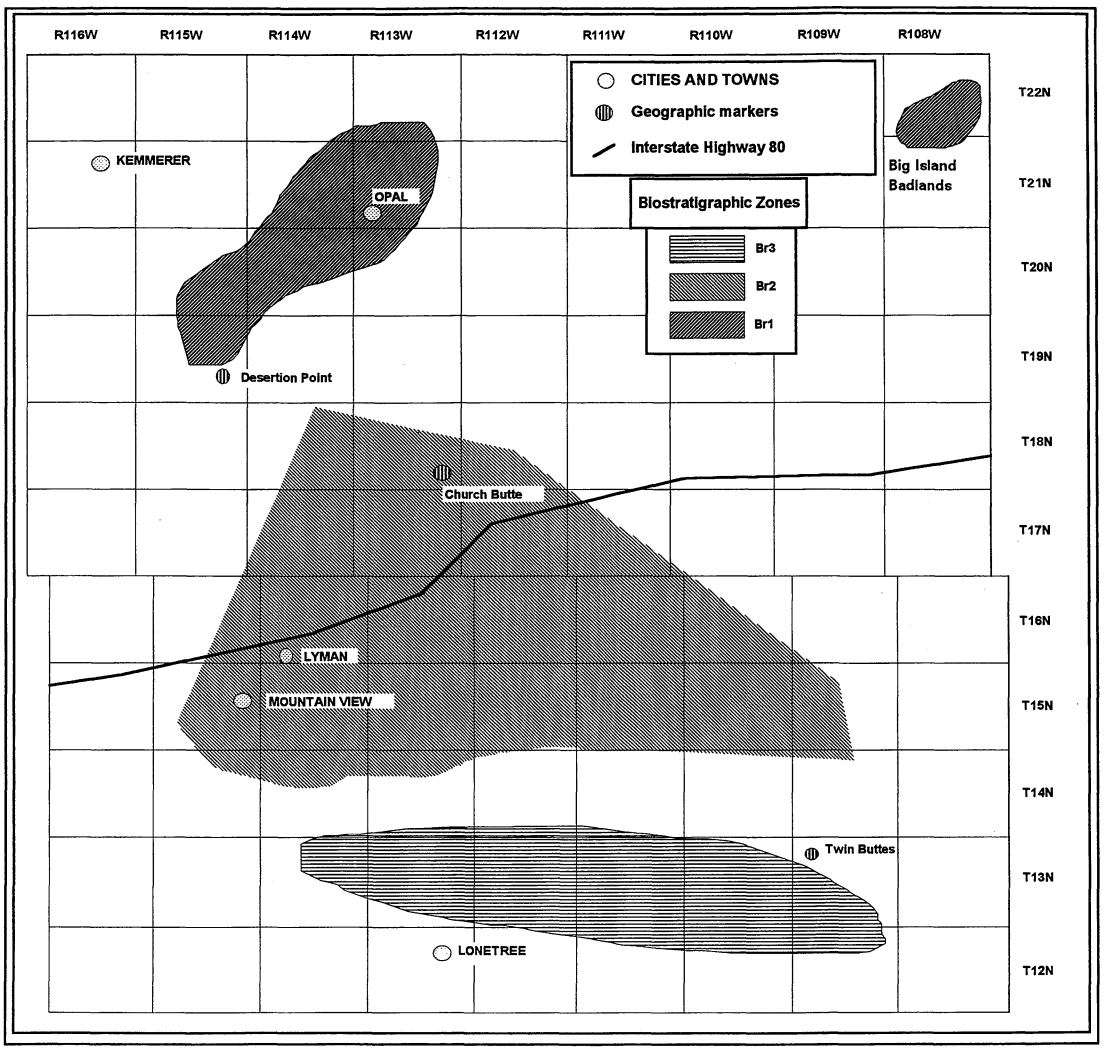

FIG. 1 — Map of southwestern Wyoming showing the southern Green River Basin and main areas of exposure of Bridger lithostratigraphic intervals A through E. All Br-1b specimens described in this paper were collected from either the Opal ("BB" localities) or Big Island-Blue Rim Badlands ("BI" localities).

Mammalian faunas from Bridger C and Bridger D differ in content and composition from those in Bridger B (Matthew, 1909, Gazin, 1976). Wood (1934) proposed grouping Matthew's Intervals A and B into the Black's Fork "Member" of the Bridger Formation, not based on lithologic evidence, but on faunal differences seen between this interval and those of Bridger C and D (termed the Twin Butte "Member" by Wood). The terms Blacksforkian and Twinbuttean have been used to designate land mammal subages of the Bridgerian Land Mammal Age (Krishtalka *et al.*, 1987). Evanoff *et al.* (in press) have proposed an additional member for Bridger E, the Turtle Bluff Member.

Vertebrate faunas from Bridger A were essentially unknown when Matthew published his 1909 monograph on the insectivores and carnivores of the Bridgerian. Little work was carried out in this lower sequence until the 1960's when Paul McGrew (University of Wyoming) began sending graduate students into the area surrounding Opal, Wyoming (Fig. 1) to study stratigraphy and vertebrate paleontology. McGrew and his students collected small faunal samples from several

areas culminating in the publication of a description of Bridger A stratigraphy and fossil vertebrates (McGrew and Sullivan, 1970). McGrew and Sullivan (1970) felt that the mammalian fauna from Bridger A was essentially the same as that from Bridger B with a few minor differences. Gingerich (1979) studied notharctine primates from Bridger A and found that differences did exist at the species level between Bridger A and later Bridgerian assemblages.

In 1989, the University of Michigan, in conjunction with Albion College and California State University, Sacramento, began a field project to examine these Bridger A sediments more closely and to test the hypothesis that few, if any, differences exist between faunal samples from Bridger A and Bridger B. Gunnell and Bartels (1994) published a preliminary faunal list from Bridger A based on this field work. They concluded that there were differences in depositional environments and vertebrate assemblages between Bridger intervals A and B. They proposed to recognize three informal biostratigraphic zones for the Bridger Formation: Br-1 corresponding to Bridger lithostratigraphic interval A; Br-2 corresponding to Bridger lithostratigraphic interval B; and Br-3 corresponding to Bridger lithostratigraphic intervals C and D. It is now appropriate to recognize a fourth biostratigraphic zone, Br-0, equivalent to the early Gardnerbuttean subage of the Bridgerian Land Mammal Age (Robinson, 1966, and pers. comm.). Bridgerian biostratigraphic zone Br-1 can be further subdivided into subzones Br-1a and Br-1b (Gunnell and Yarborough, in preparation).

Further field work has added new evidence to that summarized by Gunnell and Bartels (1994). The purpose of the present paper is to describe more fully the Bridger A mammalian faunas based primarily on collections made over the past eight years. This more detailed description of Bridger A mammals will provide evidence for in-depth comparisons (Gunnell, in preparation) between Bridger A and the preceding Gardnerbuttean subage (Robinson, 1966), as well as mammalian assemblages from the succeeding middle Bridgerian interval.

Field work over the course of the last eight years has been carried out in two principal areas where Bridger A sediments are well exposed (Fig. 1). The first area is along the northern portion of the Bridger Basin (the southern extreme of the vast Green River Basin) near the village of Opal, Wyoming. One hundred and twenty-nine localities have been examined in this area and are designated as "BB" (for Bridger Basin) in the text. The second area is approximately 50 kilometers east-northeast of Opal in a region referred to as the Big Island-Blue Rim Badlands (60 localities have been examined from this area and are designated "BI" in the text), about 20 kilometers west-southwest of the village of Farson, Wyoming. 817 cataloged mammalian specimens have been collected from these areas (see Table 1 for faunal list) along with large numbers of isolated teeth and postcranial elements cataloged in miscellaneous lots.

Additional abbreviations used in the text include: AMNH (American Museum of Natural History, New York); UCM (University of Colorado Museum, Boulder); UM (University of Michigan Museum of Paleontology, Ann Arbor); USNM (United States National Museum, Washington, DC); UW (University of Wyoming Geology Museum, Laramie); YPM (Yale Peabody Museum, Yale University, New Haven). Specimen numbers included in referred specimen lists without acronyms are UM specimens. Much of the later Bridgerian comparative sample used in this study is based on the West collections now housed at UM. These collections consist of over 8,000 specimens from 417 different localities in lithostratigraphic intervals B (Br-2) through D (Br-3; see Fig. 1). All tooth and postcranial measurements are in millimeters (mm).

SYSTEMATIC PALEONTOLOGY

Order DIDELPHIMORPHA Gill, 1872
Family DIDELPHIDAE Gray, 1821
Tribe DIDELPHINI Crochet, 1979
Peratherium Aymard, 1846
Peratherium marsupium (Troxell, 1923)
(Fig. 2A)

Distribution. — Localities BB-6, 20, 37

TABLE 1— Mammals from Bridgerian biostratigraphic zone Br-1b, based on collections from Bridger lithostratigraphic interval A. Number of specimens representing each taxon is indicated in parentheses.

- Mammalia
  - Didelphimorpha
    - Didelphidae
      - Didelphini
        - *Peratherium marsupium* (3)
        - *Peratherium innominatum* (6)
        - *Peratherium knighti* (8)
        - *Peratherium* sp. (6)
      - Peradectini
        - *Peradectes chesteri* (9)
        - Cf. *Armintodelphys* sp. (2)
  - Cimolesta
    - Apatotheria
      - Apatemyidae
        - *Apatemys bellulus* (10)
    - Pantolesta
      - Pantolestidae
        - *Pantolestes longicaudus* (1)
    - Tillodontia
      - Esthonychidae
        - *Trogosus* sp. (2)
    - Taeniodonta
      - Stylinodontidae
        - *Stylinodon mirus* (4)
        - *Stylinodon inexplicatus* (1)
  - Erinaceomorpha
    - Sespedectidae
      - *Scenopagus priscus* (1)
      - *Scenopagus edenensis* (6)
      - *Scenopagus curtidens* (15)
  - Soricomorpha
    - Geolabididae
      - *Centetodon bembicophagus* (4)
    - Nyctitheriidae
      - *Nyctitherium serotinum* (1)
  - ?Primates
    - Microsyopidae
      - *Microsyops* sp., cf. *M. elegans* (50)
  - Primates
    - Notharctidae
      - *Notharctus robinsoni* (46)
      - *Smilodectes mcgrewi* (61)
    - Omomyidae
      - Anaptomorphinae
        - Anaptomorphini
          - *Anaptomorphus westi* (18)
          - Cf. *Gazinius amplus* (2)
        - Trogolemurini
          - *Trogolemur* sp., cf. *T. amplior* (2)
      - Omomyinae
        - Uintaniini
          - *Uintanius* sp., cf. *U. rutherfurdi* (2)
        - Washakiini
          - *Washakius insignis* (18)
        - Omomyini
          - *Omomys carteri* (58)
  - Order uncertain
    - Palaeanodonta
      - Metacheiromyidae
        - *Metacheiromys* sp. (13)
        - *Brachianodon westorum* (9)
      - Epoicotheriidae
        - *Tetrapassalus* sp. (14)
  - Rodentia
    - Paramyidae
      - *Paramys delicatus* (7)
      - *Paramys delicatior* (6)
      - *Leptotomus parvus* (20)
      - *Leptotomus grandis* (14)
      - *Thisbemys plicatus* (18)
      - *Microparamys* sp., cf. *M. minutus* (9)
    - Sciuravidae
      - *Sciuravus nitidus* (98)
    - Indet. (16)
  - Creodonta
    - Oxyaenidae
      - *Patriofelis* sp., cf. *ulta* (3)
    - Hyaenodontidae
      - *Sinopa rapax* (8)
      - *Sinopa minor* (3)
      - Hyaenodontid indet. (4)
    - Limnocyonidae
      - *Limnocyon* sp. (2)
      - *Thinocyon* sp., cf. *T. velox* (7)
  - Carnivora
    - Viverravidae
      - *Viverravus minutus* (6)
      - *Viverravus gracilis* (4)
    - Miacidae
      - *Miacis parvivorus* (3)
      - *Uintacyon vorax* (1)
      - *Vulpavus* sp., cf. *V. palustris* (2)
      - *Vulpavus farsonensis*, sp. nov. (2)
  - Condylarthra
    - Hyopsodontidae
      - *Hyopsodus minusculus* (68)
  - Dinocerata
    - Uintatheriidae
      - *Bathyopsis middleswarti* (4)
  - Perissodactyla
    - Equidae
      - *Orohippus* sp., cf. *O. pumilus* (28)
    - Brontotheriidae
      - *Palaeosyops fontinalis* (14)
    - Helaletidae
      - *Helaletes nanus* (6)
      - *Hyrachyus* sp. (61)
  - Artiodactyla
    - Homacodontidae
      - *Microsus cuspidatus* (9)
      - *Antiacodon* sp., cf. *A. pygmaeus* (9)
      - Homacodontid indet. (13)

Total = (817)

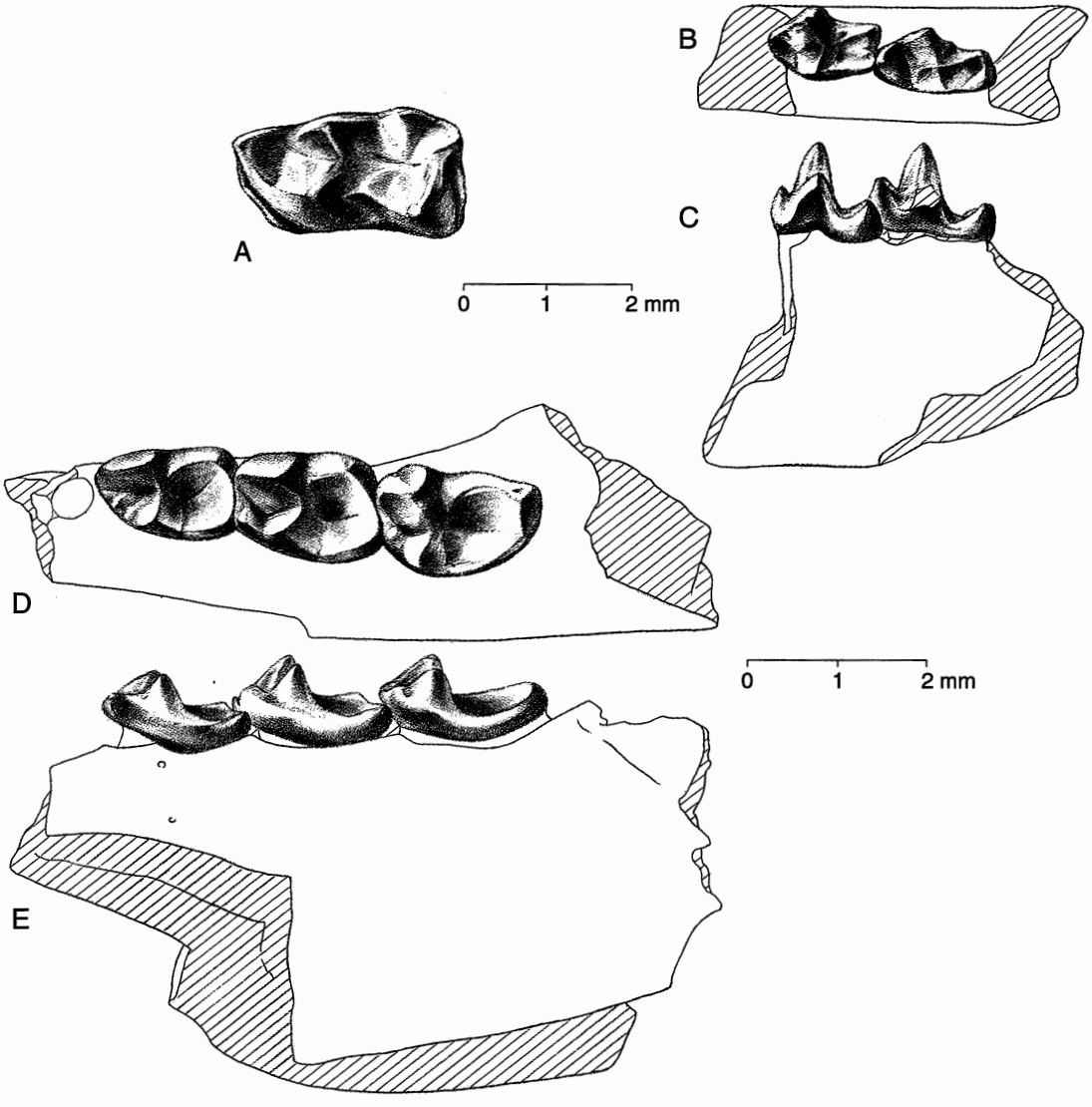

FIG. 2 — Marsupials and insectivores from Br-1b. A, *Peratherium marsupium*, UM 95611, left M_3 or M_4 from locality BB-37, in occlusal view. B-C, Cf. *Armintodelphys* sp., UM 100760, right dentary M_{3-4} from locality BI-32, in occlusal (B) and lingual (C) views. D-E, *Apatemys bellulus*, UM 95679, right dentary M_{1-3} from locality BB-53, in occlusal (D) and lingual (E) views. Scalebars = 2 mm.

Referred specimens. — **BB-6**: 101041, left dentary M_{2-3}. **BB-20**: 98941, right M_2 or M_3. **BB-37**: 95611, left dentary M_2 or M_3.

Discussion. — These three specimens represent the largest marsupials known from biostratigraphic zone Br-1b. They are larger than both *P. knighti* and *P. innominatum* but are smaller than *Peratherium comstocki*.

Measurements. — 95611: M_2 or M_3 = 2.6 × 1.5; 98941: M_2 or M_3 = 2.6 × 1.4; 101041: M_2 = 2.5 × 1.4; M_3 = 2.5 × 1.3.

Peratherium innominatum Simpson, 1928

Distribution. — Localities BB-20, 31; BI-7, 17, 20.

Referred specimens. — **BB-20**: 99963, right M^1; 101584, left dentary M_{1-2}. **BB-31**: 95583, right M_4. **BI-7**: 100424, left M_x (broken). **BI-17**: 100537, right dentary M_1 (talonid)-M_2, **BI-20**: 101183, right M^1.

Discussion. — These specimens represent the smallest species of *Peratherium* known from zone Br-1b. They appear to be slightly larger than is typical for *P. innominatum*, especially in lower molar length, but are smaller than is typical of *P. knighti* in lower molar width.

Measurements. — 95583: $M_4 = 1.9 \times 1.0$; 99963: $M^1 = 1.7 \times 1.6$; 100537: $M_2 = 2.1 \times 1.1$; 101183: $M^1 = 1.9 \times 1.7$; 101584: $M_1 = 2.0 \times 1.1$, $M_2 = 2.0 \times 1.1$.

Peratherium knighti McGrew, 1959

Distribution. — Localities BB-7, 90; BI-7, 17, 31, 32, 37.

Referred specimens. — **BB-7**: 99664, left dentary M_4. **BB-90**: 98867, right dentary P_{2-3}; 99868, right M^x (broken); 99910, right dentary M_4. **BI-7**: 100434, right M_2 or M_3. **BI-17**: 101424, right dentary M_2 or M_3. **BI-31**: 100694, right dentary P_{2-3}. **BI-32**: 100728, left dentary M_4. **BI-37**: 100790, left M^2.

Discussion. — Specimens assigned to *Peratherium knighti* are intermediate in size between those of *P. marsupium* and *P. innominatum*. The upper molars of *P. knighti* also exhibit a much shallower ectoflexus than do the other two previously mentioned species (Krishtalka and Stucky, 1983b).

Measurements. — 98867: $P_2 = 1.8 \times 0.9$, $P_3 = 1.9 \times 1.1$; 99910: $M_4 = 2.2 \times 1.2$; 100434: M_2 or $M_3 = 2.2 \times 1.3$; 100694: $P_2 = 1.9 \times 0.9$, $P_3 = 2.0 \times 1.1$; 100728: $M_4 = 2.0 \times 1.1$; 100790: $M^2 = 2.0 \times 2.0$; 101424: M_2 or $M_3 = 2.1 \times 1.1$.

Peratherium sp.

Distribution. — Localities BB-20, 109; BI-38, 43, 57, 58.

Referred specimens. — **BB-20**: 101997, left dentary M_4 (talonid). **BB-109**: 99919, right M_x (talonid). **BI-38**: 100821, right dentary M_4 (talonid). **BI-43**: 101336, left dentary P_3 (broken). **BI-57**: 101456, right dentary M_2 (talonid). **BI-58**: 101487, right M_x (broken).

Discussion. — Several specimens of *Peratherium* from Br-1b cannot be assigned with confidence to any particular species because of their fragmentary nature.

Tribe PERADECTINI Crochet, 1979
Peradectes Matthew and Granger, 1921
Peradectes chesteri Gazin, 1952

Distribution. — Localities BB-20, 37; BI-16, 17, 20, 26, 38, 54.

Referred specimens. — **BB-20**: 98945, right dentary M_{2-3}. **BB-37**: 95609, left dentary P_{1-3}, M_2. **BI-16**: 100866, left dentary M_4 (broken). **BI-17**: 100536, left dentary M_{3-4}. **BI-20**: 100589, left M_x; 101182, left dentary M_4. **BI-26**: 101189, right maxilla M^3. **BI-38**: 100817, right dentary M_1. **BI-54**: 101428, left dentary M_1.

Discussion. — These specimens are assigned to *Peradectes chesteri* based on their relatively small size and their relatively narrow molar talonids. Like all peradectins, they have low molar entoconids, a weak entoconid notch, and a closely twinned entoconid-hypoconulid with the hypoconulid dorsally projecting (Krishtalka and Stucky 1983a,b).

Measurements. — 95609: $P_1 = 1.0 \times 0.4$, $P_2 = 1.2 \times 0.6$, $P_3 = 1.1 \times 0.6$; 98945: $M_2 = 1.3 \times 0.8$, $M_3 = 1.3 \times 0.8$; 100536: $M_3 = 1.3 \times 1.0$, $M_4 = 1.4 \times 0.9$; 100589: $M_x = 1.3 \times 0.9$; 100817: $M_1 = 1.3 \times 0.7$; 101189: $M^3 = 1.3 \times 1.8$; 101428: $M_1 = 1.3 \times 0.8$.

Cf. *Armintodelphys* sp.
(Fig. 2B-C)

Distribution. — Localities BI-24, 32.

Referred specimens. — **BI-24**: 100636, left dentary M_2 (talonid)-M_3. **BI-32**: 100760, right dentary M_{3-4}.

Discussion. — Two specimens from Bridgerian zone Br-1b may represent *Armintodelphys*, previously only known from the latest Wasatchian and earliest Bridgerian in the Wind River Basin (Krishtalka and Stucky, 1983a,b) and from the early Bridgerian in the Uinta Basin (Krishtalka and Stucky, 1984). Like *Armintodelphys* and in contrast to other peradectins, these specimens have small molar entoconids, lack entoconid notches, and have molar paraconids relatively smaller than metaconids. Unlike *Armintodelphys*, the two Br-1b specimens have molar entoconids and hypoconulids of approximately the same size (not entoconid smaller as in typical *Armintodelphys*). UM 100636 and UM 100760 are similar in size to *A. dawsoni*, but unlike that species lack or have only small postcingulids on M_{2-3}.

Measurements. — 100636: $M_3 = 1.4 \times 0.8$; 100760: $M_3 = 1.3 \times 0.8$, $M_4 = 1.4 \times 0.7$.

Order CIMOLESTA McKenna, 1975
Suborder APATOTHERIA Scott and Jepsen, 1936
Family APATEMYIDAE Matthew, 1909
Apatemys Marsh, 1872
Apatemys bellulus Marsh, 1872
(Fig. 2D-E)

Distribution. — Localities BB-17, 20, 37, 53, 90; BI-20, 32, 34, 40.

Referred specimens. — **BB-17**: 94886, right edentulous dentary. **BB-20**: 99005, left edentulous dentary; 99968, left I^1. **BB-37**: 101022, right I_1. **BB-53**: 95679, right dentary M_{1-3}. **BB-90**: 101636, left edentulous dentary. **BI-20**: 100581, left edentulous dentary. **BI-32**: 100861, right I^1. **BI-34**: 100775, right I_1. **BI-40**: 101478, right I^1.

Discussion. — There are three species of *Apatemys* recognized from the Bridgerian (Fig. 3), clearly separable by size. The smallest species is *Apatemys bellulus*, while *A. bellus* is somewhat larger and *A. rodans* is much larger. An additional *Apatemys* species, smaller than *A. bellulus*, also may be present in Br-3. This species is poorly represented in UM Br-3 collections and formal description will have to await more complete specimens. All specimens of *Apatemys* from Bridgerian zone Br-1b represent *A. bellulus*.

Measurements. — 95679: $M_1 = 1.6 \times 1.2$, $M_2 = 1.8 \times 1.3$, $M_3 = 2.0 \times 1.3$.

Suborder PANTOLESTA McKenna, 1975
Family PANTOLESTIDAE Cope, 1884
Pantolestes Cope, 1872
Pantolestes longicaudus

Distribution. — Locality BB-50.

Referred specimen. — **BB-50**: 95664, right M^2.

Discussion. — There are five different species of *Pantolestes* recognized from the Bridgerian (Matthew, 1909). The single specimen from Bridgerian zone Br-1b most closely resembles

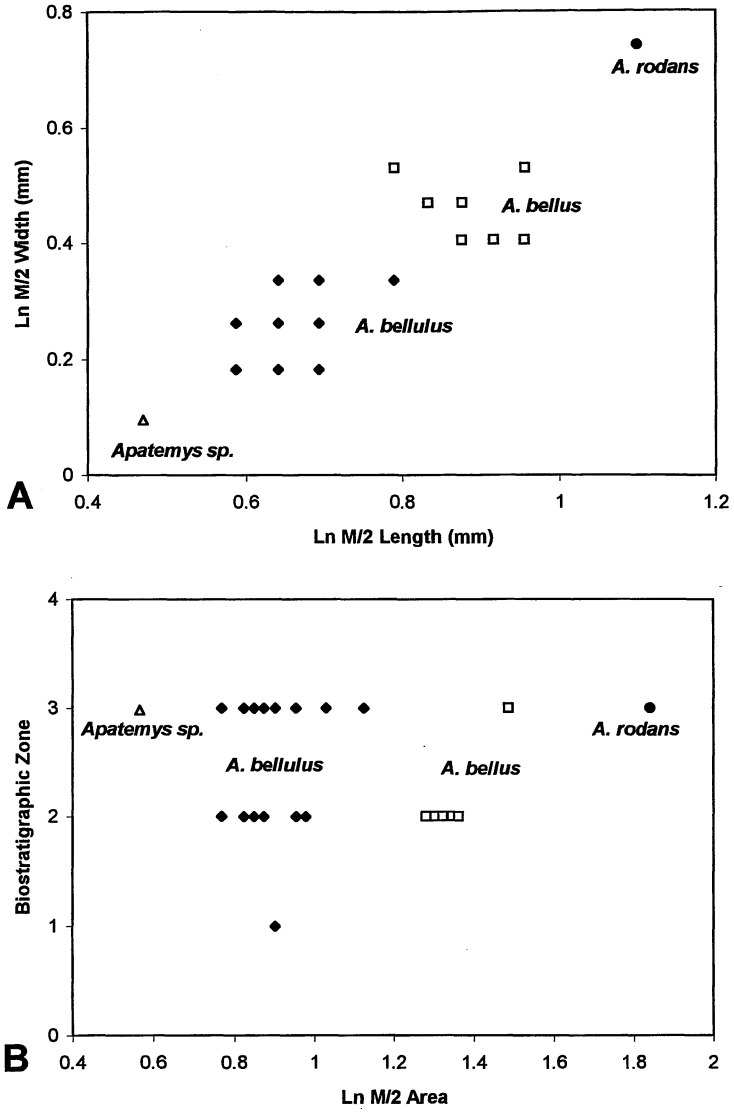

FIG. 3 — A, Bivariate plot of the natural log of M_2 length versus width for the UM sample of *Apatemys*. B, Stratigraphic distribution and size range of M_2 of *Apatemys*. Horizontal axis represents the natural log of M_2 area, vertical axis is divided into Bridgerian biostratigraphic intervals with Br-0/Br-1a (0) representing Gardnerbuttean specimens, Br-1b (1) representing specimens from lithostratigraphic interval A, Br-2 (2) representing specimens from lithostratigraphic interval B, Br-3 (3) representing specimens from lithostratigraphic intervals C and D. A fourth interval (4) is added for clarity of presentation but does not represent an included time interval. Note the presence of a single *Apatemys* species from Br-1b, two species from Br-2 and at least three species from Br-3. A single specimen (termed *Apatemys* sp.) may represent a new, very small species of *Apatemys* from Br-3.

P. longicaudus in size and morphology. The taxonomy of *Pantolestes* is confusing and it is nearly certain that the diversity recognized by Matthew (1909) is an over-estimation of the true number of Bridgerian species present.

Measurements. — 95664: $M^2 = 4.3 \times 5.6$.

Suborder TILLODONTIA Marsh, 1875
Family ESTHONYCHIDAE Cope, 1883
Trogosus Leidy, 1871
Trogosus sp.

Distribution. — Locality BB-3.
Referred specimens. — **BB-3**: 95685, molar fragment; 99682, incisor fragment.
Discussion. — These two partial teeth confirm the presence of *Trogosus* in Br-1b. Estimating tooth size from the fragments preserved indicates that these specimens were in the size range of *T. castoridens* or *T. grangeri* (Gazin, 1953).
Measurements. — Both teeth are too broken to provide accurate measurements.

Suborder TAENIODONTA Cope, 1876
Family STYLINODONTIDAE Marsh, 1875
Stylinodon Marsh, 1874
Stylinodon mirus Marsh, 1874
(Fig. 9A)

Distribution. — Localities BB-4, 20, 40, 49.
Referred specimens. — **BB-4**: 92884, two cheek teeth. **BB-20**: 95698, lower P_1, two cheek teeth (all fragmentary), associated postcranial elements. **BB-40**: 98952, cheek tooth fragments. **BB-49**: 95651, cheek tooth fragments.
Discussion. — While fragmentary, these specimens match well in size and morphology with those of *Stylinodon mirus* from the middle and later Bridgerian (Schoch, 1986).
Measurements. — All specimens are too fragmentary to be certain of tooth position or to provide accurate measurements.

Stylinodon inexplicatus Schoch and Lucas, 1981
(Fig. 9A)

Distribution. — Locality BB-10.
Referred specimen. — **BB-10**: 95485, associated cheek teeth and fragments.
Discussion. — This specimen represents a species of *Stylinodon* that is approximately half the size of *S. mirus*. Schoch and Lucas (1981) described *S. inexplicatus* from the Washakie Basin and noted that it was smaller than *S. mirus* by about one half.
Measurements. — It is impossible to determine with certainty the tooth positions of these isolated cheek teeth so no measurements were attempted.

Order ERINACEOMORPHA Gregory, 1910
Family SESPEDECTIDAE Novacek, 1985
Scenopagus McKenna and Simpson, 1959
Scenopagus priscus (Marsh, 1872)

Distribution. — Locality BI-29.
Referred specimen. — **BI-29**: 100840, left dentary $M_{1\text{-}2}$.
Discussion. — There are three *Scenopagus* species present in Bridgerian zone Br-1b. All are quite similar morphologically, differing mostly in the configuration of P_4 along with minor differences in lower and upper molar morphology (Krishtalka, 1976). *Scenopagus priscus* is the smallest species of *Scenopagus* known from the Bridgerian. A single specimen from Br-1b represents this species.
Measurements. — 100840: $M_1 = 1.5 \times 1.1$, $M_2 = 1.5 \times 1.1$.

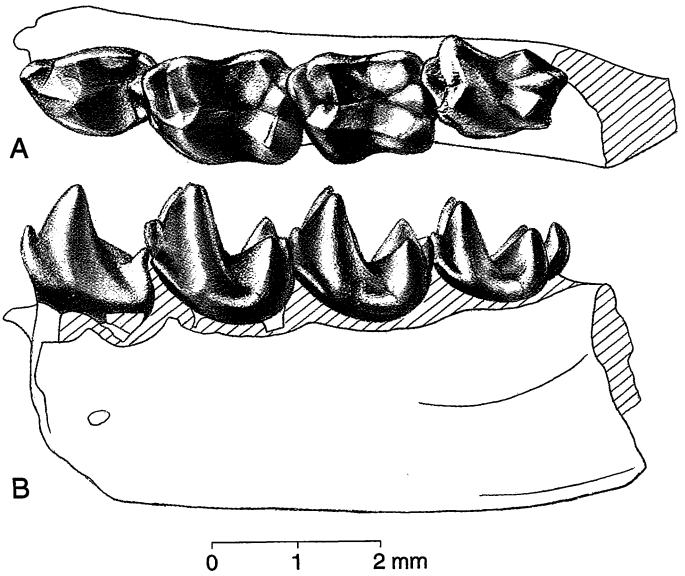

FIG. 4 — *Scenopagus curtidens* from Br-1b. UM 100534, left dentary P_4-M_3 from locality BI-17, in occlusal (A) and buccal (B) views. Scalebar = 2 mm.

Scenopagus edenensis (McGrew, 1959)

Distribution. — Localities BB-6, 90; BI-20, 26, 29, 30.

Referred specimens. — **BB-6**: 98634, left dentary P_{3-4}. **BB-90**: 98868, left dentary P_4. **BI-20**: 100610, right dentary M_{1-2}. **BI-26**: 100649, left M_x fragment. **BI-29**: 100839, right dentary P_4-M_1. **BI-30**: 100675, left dentary P_{3-4}.

Discussion. — *Scenopagus edenensis* is the largest species of *Scenopagus* found in Br-1b. *S. edenensis* can be further differentiated from the other two Br-1b species of *Scenopagus* by its more cuspate paraconid and relatively broad talonid on P_4. Additionally, *S. edenensis* has an unreduced, relatively elongate M_3 (Krishtalka, 1976).

Measurements. — 98634: $P_3 = 1.3 \times 1.1$, $P_4 = 2.1 \times 1.5$; 98868: $P_4 = 2.0 \times 1.4$; 100610: $M_2 = 2.2 \times 1.8$; 100675: $P_3 = 1.3 \times 0.9$, $P_4 = 1.9 \times 1.2$; 100839: $P_4 = 2.2 \times 1.5$, $M_1 = 2.2 \times 1.7$.

Scenopagus curtidens (Matthew, 1909)
(Fig. 4A-B)

Distribution. — Localities BB-6, 20, 37, 50, 90; BI-1, 17, 26, 30, 32, 54, 57.

Referred specimens. — **BB-6**: 98598, right dentary M_{1-2}. **BB-20**: 99972, right M_2; 99976, left dentary P_4-$M_{1,3}$, right dentary M_3. **BB-37**: 95608, right dentary M_{1-2}. **BB-50**: 98933, left dentary M_{2-3} (broken). **BB-90**: 99743, left dentary M_1. **BI-1**: 100405, right dentary M_{1-3}. **BI-17**: 100534, left dentary P_4-M_3. **BI-26**: 100646, right M_x trigonid. **BI-30**: 100676, right dentary M_3. **BI-32**: 100736, left dentary P_4; 100851, right dentary P_4 (erupting). **BI-54**: 101396, right dentary P_{3-4}. **BI-57**: 101468, left dP_4?; 101469, right dentary P_4.

Discussion. — *Scenopagus curtidens* is the most common insectivoran found in Br-1b. It can be differentiated from the other two Br-1b *Scenopagus* species by its intermediate size.

Measurements. — 95608: $M_1 = 1.5 \times 1.2$, $M_2 = 1.7 \times 1.3$; 98598: $M_1 = 1.6 \times 1.3$, $M_2 = 1.6 \times 1.3$; 99743: $M_1 = 1.8 \times 1.4$; 99972: $M_2 = 1.6 \times 1.4$; 99976: $P_4 = 1.4 \times 1.1$, $M_1 = 1.7 \times 1.3$, $M_3 = 1.6$

× 1.2; 100405: M_1 = 1.6 × 1.4, M_2 = 1.5 × 1.3, M_3 = 1.6 × 1.0; 100534: P_4 = 1.5 × 1.1, M_1 = 1.6 × 1.4, M_2 = 1.5 × 1.3, M_3 = 1.6 × 1.1; 100676: M_3 = 1.7 × 1.1; 100736: P_4 = 1.7 × 1.2; 101396: P_3 = 0.8 × 0.7, P_4 = 1.6 × 1.1; 101468: dP_4? = 2.4 × 1.5; 101469: P_4 = 1.6 × 1.2.

Order SORICOMORPHA Gregory, 1810
Family GEOLABIDIDAE McKenna, 1960
Centetodon Marsh, 1872
Centetodon bembicophagus Lillegraven *et al.*, 1981

Distribution. — Localities BI-17, 20.

Referred specimens. — **BI-17**: 100538, right dentary P_{3-4}; 101420, left maxilla P^4-M^2. **BI-20**: 100580, right M_x; 100596, right dentary M_x.

Discussion. — These specimens represent a small geolabidid and match the size and morphology of *C. bembicophagus* in nearly every way (Lillegraven *et al.*, 1981).

Measurements. — 100538: P_3 = 0.9 × 0.6, P_4 = 1.3 × 0.8; 100580: M_x = 1.5 × 1.0; 101420: P^4 = 1.7 × 1.6, M^1 = 1.6 × 2.1, M^2 = 1.5 × 2.1.

Family NYCTITHERIIDAE Simpson, 1928
Nyctitherium Marsh, 1872
Nyctitherium serotinum (Marsh, 1872)

Distribution. — Locality BI-17.

Referred specimen. — **BI-17**: 95610, left dentary M_{2-3}.

Discussion. — This specimen represents a *Nyctitherium* species intermediate in size between *N. velox* and *N. dasypelix* (Robinson, 1968). *Nyctitherium serotinum* is of the appropriate size and thus this specimen is assigned to that species.

Measurements. — 95610: M_2 = 1.4 × 1.1, M_3 = 1.4 × 0.9.

Order PRIMATES?
Suborder PLESIADAPIFORMES Simons and Tattersall, 1972
Superfamily MICROSYOPOIDEA Osborn and Wortman, 1892
Family MICROSYOPIDAE Osborn and Wortman, 1892
Microsyops Leidy, 1872
Microsyops sp., cf. *M. elegans*
(Fig. 6A, C)

Distribution. — Localities BB-1, 3, 6, 10, 11, 13, 17, 18, 20, 28, 36, 52, 73, 74, 95, 104, 119, 121; BI-14, 17, 20, 30-32, 34, 37, 38, 40.

Referred specimens. — **BB-1**: 94846, right M_2. **BB-3**: 95686, left dentary M_2; 98591, left maxilla M^3, right dentary M_{1-2}; 99684, left M_3. **BB-6**: 98649, right maxilla P^{3-4}; 98987, left M^3. **BB-10**: 95506, left M_1; 95521, right dentary M_2; 98989, right M^1. **BB-11**: 94866, left M_3 (broken). **BB-13**: 101624, left M^1 (broken). **BB-17**: 95536, left maxilla M^{2-3}. **BB-18**: 98675, left dentary M_2. **BB-20**: 95689, right dentary P_4-M_3; 95707, left dentary P_3-M_3; 98935, right dentary M_{1-2}; 98936, right P_4; 99974, left I_1; 101579, right dentary I_1, M_3; 101583, right dentary I_1. **BB-28**: 95561, left dentary M_{2-3}. **BB-36**: 99843, skull fragments, left maxilla P^3, right maxilla P^{3-4}, right dentary P_3-M_1. **BB-52**: 95673, right M_3 (broken). **BB-73**: 98711, left maxilla M^{2-3}, right P_4. **BB-74**: 98720, left M_x (broken). **BB-95**: 98954, left maxilla M^2. **BB-104**: 99669, right M^1 (broken). **BB-119**: 101516, left dentary M_1, right dentary I_1. **BB-121**: 101629, left M_2. **BI-14**: 100486, left M_1. **BI-17**: 100562, right M^3. **BI-20**: 100598, left dP^4; 100618, left M_1; 100689, right M_2. **BI-30**: 100672, left M^3. **BI-31**: 100722, right dentary M_3 (broken). **BI-32**: 100740, right dentary P_4-M_3; 100752, left P_4; 100863, right dentary M_2.

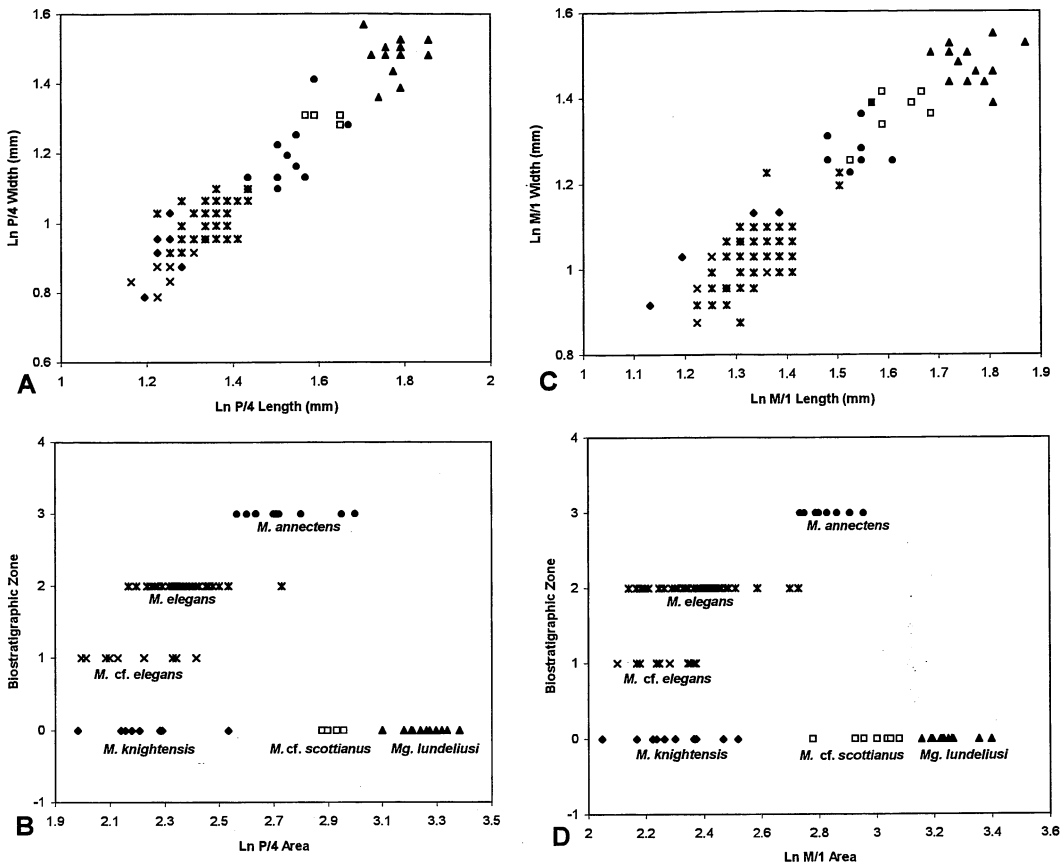

FIG. 5 — Tooth size and stratigraphic distribution of Bridgerian Microsyopidae. A and C are bivariate plots of length versus width for P_4 and M_1 based on specimens from UM, AMNH, USNM, and UCM collections. B and D are stratigraphic distributions of P_4 and M_1 size through Bridgerian sequence. Note presence of three microsyopid lineages in Br-0/Br-1a and single lineages throughout the rest of the Bridgerian.

BI-34: 100766, left M^1; 100770, left M^2. **BI-37**: 100781, left M_3 (broken). **BI-38**: 100809, left dentary P_3, M_1, right dentary P_4-M_2; 100819, left maxilla P^3-M^2; 100825, right dentary P_3-M_3; 100826, left dentary M_{2-3}. **BI-40**: 100908, right dentary P_2, M_{1-2}; 100917, right I_1; 101474, left dentary P_4-M_2, right M_2; 101475, left dentary M_{1-2}.

Discussion. — The evolutionary history of microsyopids across the Wasatchian-Bridgerian boundary is complex. Gunnell (1989) presented evidence to suggest that at least three lineages of microsyopids were present in the early Bridgerian (represented by *Microsyops knightensis*, *Microsyops* sp., cf. *M. scottianus*, and *Megadelphus lundeliusi*). This remains true, although it is now apparent that this diversity is only present in the earliest Bridgerian (Gardnerbuttean, Br-0/Br-1a), but does not typify samples derived from lithostratigraphic interval A (Br-1b) in the southern Green River Basin.

Tooth size plots of fourth lower premolars and first lower molars of Bridgerian *Microsyops* are presented in Figure 5 based on samples from UM, AMNH, USNM, and UCM collections. Br-0/Br-1a samples indicate the presence of a small lineage (*M. knightensis*) and two larger lineages (*Microsyops* sp., cf. *M. scottianus* and *M. lundeliusi*). A single lineage occurs in Br-1b, similar in size to that of the *M. knightensis* sample but also similar in size to the *M. elegans* sample from Br-2. While similar in size to *M. knightensis*, *M. elegans* differs by having more molariform upper and lower fourth premolars and more strongly dilambdodont upper molars (Gunnell, 1989). The

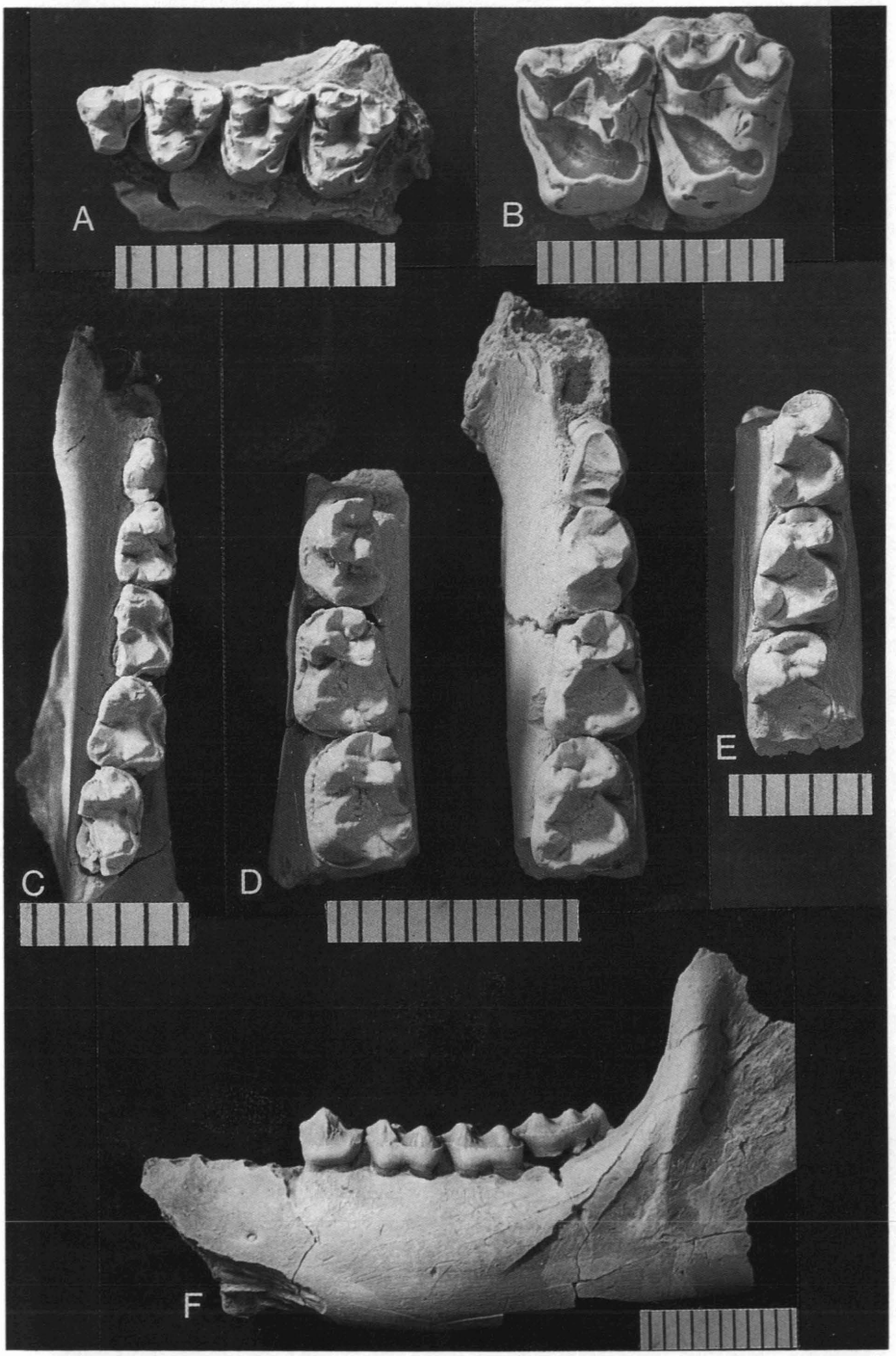

FIG. 6 — Bridgerian ?Primates and Primates from Br-1b. A, C, *Microsyops* sp., cf. *M. elegans*. A, UM 100819, left maxilla P^3-M^2 from locality BI-38, in occlusal view; C, UM 100825, right dentary P_3-M_3 from locality BI-38, in occlusal view. B, D, F, *Notharctus robinsoni*. B, UM 98590, left maxilla M^{1-2} from locality BB-3, in occlusal view; D, UM 98593, left dentary P_4-M_2 and right dentary P_3-M_2 from locality BB-3, in occlusal view; F, UM 94853, left dentary P_4-M_3 from locality BB-8, in buccal view. E, *Smilodectes mcgrewi*, UM 94887, right dentary M_{1-3} from locality BB-17, in occlusal view (M_3 missing hypoconulid).

TABLE 2 — *Microsyops* sp., cf. *M. elegans* summary tooth statistics. N = number of specimens, SD = standard deviation, CV = coefficient of variation.

Tooth Position	N	Range	Mean	SD	CV
P_3 Length	4	2.3-2.5	2.40	0.08	3.4
Width	4	1.4-1.6	1.50	0.08	5.5
P_4 Length	10	3.2-4.0	3.59	0.27	7.6
Width	10	2.2-2.8	2.46	0.19	7.7
M_1 Length	15	3.4-4.0	3.66	0.20	5.4
Width	15	2.4-3.1	2.74	0.20	7.4
M_2 Length	19	3.6-4.4	3.91	0.21	5.4
Width	19	2.7-3.2	3.02	0.16	5.4
M_3 Length	5	4.2-4.6	4.40	0.19	4.3
Width	5	2.7-3.0	2.94	0.13	4.6
P^3 Length	2	2.6	2.60	—	—
Width	2	2.8-2.9	2.85	—	—
P^4 Length	3	3.2-4.0	3.63	0.40	11.1
Width	3	3.8-4.4	4.13	0.31	7.4
M^1 Length	3	3.2-3.5	3.37	0.15	4.5
Width	3	3.9-4.1	4.00	0.10	2.5
M^2 Length	5	3.5-4.0	3.80	0.24	6.2
Width	5	4.1-4.8	4.54	0.27	6.0
M^3 Length	6	3.3-4.1	3.72	0.28	7.5
Width	6	3.8-5.4	4.25	0.58	13.7
dP^4 Length	1	3.4	3.40	—	—
Width	1	3.2	3.20	—	—

sample from Br-1b is transitional in these features, with some fourth premolars and upper molars resembling the morphology exhibited by *M. knightensis*, while others more closely resembling *M. elegans*. The samples from Br-1b are thus assigned to *Microsyops* sp., cf. *M. elegans*.

Measurements. — Measurements of *Microsyops* sp., cf. *M. elegans* are summarized in Table 2.

Order PRIMATES Linnaeus, 1758
Infraorder ADAPIFORMES Szalay and Delson, 1979
Family NOTHARCTIDAE Trouessart, 1879
Subfamily NOTHARCTINAE Trouessart, 1879
Notharctus Leidy, 1870
Notharctus robinsoni Gingerich, 1979
(Figs. 6B, D, F, 7)

Distribution. — Localities BB-2, 3, 6, 8, 10, 11, 16-18, 20, 25, 37, 44, 78, 101, 109, 119; BI-7, 9, 17, 20, 26, 30.

Referred specimens. — **BB-2**: 92881, right dentary M_1, left dentary P_3, M_{2-3}. **BB-3**: 95684, left dentary M_3; 98590, right maxilla P^4-M^1, left maxilla M^{1-2}; 98593, right dentary M_{1-2}, left dentary P_4-M_1. **BB-6**: 98605, left and right dentaries and maxillae; 98608, left dentary M_{2-3}; 98632, left M^x (broken); 98633, left dentary M_{1-2}, right dentary M_2; 98647, right M_1; 98986, left M_2. **BB-8**: 94853, left dentary P_4-M_3. **BB-10**: 94858, left dentary P_4-M_2; 95511, right M_3; 95513, right dentary P_4-M_3. **BB-11**: 94862, right dentary P_4-M_1; 94868, left dentary M_{1-3}; 94870, right dentary M_{1-2}. **BB-16**: 94881, right maxilla M^{2-3}. **BB-17**: 95534, left M^2, right M_3; 95535, right M_2; 99740, left M^2. **BB-18**: 99923, left dentary P_3-M_1, right dentary M_{1-3}; 101544, left dentary M_2. **BB-20**: 95691, right P^4. **BB-25**: 99713, associated lower teeth (broken). **BB-37**: 95607, right

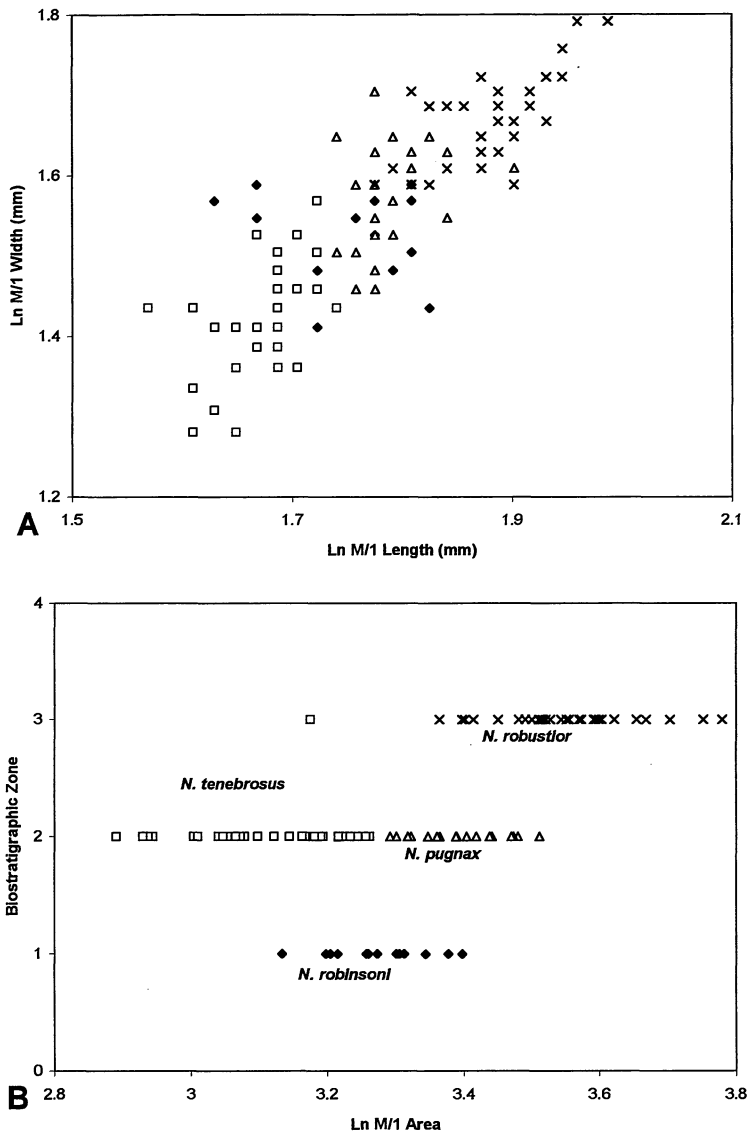

FIG. 7 — Tooth size and stratigraphic distribution of *Notharctus* specimens based on UM, AMNH, UW, and YPM collections. A, Bivariate plot of length versus width of M_1. B, Stratigraphic distribution of M_1 size through Bridgerian sequence. Note the presence of a single species of *Notharctus* in Br-1b, and the presence of two lineages in Br-2 and Br-3.

dentary P_3, left M_1; 98576, left dentary M_3. **BB-44**: 95634, right P^4, left M_{1-2}, right M_1. **BB-78**: 98751, left M^1. **BB-101**: 99654, left M_1. **BB-109**: 99917, right P_4 (broken). **BB-119**: 101512, left maxilla M^{1-3}. **BI-7**: 100435, right M_1. **BI-9**: 100443, left M_2. **BI-17**: 100553, left M^x (broken). **BI-20**: 100573, right M_3. **BI-26**: 100655, left M_2 (broken). **BI-30**: 100687, right M_1.

Discussion. — Gingerich (1979) distinguished *N. robinsoni* from *N. pugnax* by the smaller size of the former, while noting that *N. robinsoni* could be distinguished from *N. tenebrosus* by its larger size (Fig. 5). Based on the larger samples now available for *N. robinsoni*, several morphological differences can be added to the diagnosis.

TABLE 3 — *Notharctus robinsoni* summary tooth statistics. Abbreviations as in Table 2.

Tooth Position	N	Range	Mean	SD	CV
P_3 Length	5	3.4-4.3	3.96	0.34	8.7
Width	5	2.9-3.3	3.08	0.15	4.8
P_4 Length	6	5.0-5.5	5.18	0.19	3.7
Width	6	3.5-4.2	3.90	0.24	6.1
M_1 Length	16	5.1-6.2	5.80	0.33	5.6
Width	16	4.1-4.9	4.63	0.24	5.3
M_2 Length	17	5.9-6.7	6.17	0.22	3.6
Width	17	4.6-5.3	5.00	0.19	3.8
M_3 Length	10	6.4-8.0	7.15	0.46	6.4
Width	10	3.7-4.7	4.27	0.31	7.2
P^4 Length	4	4.5-4.7	4.60	0.08	1.8
Width	4	5.8-7.6	6.65	0.78	11.7
M^1 Length	3	6.1-6.4	6.20	0.17	2.8
Width	3	7.0-8.0	7.57	0.51	6.8
M^2 Length	8	5.8-6.4	6.04	0.21	3.4
Width	8	7.3-8.4	7.76	0.33	4.2
M^3 Length	3	4.8-4.9	4.87	0.06	1.2
Width	3	6.1-6.3	6.17	0.12	1.9

N. robinsoni differs from *N. pugnax* generally in having less bulbous and more acute premolar and molar cusps. The P_4 of *N. robinsoni* has a relatively narrower talonid (but often with a somewhat better developed talonid basin), a trigonid with a less distinct, but higher, pillar-like paraconid, and a higher, less anteriorly sloping paracristid. M_{2-3} of *N. robinsoni* retain small but distinct paraconids and the trigonid fovea remains open lingually, unlike the condition in *N. pugnax* where paraconids are absent on the last two molars and the lingual extension of the paracristid closes off the fovea. *N. robinsoni* has a smaller and less robust M_3 entoconid than does *N. pugnax*. M^{1-2} have smaller conules and lower hypocones that are less distinctly separated from the protocones in *N. robinsoni*. M^3 has slightly more distinct (but still tiny) conules in *N. robinsoni* compared to *N. pugnax*.

Notharctus robinsoni differs from *N. tenebrosus* in the following ways: P_4 generally broader with a more strongly developed paraconid and a lingually curving paracristid (sometimes present in *N. tenebrosus*); P_4 talonid relatively broader; M_{1-2} paraconids more prominent and higher with trigonid higher and more lingually closed; M_{1-3} relatively broader with relatively larger and more anteriorly extended trigonid fovea (especially M_3); upper molars generally similar to those of *N. tenebrosus* but with relatively weaker conules.

Measurements. — Measurements of *Notharctus robinsoni* are summarized in Table 3.

Smilodectes Wortman, 1903
Smilodectes mcgrewi Gingerich, 1979
(Fig. 6E)

Distribution. — Localities BB-6, 7, 10, 16-18, 25, 29, 37, 74, 105; BI-7, 11, 16, 20, 23, 26, 30-32, 34, 37, 38, 40, 49, 52, 55-57.

Referred specimens. — **BB-6**: 98640, right dentary M_2; 99689, left maxilla M^{2-3}, petrosal. **BB-7**: 98739, right P^3; 98742, right dentary P_4 (broken); 101045, left dentary P_3-M_1. **BB-10**: 95504, left maxilla M^{2-3}. **BB-16**: 94882, left dentary M_1. **BB-17**: 94887, right dentary M_{1-3}. **BB-18**: 98670,

right dentary M_{1-2}, postcrania; 98673, postcrania; 98674, left P_3; 99724, right M_3; 101541, left M_1. **BB-25**: 99712, upper molar fragment. **BB-29**: 99008, distal humerus. **BB-37**: 95606, left dentary M_{1-2}. **BB-74**: 98723, left dentary P_4 (broken). **BB-105**: 99672, left M_1 (broken); 99674, right dentary M_{1-3}; 99676, right dentary P_4-M_1. **BI-7**: 101176, right P_4 (broken). **BI-11**: 100464, left M_2 (broken). **BI-16**: 100873, left M_1 (trigonid); 100874, right M_3; 100876, left dentary P_4-M_1. **BI-20**: 100579, left dentary M_2; 100603, skull, postcrania; 100608, right M_3. **BI-23**: 100626, right M^1; 100627, right M_3. **BI-26**: 100652, right P^3; 100654, right M^3. **BI-30**: 100671, right dentary M_1; 100684, right dP_4; 101401, right M^3. **BI-31**: 100697, right dentary P_{3-4}; 100716, left dentary M_1 (broken); 101193, right M^3; 101194, right P_4; 101361, right M_3. **BI-32**: 100855, left M^1; 100858, left P_4; 100859, left M_2. **BI-34**: 100764, right dentary P_3-M_1; 100776, left dentary P_4-$M_{1,3}$. **BI-37**: 100780, right M_3 (broken); 100782, right M^3. **BI-38**: 100820, left M^x (broken). **BI-40**: 101505, right M^1, left M_3. **BI-49**: 101377, right dentary P_3. **BI-52**: 101392, right P^4. **BI-55**: 101432, left dentary M_{1-2}, postcrania. **BI-56**: 101434, left M^3 (broken). **BI-57**: 101465, right M_3; 101470, left M_1 (broken).

Discussion. — Gingerich (1979) differentiated *Smilodectes mcgrewi* from *S. gracilis* by the somewhat larger size of the former and also noted that there were few, if any, morphological characters that distinguished these species. Larger samples sizes now available do not help to clarify the species level taxonomy of *Smilodectes*. A careful comparison between samples of *Smilodectes* from Br-1b and Br-2 reveals only minor morphological differences. The only notable, consistent difference between the two samples is the presence of buccal and lingual cingulids on P_{3-4} in the Br-2 sample and the absence of these cingulids in the Br-1b sample.

Tooth size differences between the Br-1b and Br-2 *Smilodectes* samples do exist (Fig. 8), but are inconsistent through the tooth row. Br-1b *Smilodectes* molars tend to be slightly larger than those from Br-2, but P_4 does not differ much in size between the two samples. *Smilodectes mcgrewi* is maintained here as a distinct chronospecies, but it is recognized that the differences between the two samples are slight and all specimens probably could be included in a single species, *Smilodectes gracilis*.

Measurements. — Measurements of *Smilodectes mcgrewi* are summarized in Table 4.

Infraorder OMOMYIFORMES Trouessart, 1879
Family OMOMYIDAE Trouessart, 1879

Omomyid primates from the Bridger Formation have been reviewed recently by Gunnell (1995). The following is presented as a summary of biostratigraphic zone Br-1b omomyids only.

Subfamily ANAPTOMORPHINAE Cope, 1883
Tribe ANAPTOMORPHINI Cope, 1883
Anaptomorphus Cope, 1872
Anaptomorphus westi Szalay, 1976

Distribution. — Localities BB-6, 18, 20; BI-16, 20, 26, 32, 37, 38.

Referred specimens. — **BB-6**: 98607, right maxilla P^4-M^1 (broken M^{2-3}); 98644, right maxilla M^{1-3}. **BB-18**: 99723, right maxilla M^{1-3}. **BB-20**: 94891, right dentary M_{2-3}; 95709, left dentary P_4-M_2; 95710, left maxilla, M^{1-2}; 95713, right M^2; 98947, left dentary M_3; 99973, right dentary P_4-M_3. **BI-16**: 100867, left dentary M_{1-2}. **BI-20**: 100611, right dentary P_4-$M_{1,3}$; 101186, right M_2. **BI-26**: 100656, right dentary P_4-M_1. **BI-32**: 100751, left dentary M_2, right dentary M_{2-3}; 100846, left dentary M_{1-3}. **BI-37**: 100784, right dentary M_1. **BI-38**: 100805, right M_1; 100822, right dentary M_2.

Discussion. — See Gunnell (1995) for measurements and further discussion of *Anaptomorphus westi*.

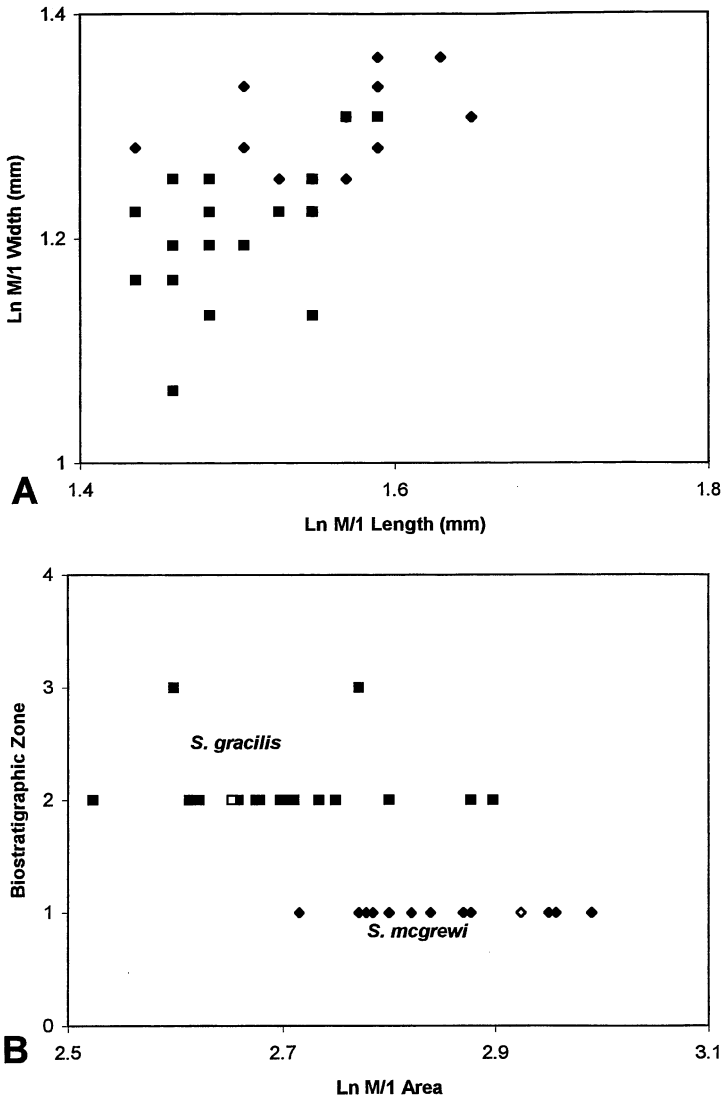

FIG. 8 — Tooth size and stratigraphic distribution of *Smilodectes* specimens based on UM, AMNH, UW, and YPM collections. A, Bivariate plot of length versus width of M_1. B, Stratigraphic distribution of M_1 size through Bridgerian sequence. Note presence of a single lineage throughout Bridgerian sequence. *Smilodectes mcgrewi* and *Smilodectes gracilis* can only be distinguished based on slight differences in the ranges of tooth size and may represent a single species. Open symbols represent holotype specimens of *S. mcgrewi* (diamond) and *S. gracilis* (square).

Gazinius Bown, 1979
Cf. *Gazinius amplus*

Distribution. — Localities BI-9, 32.

Referred specimens. — **BI-9**: 100442, right P_4. **BI-32**: 100750, left M^2.

Discussion. — See Gunnell (1995) for measurements and discussion of these Cf. *Gazinius amplus* specimens. Note that Gunnell (1995) states that these specimens are from Bridgerian zone Br-2, when in fact, both are from zone Br-1b.

TABLE 4 — *Smilodectes mcgrewi* summary tooth statistics. Abbreviations as in Table 2.

Tooth Position	N	Range	Mean	SD	CV
P_3 Length	6	3.0-4.2	3.55	0.44	12.3
Width	6	2.1-3.2	2.57	0.41	15.9
P_4 Length	10	3.6-4.3	4.06	0.25	6.1
Width	10	2.8-3.4	3.04	0.22	7.1
M_1 Length	15	4.2-5.2	4.75	0.25	5.3
Width	15	3.4-3.9	3.65	0.16	4.4
M_2 Length	9	4.4-5.6	5.00	0.32	6.4
Width	9	3.7-4.9	4.00	0.39	9.8
M_3 Length	9	5.3-6.9	6.14	0.51	8.3
Width	9	3.4-4.9	3.92	0.61	15.5
P^3 Length	3	3.2-3.4	3.30	0.10	3.0
Width	3	3.4-3.7	3.60	0.17	4.8
P^4 Length	2	3.7-3.8	3.75	—	—
Width	2	4.6-4.7	4.65	—	—
M^1 Length	2	4.6-4.9	4.75	—	—
Width	2	5.2-6.0	5.60	—	—
M^2 Length	2	4.9	4.90	—	—
Width	2	5.9-6.5	6.20	—	—
M^3 Length	6	3.9-4.3	4.10	0.17	4.1
Width	6	4.8-5.7	5.20	0.32	6.1

Tribe TROGOLEMURINI Szalay, 1976
Trogolemur Matthew, 1909
Trogolemur sp., cf. *T. amplior*

Distribution. — Localities BB-6; BI-17.

Referred specimens. — **BB-6**: 99703, left dentary M_3. **BI-17**: 100549, left dentary P_4-M_3.

Discussion. — See Gunnell (1995) for measurements and discussion of these *Trogolemur* sp., cf. *T. amplior* specimens. *Trogolemur amplior* was previously known only from the early Gardnerbuttean (Br-0) in the Wind River Basin, Wyoming (Beard *et al.*, 1992).

Subfamily OMOMYINAE Trouessart, 1879
Tribe UINTANIINI Szalay, 1976
Uintanius Matthew, 1915
Uintanius sp., cf. *U. rutherfurdi*

Distribution. — Localities BB-90; BI-38.

Referred specimens. — **BB-90**: 99727, left dentary P_3-M_1. **BI-38**: 101200, right P_3.

Discussion. — See Gunnell (1995) for measurements and discussion of these *Uintanius* sp., cf. *U. rutherfurdi* specimens. Gunnell (1995) states that locality BB-90 is in Bridgerian zone Br-1b (Br-1 of Gunell, 1995). Locality BB-90 is earliest Br-2 instead (the base of this locality is formed by the ostracodal limestone layer separating lithostratigraphic intervals A and B). *U. rutherfurdi* has previously been described only from the late Gardnerbuttean (Br-1a) of the Huerfano Basin in Colorado (Robinson, 1966) and the early Gardnerbuttean (Br-0) in the Wind River Basin, Wyoming (Beard *et al.*, 1992).

Tribe WASHAKIINI Szalay, 1976
Washakius Leidy, 1873
Washakius insignis Leidy, 1873

Distribution. — Localities BB-6, 17, 37, 73, 90; BI-7, 15, 17, 20, 30-32.

Referred specimens. — **BB-6**: 97874, left dentary C_1-M_1; 99702, left dentary M_1. **BB-17**: 99718, left dentary M_1. **BB-37**: 98575, right dentary P_3; 101019, left dentary M_2. **BB-73**: 98708, left dentary M_{2-3}. **BB-90**: 99726, left dentary P_2-M_2. **BI-7**: 100440, right dentary M_{2-3}. **BI-15**: 100884, right P_4. **BI-17**: 100560, left maxilla M^{1-3}. **BI-20**: 100582, right P_3; 100583, right dentary M_{1-2}; 100593, left dentary P_4. **BI-30**: 100683, right M_1. **BI-31**: 100695, right dentary M_{1-2}; 100696, left maxilla M^{1-2}; 100705, right dentary P_2-M_2. **BI-32**: 100749, left dentary M_{2-3}; 100860, right dentary M_3 talonid.

Discussion. — See Gunnell (1995) for measurements and discussion of these *Washakius insignis* specimens.

Tribe OMOMYINI Trouessart, 1879
Omomys Leidy, 1869
Omomys carteri Leidy, 1869

Distribution. — Localities BB-6, 7, 10, 11, 17, 20, 28, 30, 40, 64, 70, 74, 82, 102; BI-7, 9, 10, 15-17, 20, 26, 29-32, 37, 38, 43, 46, 54.

Referred specimens. — **BB-6**: 98604, left dentary P_{3-4}, right dentary P_4-M_3, postcrania; 98638, right dentary M_1; 98639, left dentary P_4; 98643, left dentary M_{1-3}; 98645, left astragalus; 98983, right proximal calcaneum; 99699, left dentary P_{3-4}; 99700, right dentary P_{3-4}; 99701, left dentary P_3; 99736, left dentary M_{1-3}. **BB-7**: 98652, right dentary P_4-M_1; 99663, left M_3. **BB-10**: 95509, right maxilla M^{2-3}; 98685, left dentary M_{1-2}. **BB-11**: 94865, right M_3. **BB-17**: 99717, right M_1. **BB-20**: 95711, left dentary M_{1-3}. **BB-28**: 101600, right M^x. **BB-30**: 95577, right P_4. **BB-40**: 95617, left M^3. **BB-64**: 98615, right M^x. **BB-70**: 99658, right maxilla P^3-M^2. **BB-74**: 101038, right dentary M_{2-3}. **BB-82**: 98768, right dentary P_3-M_3. **BB-102**: 99655, right M_2. **BI-7**: 101177, right P^4. **BI-9**: 100448, right dentary P_4; 101178, left M^1. **BI-10**: 101179, left P^3. **BI-15**: 100528, right dentary M_{1-2}. **BI-16**: 100870, left M^1. **BI-17**: 100546, right M_2. **BI-20**: 100590, right M_1; 100592, right M_2; 100597, right dentary M_{1-3}; 100602, left M_{1-2}; 100609, left maxilla P^4-M^2; 100619, right M_3; 100800, left M^1; 101185, right P_3. **BI-26**: 100650, left dentary P_4-M_1. **BI-29**: 100838, left M_2. **BI-30**: 100685, left M^1. **BI-31**: 100703, right M_2; 100707, left dentary P_4-M_1; 100708, right P_3; 100710, left dentary P_4-M_2; 101362, left dentary M_{1-2}. **BI-32**: 100748, right dentary M_2; 101196, right M_1; 101197, right M_1; 101198, left M_2; 101199, right P^4. **BI-37**: 100786, right dentary P_3-M_1. **BI-38**: 100815, distal phalanx. **BI-43**: 101335, right M_2. **BI-46**: 101351, left M_1. **BI-54**: 101429, right M^3.

Discussion. — The UM sample of *Omomys carteri* has been recently reviewed by Coupar (1996, and in preparation).

Order DINOCERATA Marsh, 1873
Family UINTATHERIIDAE Flower, 1876
Bathyopsis Cope, 1881
Bathyopsis middleswarti Wheeler, 1961
(Fig. 9B)

Distribution. — Localities BB-8; BI-13, 40.

Referred specimens. — **BB-8**: 94852, right I_3, two broken cheek teeth, associated fragments. **BI-13**: 100474, edentulous right dentary and left maxilla of juvenile, associated fragments. **BI-40**:

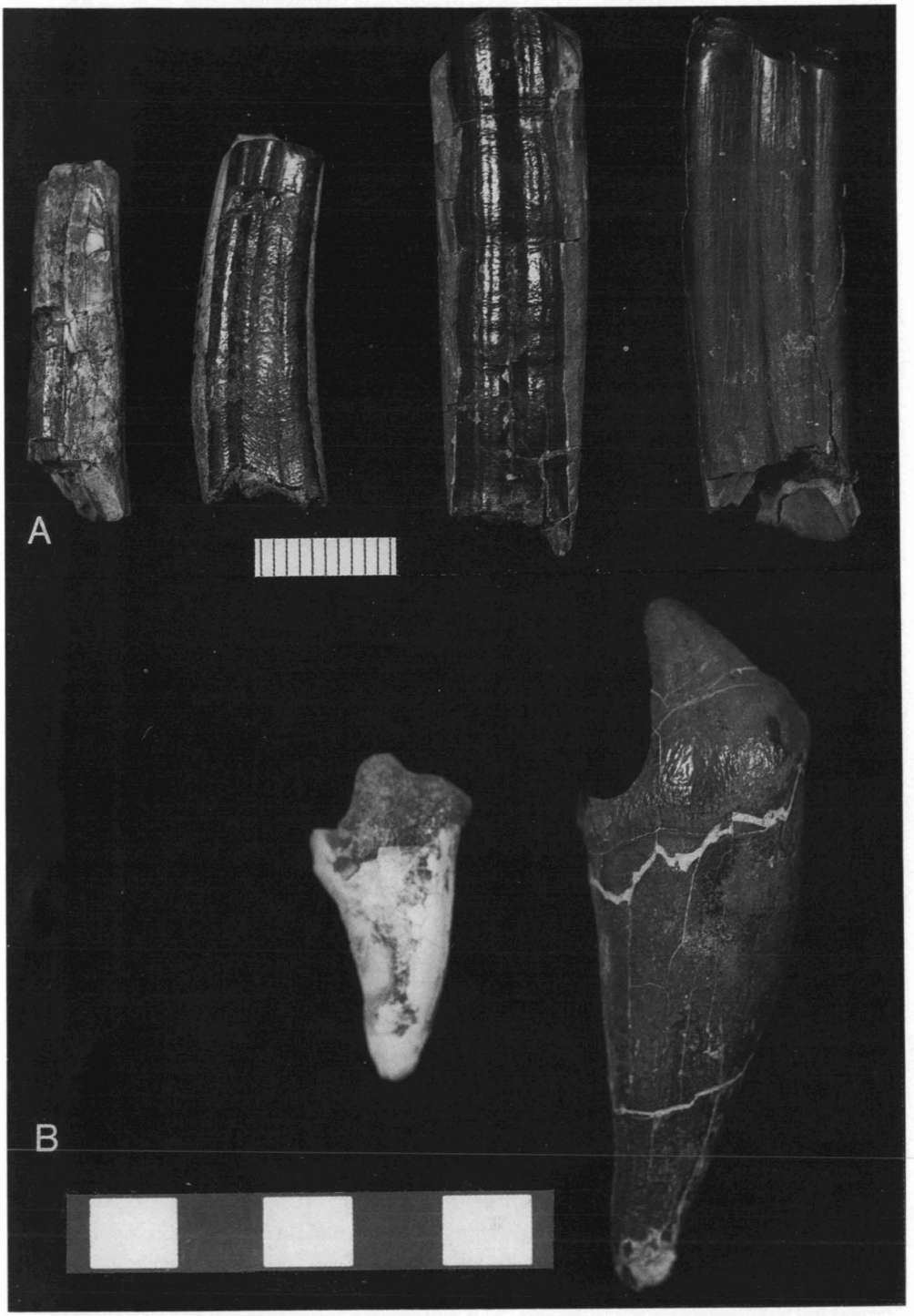

FIG. 9 — Taeniodonta, Dinocerata, and Condylarthra from Br-1b. A, Left two specimens, *Stylinodon inexplicatus*, UM 95485, cheek teeth from locality BB-10, right two specimens, *Stylinodon mirus*, UM 95698, cheek teeth from locality BB-20. Note much larger size of *S. mirus* cheek teeth. B, *Bathyopsis middleswarti*, on left, UM 94852, right I_3 from locality BB-8, on right, UM 101481, right I_2 from locality BB-40, both in lateral view.

FIG. 10 — *Hyopsodus minusculus*, UM 100642, rostrum with right P^3-M^3 from locality BI-26, in occlusal view.

101481, symphysis with edentulous dentary fragments, right I_2, associated fragments; 101507, associated postcranial fragments.

Discussion. — *Bathyopsis* specimens from Br-1b are fragmentary but all represent a medium sized uintathere distinct from later occurring *Uintatherium*. There are no known specimens representing uintatheres from Br-2. *Bathyopsis* is only known from Br-1b in the Green River Basin, while *Uintatherium* is known only from Br-3 (Wheeler, 1961; Gunnell and Bartels, 1994).

Measurements. — 94852: I_3 = 19.6 × 9.5; 101481: I_2 = 29.1 × 17.4.

Order CONDYLARTHRA Cope, 1881
Family HYOPSODONTIDAE Trouessart, 1879
Hyopsodus Leidy, 1870
Hyopsodus minusculus Leidy, 1870
(Fig. 10)

Distribution. — Localities BB-10, 17, 20, 21, 28, 29, 42, 47, 50, 63, 80; BI-9, 14-18, 20, 22, 24, 26, 30-32, 34, 37-40, 46, 57, 60.

Referred specimens. — **BB-10**: 95507, right dentary M_{1-2}; 95515, right dentary M_{2-3}. **BB-17**: 99716, right maxilla M^{2-3}. **BB-20**: 94892, right dentary M_{1-3}; 95699, left P_3, M_1; 95700, left dentary P_3, M_{1-3}; 95701, left dentary P_2-M_2; 95702, left maxilla P^3-M^3; 95706, left dentary P_4-M_3; 95712, left maxilla P^3-M^3; 95715, left dentary M_{1-2}; 95716, left dentary P_4-M_1; 98937, left dentary M_{2-3}; 98938, right dentary P_4-M_2; 98940, right dentary P_2, M^x; 98946, left maxilla P^{2-3}; 99962, left dentary P_3-M_1, left and right P^4, left M^1; 99964, left dentary P_4-M_1; 99965, left maxilla M^{2-3}; 99966, right dentary P_{2-3}; 101575, right maxilla P^4-M^3; 101580, left maxilla M^{2-3}; 101589, right maxilla M^3; 101998, right maxilla M^{1-2}. **BB-21**: 94895, left and right dentaries I_x, P_3. **BB-28**: 101601, left M^3. **BB-29**: 95569, left maxilla P^2-M^1, left dentary M_{2-3}. **BB-42**: 95624, right P^4-M^3. **BB-47**: 95642, right M^{2-3}. **BB-50**: 98934, right dentary P_{3-4}. **BB-63**: 98611, right M_x. **BB-80**: 98764, right M^{1-2}. **BI-9**: 100446, right M^1; 100447, right M^x. **BI-14**: 100485, right M_2. **BI-15**: 100530, right M_2. **BI-16**: 100868, right M^x. **BI-17**: 100542, right dentary M_x; 100548, right M^x. **BI-18**: 100564, right maxilla M^{2-3}. **BI-20**: 100616, right M^2. **BI-22**: 100623, right dentary M_{2-3}. **BI-24**: 100634, left dP_4. **BI-26**: 100642,

TABLE 5 — *Hyopsodus minusculus* summary tooth statistics. Abbreviations as in Table 2.

Tooth Position	N	Range	Mean	SD	CV
P_2 Length	2	1.9-2.2	2.05	—	—
Width	2	1.5	1.50	—	—
P_3 Length	9	2.4-2.9	2.60	0.15	5.8
Width	9	1.8-2.0	1.84	0.07	4.0
P_4 Length	10	2.7-3.1	2.92	0.16	5.3
Width	10	2.0-2.4	2.22	0.10	4.7
M_1 Length	13	3.2-3.7	3.43	0.14	4.0
Width	13	2.5-2.8	2.67	0.09	3.2
M_2 Length	17	3.3-3.8	3.65	0.19	5.1
Width	17	2.7-3.1	2.86	0.14	4.8
M_3 Length	9	3.5-4.3	3.86	0.26	6.6
Width	9	2.4-2.9	2.62	0.14	5.3
P^2 Length	3	2.1-2.5	2.33	0.21	8.9
Width	3	1.8-2.0	1.90	0.10	5.3
P^3 Length	5	2.6-2.8	2.68	0.08	3.1
Width	5	2.9-3.1	3.04	0.09	2.9
P^4 Length	8	2.4-2.6	2.54	0.09	3.6
Width	8	3.4-4.2	3.71	0.25	6.8
M^1 Length	8	3.0-3.6	3.34	0.18	5.3
Width	8	3.8-4.5	4.11	0.24	5.7
M^2 Length	16	3.3-4.1	3.57	0.19	5.3
Width	16	4.3-5.4	4.80	0.29	5.9
M^3 Length	10	2.5-3.4	2.88	0.25	8.8
Width	10	3.7-4.6	4.19	0.30	7.2

rostrum with right P^3-M^3. **BI-30**: 100678, left dentary M_{1-2}; 100833, left dentary P_{3-4}. **BI-31**: 100693, left M^1; 100701, right M^2; 100717, left and right dentaries M_{2-3}; 100724, left M^x; 100849, left dentary M_{1-2}, left M_1; 101192, left M^3; 101195, left P_4. **BI-32**: 100735, left and right M_x; 100742, right dentary M_{2-3}; 100745, right dP^4; 100747, left dentary P_3-M_1, left P^4; 100754, right maxilla P^2. **BI-34**: 100774, left M_2. **BI-37**: 100789, left M^3; 100793, right dentary P_4. **BI-38**: 100808, left dentary M_{2-3}. **BI-39**: 100880, right M^2. **BI-40**: 101503, left M_2. **BI-46**: 101350, left M_3. **BI-57**: 101459, right M^x; 101462, right M^x; 101464, right P_4. **BI-60**: 101494, right M^3.

Discussion. — Gazin (1968) and West (1979a,b) have thoroughly described the dental variation and size distribution of Bridgerian *Hyopsodus*. Two species of *Hyopsodus* are known from Br-2, *H. paulus* (larger) and *H. minusculus* (smaller). The specimens from Br-1b fall into the size range of *H. minusculus* and are assigned to that species.

Gazin (1968) noted an interesting distribution of *Hyopsodus* species within the Bridger Basin, with both Br-2 species being present in the northern parts of the basin, but only *H. paulus* being known from the southern portions of the basin. All of the Br-1b localities are situated in the northern part of the Bridger Basin. This may indicate that *H. minusculus* represented an immigrant species that arrived from a northern source area or alternatively that *Hyopsodus* species practiced some form of habitat specialization and partitioning. Further evidence of possible habitat preference comes from the distribution of *Hyopsodus* specimens in the BB localities. Of the 32 specimens of *Hyopsodus* known from the BB localities, 21 (over 65%) come from a single locality (BB-20). BB-20 represents a much different depositional setting (drier with more fluvial deposits and fewer lacustrine deposits) than most other BB localities and suggests that *Hyopsodus minusculus* may have preferred areas away from the major lake system that dominated much of the Bridger Basin during the middle Eocene (Lillegraven and Ostresh, 1988).

Measurements. — Measurements of *Hyopsodus minusculus* are summarized in Table 5.

Order Uncertain
Suborder PALAEANODONTA Matthew, 1918
Family METACHEIROMYIDAE Wortman, 1903
Metacheiromys Wortman, 1903
Metacheiromys sp.

Distribution. — Localities BB-6, 10, 17, 20, 35, 37, 74; BI-1, 17, 24, 38, 47.

Referred specimens. — **BB-6**: 99688, right proximal and distal femur. **BB-10**: 99641, postcrania. **BB-17**: 99715, postcrania. **BB-20**: 101578, right proximal humerus. **BB-35**: 95594, right astragalus, associated postcrania. **BB-37**: 98573, third metacarpal. **BB-74**: 101037, left dentary. **BI-1**: 100408, distal femoral epiphysis; 100409, left third metacarpal. **BI-17**: 100557, right dentary. **BI-24**: 100632, proximal humerus. **BI-38**: 100828, proximal humerus. **BI-47**: 101370, second metacarpal.

Discussion. — There are at least two different species of *Metacheiromys* present from Br-1b. The smaller species probably represents *M. marshi*, while the larger species may represent either *M. tatusia* or *M. dasypus* (Simpson, 1931; Schoch, 1984). The UM Bridgerian sample of metacheiromyids is currently under study (Rose and Emry, in preparation) and will be reported on more fully elsewhere.

Brachianodon Gunnell and Gingerich, 1993
Brachianodon westorum Gunnell and Gingerich, 1993

Distribution. — Localities BB-6, 7, 17; BI-3, 15, 24, 31.

Referred specimens. — **BB-6**: 101559, left distal radius. **BB-7**: 98743, left and right dentaries, skeleton (Holotype). **BB-17**: 99720, right dentary with postcanine tooth. **BI-3**: 100415, left third metacarpal; 101175, left proximal humerus. **BI-15**: 101181, right second metacarpal. **BI-24**: 101187, right proximal humerus. **BI-31**: 100692, left third metacarpal; 100699, left second metacarpal; 100709, right second metacarpal, distal femur.

Discussion. — *Brachianodon westorum* has been thoroughly described by Gunnell and Gingerich (1993).

Family EPOICOTHERIIDAE Simpson, 1927
Tetrapassalus Simpson, 1959
Tetrapassalus sp.

Distribution. — Localities BB-6, 10, 109; BI-1, 7, 10, 24, 26, 31, 37, 40, 57.

Referred specimens. — **BB-6**: 99694, proximal humerus. **BB-10**: 99644, proximal humerus. **BB-109**: 99920, right proximal humerus and proximal ulna. **BI-1**: 100410, left dentary with three postcanine teeth. **BI-7**: 100438, right third metacarpal. **BI-10**: 101180, phalanx. **BI-24**: 100633, right third metacarpal, distal femur; 100635, right dentary with one postcanine tooth. **BI-26**: 100643, phalanx; 101190, metatarsal. **BI-31**: 100712, left dentary. **BI-37**: 100791, proximal humerus. **BI-40**: 100914, left third metacarpal. **BI-57**: 101457, right dentary.

Discussion. — *Tetrapassalus* is a poorly understood genus represented by only a few specimens. Two species, *T. mckennai* (Simpson, 1959) and *T. proius* (West, 1973) have been described but it remains unclear if these truly represent different species as the record of each is restricted to the holotype only. The Br-1b specimens are smaller in comparable morphology than *T. mckennai* and may well represent *T. proius* or a new species. The UM sample of Bridgerian epoicotheriids is under study (Rose and Emry, in preparation) and will be reported on elsewhere.

Order RODENTIA Bowdich, 1821
Family PARAMYIDAE Miller and Gidley, 1918
Paramys Leidy, 1871
Paramys delicatus Leidy, 1871
(Figs. 11A, 12)

Distribution. — Localities BB-3, 10; BI-16, 20, 29-31.

Referred specimens. — **BB-3**: 95682, right dentary M_{1-3}. **BB-10**: 95517, two upper molars. **BI-16**: 100872, left dentary M_{1-2}, postcrania. **BI-20**: 100614, left M_2. **BI-29**: 100667, left dentary P_4. **BI-30**: 100842, left dentary M_{1-2}. **BI-31**: 101364, right dentary M_1.

Discussion. — *Paramys* is not one of the more common paramyid genera found in Br-1b. These specimens represent the larger of the two species of *Paramys* present.

Measurements. — 95517: $M^1 = 4.4 \times 5.2$; 95682: $M_2 = 4.3 \times 4.1$, $M_3 = 5.4 \times 4.1$; 100614: $M_2 = 4.5 \times 4.4$; 100667: $P_4 = 4.3 \times 4.3$; 100872: $M_1 = 4.1 \times 3.9$, $M_2 = 4.4 \times 4.3$.

Paramys delicatior Leidy, 1871
(Fig. 11B)

Distribution. — Localities BB-11, 15, 20, 73; BI-38.

Referred specimens. — **BB-11**: 94860, left and right dentaries. **BB-15**: 94879, left dentary P_4-M_1. **BB-20**: 101576, right M_x. **BB-73**: 98710, right dentary M_{2-3}. **BI-38**: 100803, right M_2; 100827, right maxilla P^3-M^1;

Discussion. — These specimens represent the smaller of the two *Paramys* species present in Br-1b.

Measurements. — 94860: $P_4 = 3.4 \times 3.1$, $M_1 = 3.3 \times 3.3$, $M_2 = 3.6 \times 3.5$, $M_3 = 4.0 \times 3.6$; 94879: $M_1 = 3.6 \times 3.5$; 98710: $M_2 = 3.3 \times 3.2$, $M_3 = 3.6 \times 3.3$; 100803: $M_2 = 3.6 \times 3.5$; 100827: $P^3 = 1.1 \times 1.3$, $P^4 = 3.2 \times 3.8$, $M^1 = 3.1 \times 3.8$.

Leptotomus Matthew, 1910
Leptotomus parvus Wood, 1959

Distribution. — Localities BB-6, 10, 11, 20, 42, 50, 71, 78, 90, 103; BI-16, 32, 34, 37, 38.

Referred specimens. — **BB-6**: 101043, left P^4. **BB-10**: 95520, left dentary M_2; 98683, right dentary M_{1-3}. **BB-11**: 94861, right dentary, postcrania. **BB-20**: 98948, right P^4. **BB-42**: 95627, left dentary P_4-M_1. **BB-50**: 98957, right maxilla M^{1-2}. **BB-71**: 98702, right M^x. **BB-78**: 98754, left P^4, left M_x (unassociated). **BB-90**: 101054, left M_3. **BB-103**: 99660, left maxilla P^{3-4}. **BI-16**: 100875, left M_3. **BI-32**: 100852, right P^4. **BI-34**: 100767, left M^x; 100771, left M^x. **BI-37**: 100787, right dentary M_x (broken). **BI-38**: 100802, right dentary P_4-M_2; 100816, M^3, M^x (unassociated); 100823, left M^x; 100829, left maxilla P^4-M^2, postcrania.

Discussion. — There are two species of *Leptotomus* present in Br-1b. *Leptotomus parvus* is the smaller of these two species. *Leptotomus* is the most common paramyid found in Br-1b but as Korth (1984) notes, there are few discernable differences between *L. parvus* and *Paramys* and the former may well be a species of *Paramys*.

Measurements. — 95520: $M_2 = 3.6 \times 3.4$; 95627: $P_4 = 3.1 \times 2.9$, $M_1 = 3.4 \times 3.1$; 98683: $M_1 = 3.5 \times 3.3$, $M_2 = 3.5 \times 3.4$, $M_3 = 4.0 \times 3.3$; 98754: $P^4 = 3.2 \times 4.1$; 98948: $P^4 = 3.5 \times 4.0$; 98957: $M^1 = 3.4 \times 4.2$, $M^2 = 3.5 \times 4.1$; 99660: $P^3 = 1.9 \times 2.1$; 100802: $P_4 = 3.7 \times 3.0$, $M_1 = 3.4 \times 2.9$, $M_2 = 3.6 \times 3.4$; 100816: $M^3 = 4.0 \times 2.7$; 100829: $P^4 = 3.7 \times 4.2$, $M^1 = 3.4 \times 4.4$, $M^2 = 3.8 \times 4.4$; 100852: $P^4 = 3.9 \times 3.9$; 100875: $M_3 = 4.0 \times 3.1$; 101043: $P^4 = 3.4 \times 4.1$; 101054: $M_3 = 3.9 \times 3.5$.

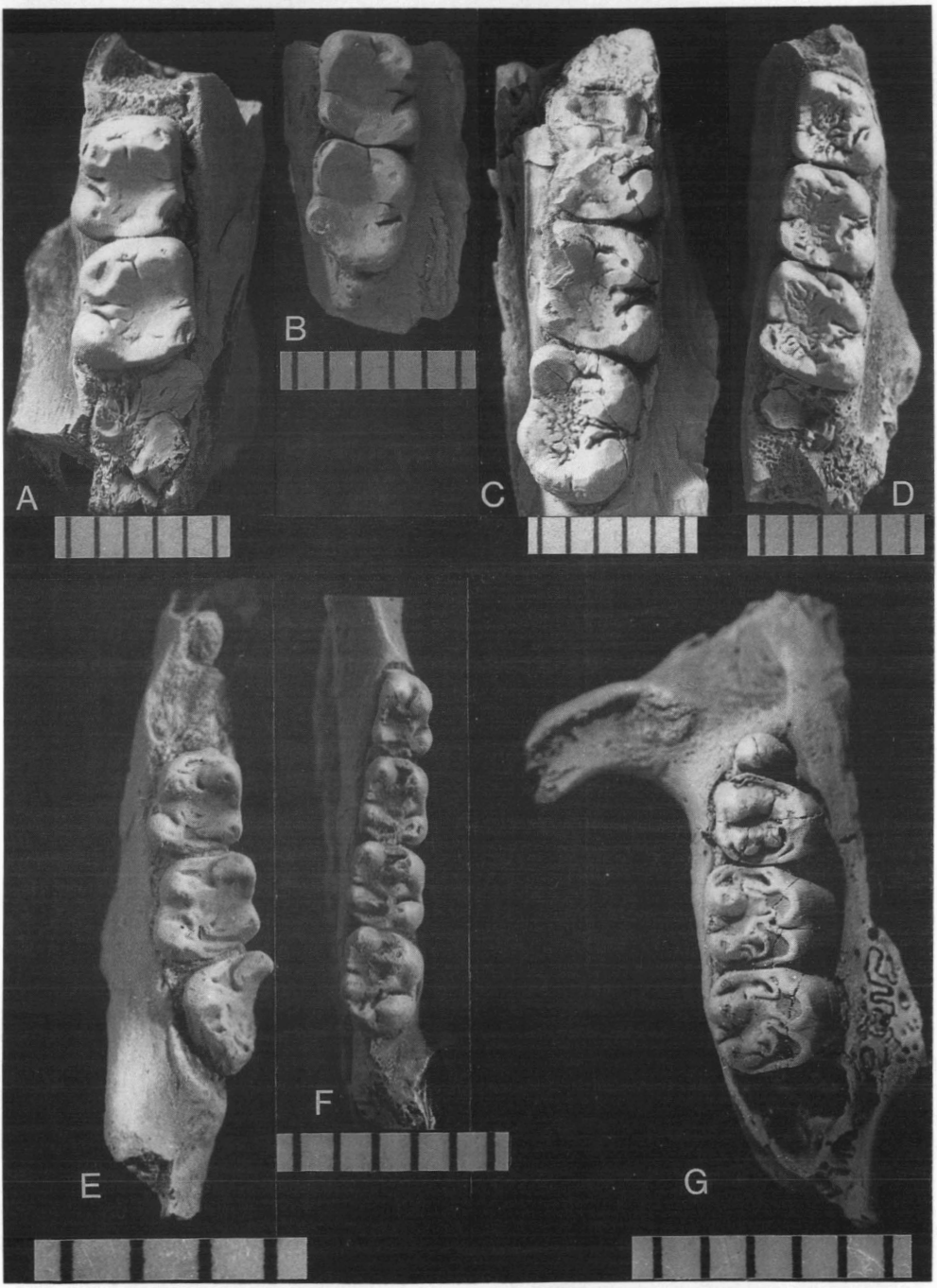

FIG. 11 — Rodentia from Br-1b. A, *Paramys delicatus*, UM 100872, left dentary M_{1-2} from locality BI-16, in occlusal view. B, *Paramys delicatior*, UM 98710, right dentary M_{2-3} from locality BB-73, in occlusal view. C, *Leptotomus grandis*, UM 94844, right dentary M_{2-3} from locality BB-1, in occlusal view. D, *Thisbemys plicatus*, UM 99863, right dentary P_4-M_2 from locality BB-90, in occlusal view. E, *Microparamys* cf. *M. minutus*, UM 99997, left dentary M_{1-3} from locality BI-16, in occlusal view. F-G, *Sciuravus nitidus*. F, UM 99662, right dentary P_4-M_3 from locality BB-7, in occlusal view; G, UM 100566, right maxilla P^3-M^2 from locality BI-18, in occlusal view.

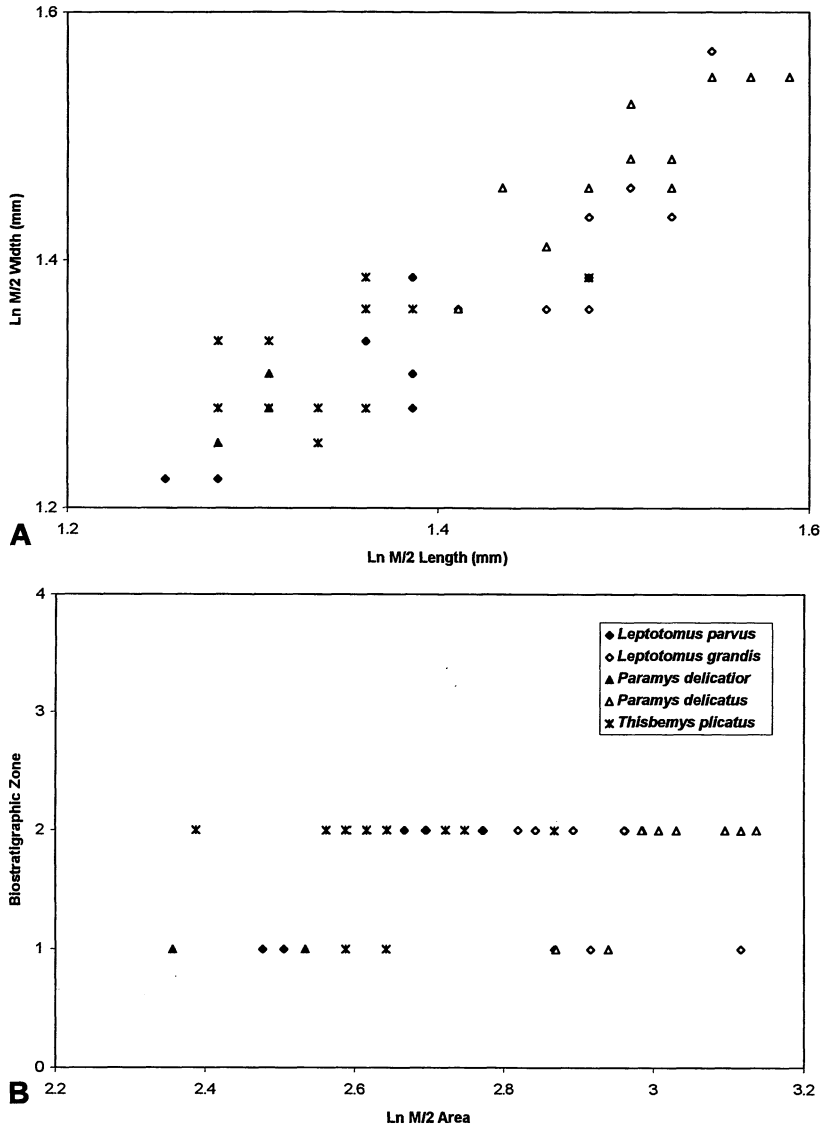

FIG. 12 — Tooth size and stratigraphic distribution of paramyid rodent specimens based on UM collections. A, Bivariate plot of length versus width of M_2. B, Stratigraphic distribution of M_2 size through Bridgerian sequence. Note the presence of two species of *Paramys* and *Leptotomus* and a single species of *Thisbemys* in Br-1b. An additional species of *Thisbemys* may also be present in Br-2.

Leptotomus grandis Wood, 1962
(Fig. 11c)

Distribution. — Localities BB-1, 23; BI-20, 22, 30, 34, 43, 57.

Referred specimens. — **BB-1**: 92875, right dentary M_{1-2}, left M_x (broken); 92877, left M_2; 94844, right dentary M_{1-3}. **BB-23**: 95460, right dentary P_4, M_3. **BI-20**: 100584, left dentary M_{1-2}; 100617, right M_1; 100620, left M_1. **BI-22**: 100624, left and right dentaries, postcrania. **BI-30**:

100673, left M^x; 101359, right dentary M_{1-2}, postcrania. **BI-34**: 100773, right M^3. **BI-43**: 101334, right M^x. **BI-57**: 101461, left M_3; 101480, right M^x.

Discussion. — These specimens represent the larger species of *Leptotomus* found in Br-1b. Wood (1962) originally described *L. grandis* based on specimens from the upper sequence in Huerfano Park (late Gardnerbuttean = Br-1a) and noted that it might also occur in Br-2. Other specimens in UM collections confirm that *L. grandis* does occur in Br-2 as well as Br-1b.

Measurements. — 92875: $M_1 = 4.1 \times 3.9$, $M_2 = 4.4 \times 4.0$; 92877: $M_2 = 4.4 \times 4.0$; 94844: $M_2 = 4.4 \times 4.2$, $M_3 = 5.2 \times 4.1$; 95460: $P_4 = 3.5 \times 3.5$, $M_3 = 4.7 \times 3.6$; 100584: $M_1 = 4.6 \times 4.5$, $M_2 = 4.7 \times 4.8$; 100617: $M_1 = 4.9 \times 4.2$; 100620: $M_1 = 4.2 \times 3.9$; 100773: $M^3 = 4.7 \times 4.5$; 101461: $M_3 = 5.4 \times 4.0$.

Thisbemys Wood, 1959
Thisbemys plicatus Wood, 1962
(Fig. 11D)

Distribution. — Localities BB-6, 7, 15, 17, 18, 20, 61, 73, 90, 105; BI-17, 31, 32.

Referred specimens. — **BB-6**: 98630, left M^3; 98650, left dentary M_{1-2} (broken). **BB-7**: 13982, right dentary M_3, right M^2. **BB-15**: 94884, right dentary P_4-M_3. **BB-17**: 99739, right M_x. **BB-18**: 101539, left dentary I_1, M_{1-2}; 101546, right M_3. **BB-20**: 99967, left maxilla M^{1-3}. **BB-61**: 98581, associated teeth and postcrania. **BB-73**: 98706, right M_x. **BB-90**: 99863, right dentary P_4-M_2. **BB-105**: 99673, left maxilla M^{1-2}, right M^2. **BI-17**: 100558, right M_1. **BI-31**: 100844, left M_3. **BI-32**: 100731, left M_1; 100738, right M_3; 100744, left M_3; 100757, left M_x (broken).

Discussion. — These specimens represent a species of *Thisbemys* smaller than *T. corrugatus* but larger than *T. perditus*, and are thus assigned to *T. plicatus*.

Measurements. — 13982: $M_3 = 4.2 \times 3.6$, $M^2 = 3.5 \times 4.4$; 94884: $P_4 = 3.3 \times 3.1$, $M_1 = 3.6 \times 3.3$, $M_2 = 3.8 \times 3.5$; 98581: $P_4 = 3.3 \times 3.0$; 98630: $M^3 = 3.7 \times 3.6$; 99673: $M^2 = 3.7 \times 4.2$; 99863: $P_4 = 3.3 \times 3.3$, $M_1 = 3.6 \times 3.4$, $M_2 = 3.9 \times 3.6$; 99967: $M^2 = 3.5 \times 3.9$, $M^3 = 4.1 \times 3.7$; 100558: $M_1 = 3.6 \times 3.0$; 100731: $M_1 = 3.6 \times 3.5$; 100738: $M_3 = 4.3 \times 3.4$; 100744: $M_3 = 4.6 \times 3.7$; 100844: $M_3 = 4.4 \times 3.6$; 101539: $M_1 = 3.4 \times 3.3$, $M_2 = 3.8 \times 3.5$; 101546: $M_3 = 4.4 \times 3.4$.

Microparamys Wood, 1959
Microparamys sp., cf. *M. minutus*
(Fig. 11E)

Distribution. — Localities BB-6, 10, 20, 26; BI-10, 16, 17, 30, 37.

Referred specimens. — **BB-6**: 98603, left maxilla P^3-M^1. **BB-10**: 95516, right dentary M_{1-2}. **BB-20**: 98944, left M_2. **BB-26**: 95543, right M_x. **BI-10**: 100921, left M^x. **BI-16**: 99997, left dentary M_{1-3}. **BI-17**: 100423, right M^x. **BI-30**: 100680, right M_x. **BI-37**: 100783, left M^x, right M_x (unassociated).

Discussion. — The sample of *Microparamys* specimens from Br-1b is small. These specimens are tentatively referred to *M. minutus* but differ from more typical specimens of that species by being somewhat larger. In general, the teeth are intermediate in size between *M. minutus* and *M. cathedralis* (Wood, 1962). It is uncertain, however, if *M. cathedralis* actually is representative of *Microparamys* (Dawson, 1968; Guthrie, 1971; Korth, 1984) making assignment of the Br-1b specimens problematic. It is possible that the sample from Br-1b represents a distinct species of *Microparamys* but further evidence is required before the inter-relationships of *Microparamys* species are understood.

Measurements. — 95516: $M_1 = 1.6 \times 1.4$, $M_2 = 1.6 \times 1.5$; 95543: $M_x = 1.4 \times 1.6$; 98603: $P^4 = 1.1 \times 1.4$, $M^1 = 1.4 \times 1.6$; 98944: $M_2 = 1.7 \times 1.6$; 99997: $M_1 = 1.4 \times 1.5$, $M_2 = 1.5 \times 1.6$; 100423: $M^x = 1.6 \times 1.9$; 100680: $M_x = 1.9 \times 1.6$; 100783: $M_x = 1.6 \times 1.5$, $M^x = 1.6 \times 1.8$; 100921: $M^x = 1.5 \times 1.6$.

Family SCIURAVIDAE Miller and Gidley, 1918
Sciuravus Marsh, 1871
Sciuravus nitidus Marsh, 1871
(Fig. 11F-G)

Distribution. — Localities BB-1, 3, 6, 7, 10, 11, 17, 20, 24, 37, 40, 48, 74, 78, 99, 105, 109, 119; BI-7, 9, 10, 14, 17, 18, 20, 29, 31, 32, 34, 35, 38, 40, 43, 45, 46, 52, 54, 57, 58, 60.

Referred specimens. — **BB-1**: 94845, right dentary P_4-M_2; 95455, right maxilla P^4-M^1. **BB-3**: 99732, right dentary P_4-M_1; 101047, left dentary M_{1-2}. **BB-6**: 95687, right dentary P_4, M_3; 98606, left dentary M_{1-3}; 99687, right M_2; 99691, right dentary I_1-M_3; 99698, right dentary M_{1-3}; 101557, right dentary P_4-M_2; 101558, left maxilla P^4-M^1. **BB-7**: 99662, right dentary P_4-M_3. **BB-10**: 95784, left M_x; 98681, right maxilla M^3; 99642, right dentary P_4-M_1. **BB-11**: 94863, two unassociated upper molars. **BB-17**: 99721, right dentary P_4-M_3. **BB-20**: 98939, associated teeth; 98942, right dentary, postcrania; 99971, left M^x. **BB-24**: 95555, left M_x; 101638, right dentary P_4-M_3. **BB-37**: 101018, left M^2. **BB-40**: 95639, right M_x. **BB-48**: 95644, teeth, postcrania; 95645, left and right M^x. **BB-74**: 99637, right dentary M_{1-3}. **BB-78**: 98753, five unassociated teeth; 98756, five unassociated teeth. **BB-99**: 99650, left maxilla P^4, M^2. **BB-105**: 99675, right dentary P_4-M_1. **BB-109**: 99918, right M^2, postcrania. **BB-119**: 101511, left M_x; 101513, right dentary P_4-M_3, left M_1; 101515, left dentary M_2, postcrania. **BI-7**: 100436, left M_x; 100439, right M^x. **BI-9**: 100444, right M^x (2); 100445, right M_x. **BI-10**: 100456, right M_x. **BI-14**: 100481, left M_x; 100484, left P^4. **BI-17**: 100540, right maxilla M^{1-2}; 100550, right M^x; 100552, left M^x; 100559, right M_3; 100561, right M_3. **BI-18**: 100566, right maxilla P^3-M^2, postcrania. **BI-20**: 100569, left dentary M_3; 100570, left and right maxillae, left dentary, postcrania; 100574, right dentary M_3; 100577, left dentary P_4-M_2; 100578, left dentary M_{1-2}; 100595, right dentary P_4-M_2; 100606, right dentary M_{2-3}; 100607, right maxilla P^4-M^1. **BI-29**: 100662, left maxilla P^4. **BI-31**: 100711, right maxilla P^4-M^1; 100714, left maxilla P^4-M^3; 100718, right dentary M_{1-2}, left M_2; 100719, right maxilla P^{3-4}. **BI-32**: 100730, right maxilla P^4-M^1; 100733, right dentary M_{1-2}, postcrania; 100734, right dentary $M_{1,3}$, skull fragments; 100739, left maxilla P^4-M^1; 100746, left maxilla P^3-M^1; 100753, right maxilla P^4-M^2; 100756, right maxilla P^3-M^1; 100758, left maxilla P^4-M^1; 100856, right dentary M_{1-2}; 100857, right dentary M_{1-2}; 101366, left P^4; 101368, right M_x. **BI-34**: 100765, left M_{1-2}. **BI-35**: 100778, left dentary P_4-M_2. **BI-38**: 100804, left maxilla P^3-M^3. **BI-40**: 100907, left dentary M_1, right M_x, postcrania; 100915, right dentary M_{1-2}; 100916, left dentary P_4-M_3; 101473, left M^x; 101476, left dentary M_{1-3}. **BI-43**: 101332, left M_3; 101337, left M_x. **BI-45**: 101346, right maxilla P^3-M^1; 101353, right maxilla P^4, M^x; 101354, left dentary M_{1-2}. **BI-46**: 101356, left M_3. **BI-52**: 101391, postcrania; 101393, right P^4. **BI-54**: 101397, right M^x; 101398, left M^x. **BI-57**: 101466, left M_3; 101467, five unassociated molars; 101471, four unassociated molars. **BI-58**: 101486, left M_x. **BI-60**: 101493, M^x; 101495, right P_4; 101496, right M_x;

Discussion. — By far, the most common rodent from Br-1b is *Sciuravus nitidus*. There is no evidence in the UM Br-1b sample of the presence of *Sciuravus bridgeri*, although McGrew and Sullivan (1970) report a single specimen of this species from their Br-1b sample.

Measurements. — Measurements of *Sciuravus nitidus* are summarized in Table 6.

Rodentia, *indet.*

Distribution. — Localities BB-6, 10, 13W, 20, 76, 109; BI-7, 9-11, 13, 14, 17, 34.

Referred specimens. — **BB-6**: 99690, right proximal and distal tibia; 99692, right proximal and distal tibia. **BB-10**: 95514, postcrania; 95586, right astragalus. **BB-13W**: 98694, incisor. **BB-20**: 98949, postcrania. **BB-76**: 98730, tooth fragments. **BB-109**: 99916, distal tibia, associated other postcrania. **BI-7**: 100425, unassociated calcanei. **BI-9**: 100449, postcrania. **BI-10**: 100454, right astragalus. **BI-11**: 100461, postcrania (associated?). **BI-13**: 100469, left astragalus. **BI-14**: 100480, unassociated postcrania. **BI-17**: 100539, right edentulous dentary. **BI-34**: 100769, astragalus.

TABLE 6 — *Sciuravus nitidus* summary tooth statistics. Abbreviations as in Table 2.

Tooth Position	N	Range	Mean	SD	CV
P_4 Length	16	1.9-2.4	2.13	0.16	7.6
Width	16	1.5-1.9	1.71	0.11	6.6
M_1 Length	27	2.1-2.4	2.29	0.09	4.0
Width	27	1.8-2.3	2.00	0.11	5.5
M_2 Length	23	2.2-2.6	2.34	0.10	4.0
Width	23	1.9-2.3	2.12	0.08	3.8
M_3 Length	20	2.5-2.9	2.68	0.12	4.3
Width	20	1.8-2.2	2.11	0.10	4.7
P^3 Length	6	0.8-1.1	0.97	0.12	12.5
Width	6	1.1-1.2	1.13	0.05	4.6
P^4 Length	21	1.6-2.0	1.88	0.09	5.0
Width	21	2.0-2.6	2.33	0.16	6.9
M^1 Length	17	1.9-2.3	2.15	0.12	5.5
Width	17	2.3-2.6	2.41	0.09	3.7
M^2 Length	6	2.2-2.3	2.23	0.05	2.3
Width	6	2.4-2.6	2.45	0.08	3.4
M^3 Length	5	2.2-2.4	2.26	0.09	4.0
Width	5	2.3-2.5	2.36	0.09	3.8

Discussion. — There are several rodent specimens that cannot be assigned to a specific taxon due to their incomplete nature. Most are represented by associated postcranial remains although some are isolated or questionably associated dental or postcranial elements.

Order CREODONTA Cope, 1875
Family OXYAENIDAE Cope, 1877
Patriofelis Leidy, 1870
Patriofelis sp., cf. *P. ulta*
(Fig. 13A)

Distribution. — Localities BB-9, 11, 20.

Referred specimens. — **BB-9**: 94855, right edentulous dentary. **BB-11**: 94869, right M_1 (broken), associated tooth fragments. **BB-20**: 95708, left M^1.

Discussion. — These fragmentary specimens probably represent the early Bridgerian species of *Patriofelis*, *P. ulta.* They are of an appropriate size but because of their fragmentary nature it is not possible to assign them to this species with complete confidence.

Measurements. — 95708: M^1 = 22.1 × 13.6.

Family HYAENODONTIDAE Leidy, 1869
Sinopa Leidy, 1871
Sinopa rapax Leidy, 1871
(Fig. 13B)

Distribution. — Localities BB-6, 10, 20, 53, 64; BI-14, 30.

Referred specimens. — **BB-6**: 98636, left dentary P_3-M_1, postcrania; 98642, right maxilla M^{1-2} (broken). **BB-10**: 95487, right canine, M_x (trigonid). **BB-20**: 101574, right M^1 (broken). **BB-53**: 95677, left dentary M_{2-3}. **BB-64**: 98616, left M_1. **BI-14**: 100479, right M_x (talonid). **BI-30**: 100835, right M_1.

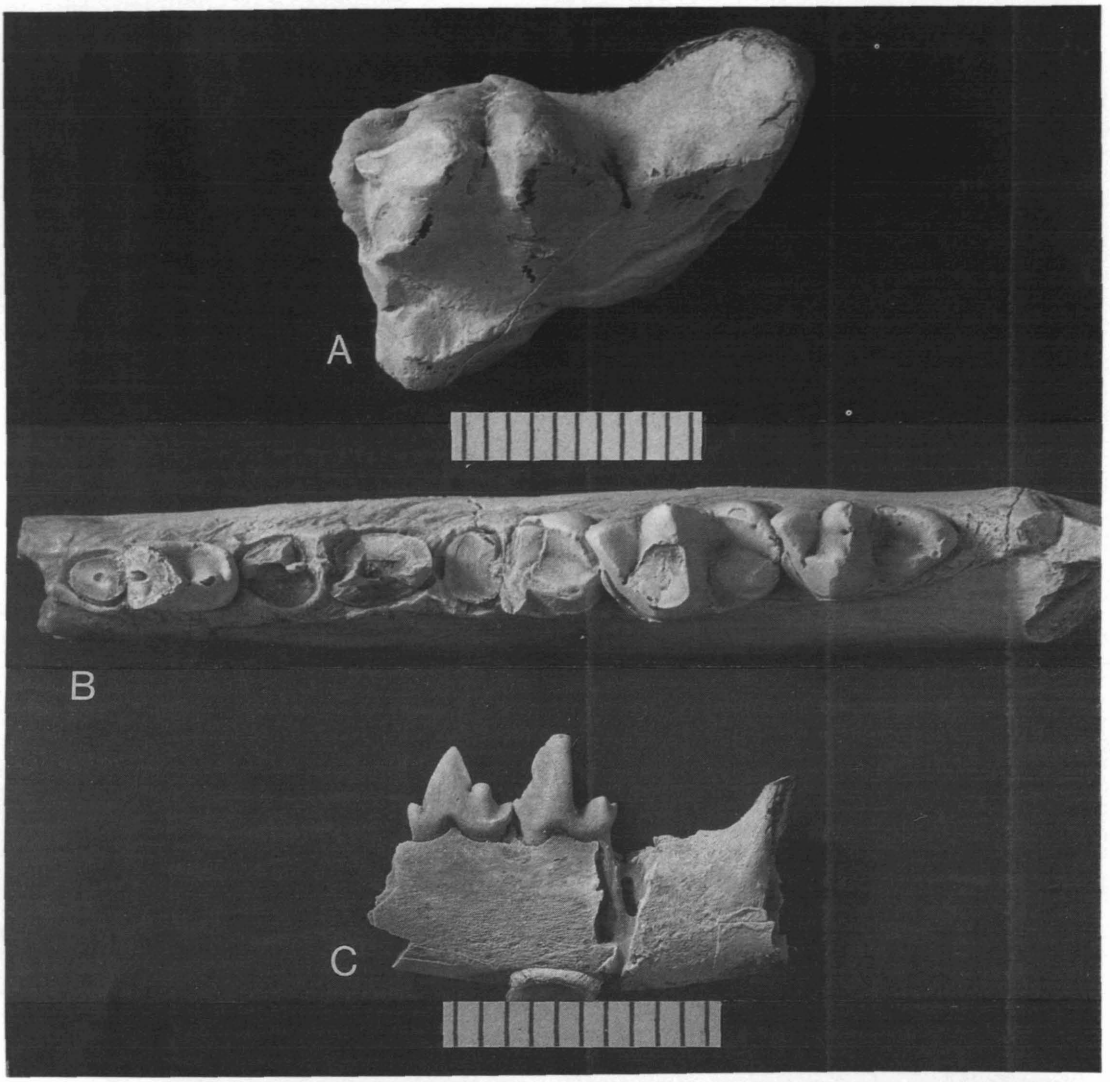

FIG. 13 — Creodonta and viverravid Carnivora from Br-1b. A, *Patriofelis* sp., cf. *P. ulta*, UM 95708, left M^1 from locality BB-20, in occlusal view. B, *Sinopa rapax*, UM 95677, left dentary M_{2-3} from locality BB-53, in occlusal view. C, *Viverravus minutus*, UM 95690, left dentary P_4-M_1 from locality BB-20, in lateral view.

Discussion. — These specimens represent an intermediate sized hyaenodontid and are of appropriate size and morphology to be assigned to *Sinopa rapax*.

Measurements. — 95677: $M_2 = 8.3 \times 5.0$, $M_3 = 7.4 \times 4.1$; 98616: $M_1 = 7.5 \times 4.3$; 98636: $P_3 = 8.3 \times 3.2$, $P_4 = 9.0 \times 4.4$, $M_1 = 8.3 \times 5.0$; 98642: $M^1 = 8.3 \times 8.4$; 100835: $M_1 = 7.5 \times 4.2$.

Sinopa minor Wortman, 1902

Distribution. — Localities BB-9, 20, 78.

Referred specimens. — **BB-9**: 95473, left maxilla M^x fragment, M^3. **BB-20**: 95697, left M^1, associated postcrania. **BB-78**: 98752, left M_1.

Discussion. — These three specimens represent a small *Sinopa* species and are assigned to *S. minor* based on their size (Wortman, 1902).

Measurements. — 95473: $M^3 = 3.5 \times 7.2$; 98752: $M_1 = 6.8 \times 3.7$.

Family LIMNOCYONIDAE Gazin, 1946
Limnocyon (Marsh), 1872
Limnocyon sp.

Distribution. — Localities BB-50, 78.

Referred specimens. — **BB-50**: 95663, left P^2?. **BB-78**: 98755, postcrania.

Discussion. — These two fragmentary specimens probably represent *Limnocyon.*

Thinocyon Marsh, 1872
Thinocyon sp., cf. *T. velox*

Distribution. — Localities BB-7, 10; BI-20, 25, 31, 38, 39.

Referred specimens. — **BB-7**: 98653, right M_1. **BB-10**: 95486, right P_4. **BI-20**: 100690, right P_4. **BI-25**: 100639, right dentary $M_{1\text{-}2}$. **BI-31**: 100713, left dentary M_2. **BI-38**: 100830, right M_x (trigonid). **BI-39**: 100882, left dentary P_3, right P_2.

Discussion. — The species assigned to the genus *Thinocyon* are difficult to separate except based on size. It is unclear which species are valid amongst the four or five species that have been proposed (Matthew, 1909; Gazin, 1976). Matthew (1909) included three *Thinocyon* species in his faunal list at the beginning of his monograph, *T. velox*, *T. medius*, and *T. minimus*, the last of which was proposed as a new species. Yet in the text of the monograph, Matthew (1909) mentioned *T. velox* and *T. medius* and proposed two new species *T. cledensis* and *T. mustelinus* without mentioning *T. minimus*. Presumably, *T. mustelinus* is the same taxon as *T. minimus* as the former was described as being smaller than the other two Bridgerian species. *T. cledensis* was probably not mentioned in the faunal list at the beginning because only Bridger Basin species were included, not those from the Washakie Basin (*T. cledensis* is only known from the Washakie Basin). Many of the features used by Matthew (1909) to distinguish between the various species of *Thinocyon* appear quite variable such that size may be the only valid criterion available until further analysis is done. The specimens from Br-1b are closest in size and morphology to *Thinocyon velox.*

Measurements. — 95486: $P_4 = 4.6 \times 2.2$; 98653: $M_1 = 6.3 \times 3.7$; 100690: $P_4 = 5.1 \times 2.4$; 100882: $P_2 = 3.6 \times 1.5$; $P_3 = 4.6 \times 2.0$.

Family HYAENODONTIDAE Indet.

Distribution. — Localities BB-71, 130; BI-1, 46.

Referred specimens. — **BB-71**: 98992, right astragalus. **BB-130**: 101676, left astragalus. **BI-1**: 100406, associated postcrania. **BI-46**: 101352, right astragalus.

Discussion. — These fragmentary specimens represent medium sized creodonts. All are probably *Sinopa* but it remains uncertain which species of *Sinopa* they may represent.

Order CARNIVORA Bowdich, 1821
Family VIVERRAVIDAE Wortman and Matthew, 1899
Viverravus Marsh, 1872
Viverravus gracilis Marsh, 1872

Distribution. — Localities BB-28, 79; BI-9, 26.

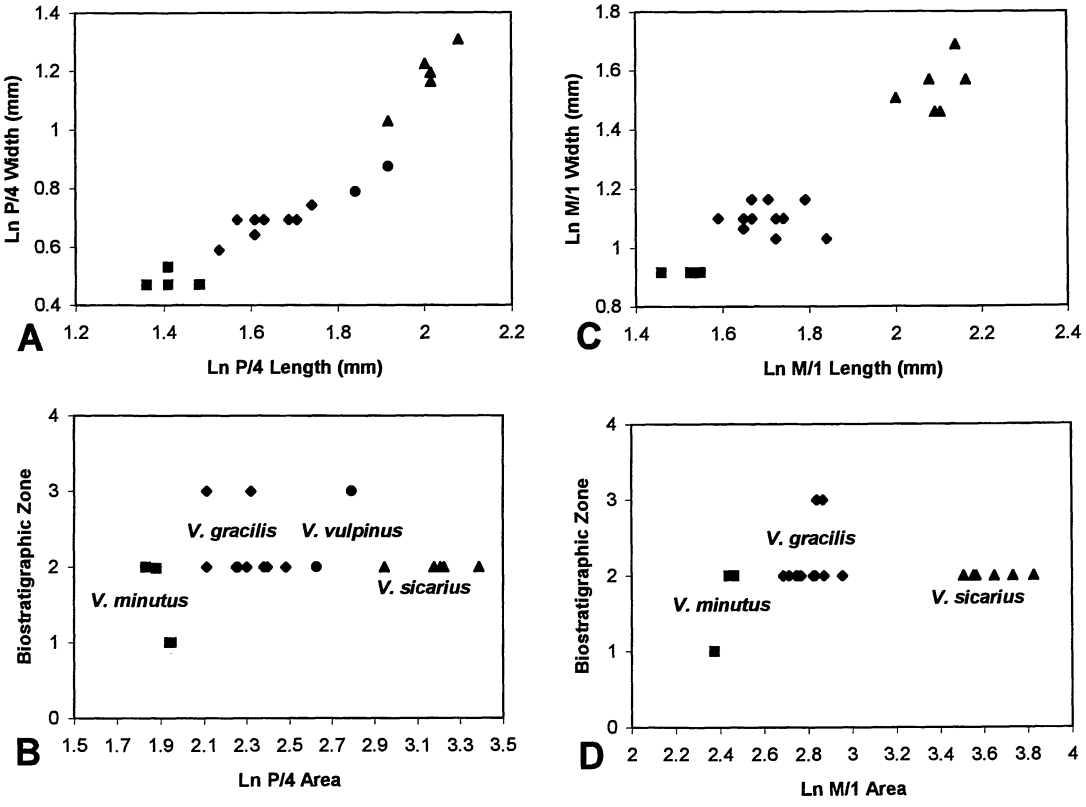

FIG. 14 — Tooth size and stratigraphic distribution of Bridgerian Viverravidae. A and C are bivariate plots of length versus width for P_4 and M_1 based on specimens from UM, AMNH, and YPM collections. B and D are stratigraphic distributions of P_4 and M_1 size through Bridgerian sequence. Note presence of three or possibly four lineages of viverravids in Br-2. Only *V. minutus* is represented from Br-1b in these figures but *V. gracilis* is also present based on other teeth. Open symbols represent holotype specimens of each species in plots C and D.

Referred specimens. — **BB-28**: 95562, left dentary C_1, P_2. **BB-79**: 98759, right P_2. **BI-9**: 100450, right dentary M_1 (talonid). **BI-26**: 100647, left P_2.

Discussion. — There are two species of *Viverravus* present in Br-1b. These poorly preserved specimens represent the larger of these two species, *V. gracilis*.

Measurements. — 98759: $P_2 = 3.6 \times 1.8$.

Viverravus minutus Wortman, 1901
(Figs. 13C, 14)

Distribution. — Localities BB-6, 20, 37, 80, 90; BI-34.

Referred specimens. — **BB-6**: 98637, right dentary $P_{3\text{-}4}$. **BB-20**: 95690, left dentary P_4-M_1. **BB-37**: 101017, left M^1. **BB-80**: 98765, left dentary M_2 (trigonid). **BB-90**: 99867, right dentary M_1. **BI-34**: 100772, left dentary P_2.

Discussion. — These specimens represent the smaller of the two *Viverravus* species present in Br-1b, *V. minutus*.

Measurements. — 95690: $P_4 = 4.4 \times 1.6$, $M_1 = 4.3 \times 2.5$; 98637: $P_4 = 4.1 \times 1.7$; 101017: $M^1 = 3.5 \times 4.8$.

Family MIACIDAE Cope, 1880
Miacis Cope, 1872
Miacis parvivorus Cope, 1872
(Fig. 15A)

Distribution. — Localities BB-65, 71, 90.

Referred specimens. — **BB-65**: 98621, left dentary P_2, postcrania. **BB-71**: 98700, right M_1. **BB-90**: 99864, right dentary P_3, M_2.

Discussion. — These specimens agree in size and morphology with Bridgerian *Miacis parvivorus* from zone Br-2.

Measurements. — 98621: $P_2 = 3.5 \times 1.7$; 99864: $P_3 = 3.5 \times 1.8$, $M_2 = 4.3 \times 3.4$.

Uintacyon Leidy, 1872
Uintacyon vorax Leidy, 1872
(Fig. 15B)

Distribution. — Locality BB-10.

Referred specimen. — **BB-10**: 95510, left M_2.

Discussion. — This specimen agrees in size and morphology with Br-2 specimens of *Uintacyon vorax*.

Measurements. — 95510: $M_2 = 5.7 \times 4.0$.

Vulpavus Marsh, 1871
Vulpavus sp., cf. *V. palustris*
(Fig. 15C-D)

Distribution. — Locality BI-40.

Referred specimens. — **BI-40**: 100905, right dentary P_3-M_1; 100912, left and right maxillae M^{1-2}.

Discussion. — These two specimens share features of both *V. palustris* and *V. profectus*, the two typical Br-2 *Vulpavus* species, as well as features with *V. canavus*, one of the typical Lostcabinian (late early Eocene) species of the genus (Matthew, 1915). In terms of size, P_{3-4} are more similar in size to *V. palustris*, but M_1 is larger than is typical of *V. palustris*, more in line with the size of *V. profectus*. Both M^{1-2} are larger than *V. palustris* and are more typical of *V. profectus*.

Morphologically, M^{1-2} resemble *V. palustris* in the following features (in contrast to *V. profectus*): both teeth have large hypocones and lack internal cingula; M^1 has a well developed parastylar shelf but no parastylar cusp and a large, crescentic metastyle; M^2 has a small parastylar cusp, a large, bulbous, non-crescentic metastyle, and a hypocone that is shifted anteriorly such that it is nearly directly lingual to the protocone.

The lower premolars are separated by short diastemata, a characteristic of Lostcabinian *V. canavus*, but not typical of either Br-2 species. P_4 has small anterior and posterior accessory cuspules that are often present in both Br-2 taxa (as well as *V. canavus*). M_1 has a very large, basined heel that has several accessory cuspules developed along its lingual border, again a feature often seen in *V. canavus*. Overall, based on the morphology of the upper molars, these specimens are tentatively assigned to *Vulpavus palustris* pending a more complete understanding of *Vulpavus*.

Measurements. — 100905: $P_3 = 4.2 \times 2.4$, $P_4 = 5.3 \times 3.0$, $M_1 = 6.7 \times 4.3$; 100912: left $M^1 = 6.4 \times 8.0$, left $M^2 = 5.0 \times 8.1$, right $M^1 = 6.2 \times 7.9$, right $M^2 = 4.5 \times 7.7$.

***Vulpavus farsonensis*, sp. nov.**
(Fig. 16A-B)

Distribution. — Localities BI-18, 40.

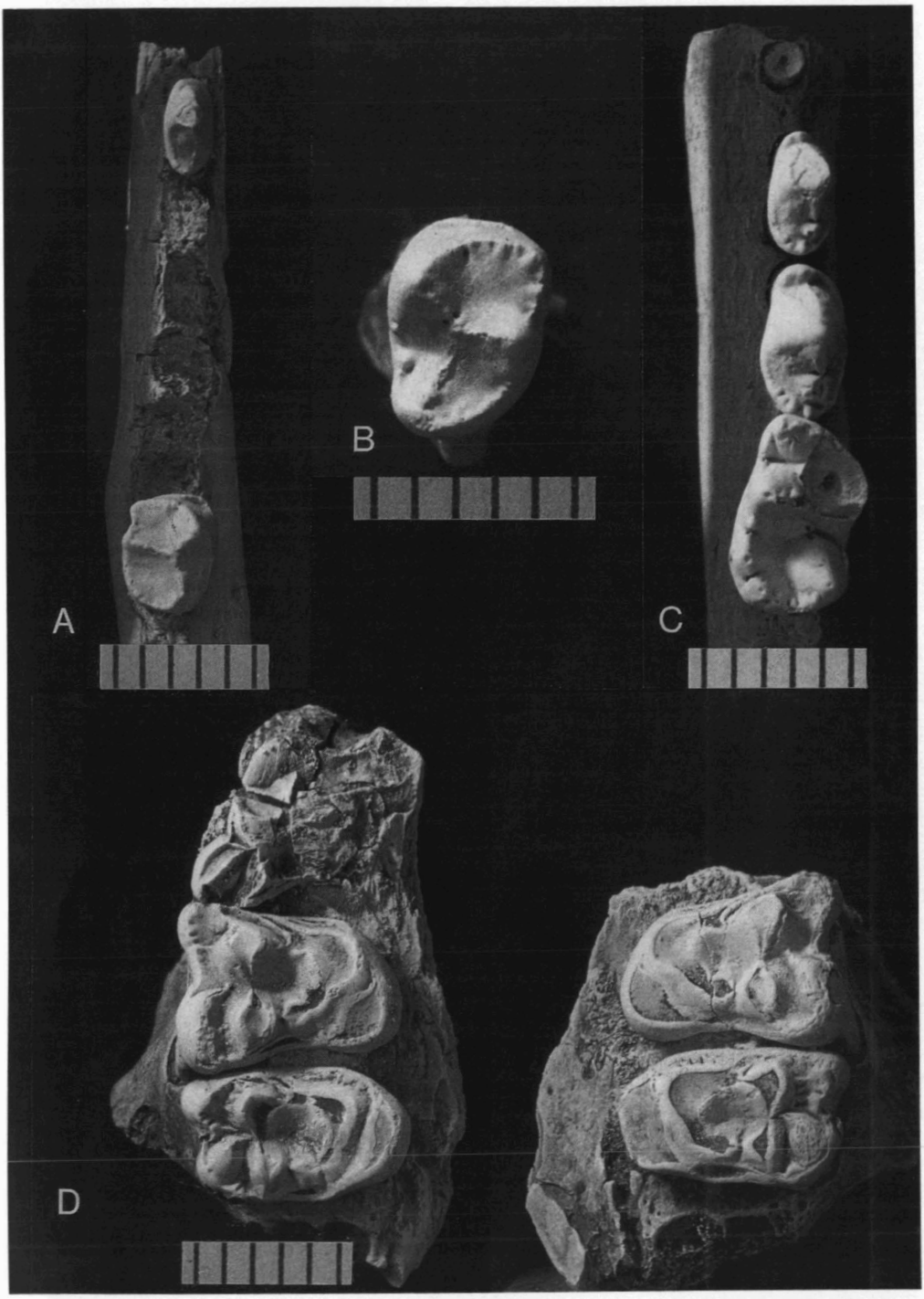

FIG. 15 — Miacid Carnivora from Br-1b. A, *Miacis parvivorus*, UM 99864, right dentary P_3, M_2 from locality BB-90, in occlusal view. B, *Uintacyon vorax*, UM 95510, left M_2 from locality BB-10, in occlusal view. C-D, *Vulpavus* sp., cf. *V. palustris*. C, UM 100905, right dentary P_3-M_1 from locality BI-40, in occlusal view. D, UM 100912, left and right maxillae M^{1-2} from locality BI-40, in occlusal view.

FIG. 16 — *Vulpavus farsonensis*, new species. A, UM 100565 (Holotype), left dentary P_{2-4} (P_2 and P_4 somewhat damaged) and alveoli for C_1-P_1, M_{1-2} from locality BI-18, in lateral view. B, UM 100910, left M_1 from locality BI-40, in occlusal view.

Holotype. — **BI-18**: 100565, left dentary with P_{2-4} (P_2 and P_4 somewhat broken), and alveoli for C_1-P_1, M_{1-2}.

Referred specimen. — **BI-40**: 100910, left M_1.

Diagnosis. — Differs from all other species of *Vulpavus* in being much smaller (27% smaller in P_3 area than the other Br-1b species of *Vulpavus*) and in having a shallower dentary. Differs from *Miacis* and *Uintacyon* in lacking an enlarged M_1, in having P_3 and P_4 nearly the same size (the other two genera have an enlarged P_4), and in lacking a greatly reduced M_2 (M_1 was only slightly larger than M_2 judging from the alveoli, as in other *Vulpavus* species).

Etymology. — Named for the small village of Farson, Wyoming, situated not far from the type locality.

Description. — Although UM 100565 is somewhat broken, many relevant features can be seen. The canine is relatively large, while the first premolar is small, single rooted, and not separated from P_2 by a diastema. P_2 is missing its anterior half but is somewhat larger than P_1 and is double rooted. P_2 has a low, small talonid shelf connected to the apex of the protoconid by a weak, lingual crest. There is a moderate lingual cingulid that is continuous with the talonid shelf.

P_3 is somewhat triangular in occlusal outline as in other Bridgerian *Vulpavus*. It is larger than P_2 and has a small anterolingual basal cuspule. In other respects P_3 resembles P_2 closely. P_4 is broken posteriorly. It is only slightly larger than P_3, and like that tooth has a small anterolingual basal cuspule. All of the premolars are only moderately laterally compressed as is typical of *Vulpavus* (unlike *Miacis* or *Uintacyon* and especially viverravids). None of the premolars are separated by diastemata from either themselves or the first molar. Judging from alveolar size, M_1 was only slightly larger than M_2. Alveolar lengths (from anterior to posterior alveolar margins) are 3.9 mm for M_1 and 3.5 mm for M_2.

The dentary of UM 100565 is relatively shallow as is the symphysis. There are two mental foramina developed along the buccal side, one beneath the anterior root of P_2 and the other beneath the posterior root of P_3.

UM 100910 is an unworn and unbroken lower first molar. The protoconid, metaconid, and paraconid are nearly equally spaced with the protoconid the tallest and the others of approximately the same height. The trigonid fovea is relatively deep posterior to the paraconid. The trigonid is about twice the height of the talonid with the talonid nearly as broad as the trigonid. The talonid has distinct entoconid and hypoconid cusps and accessory cuspules developed on the

entocristid, postcristid, and cristid obliqua. The cristid obliqua is angled from anterolingual to posterobuccal and joins the postvallid nearly at the midline. The talonid basin deepens lingually. There are small anterior and buccal cingulids developed on M_1. Unlike *Miacis* and *Uintacyon*, the prevallid slicing blade is not as extended anteriorly and the trigonid is not as elevated above the surface of the talonid.

Discussion. — Miacid carnivores from the Bridger Formation are a confusing mixture of sizes and morphologies. The following notes are based on a cursory examination of miacid collections at the AMNH, USNM, YPM, and the West collections at UM. Based on morphological attributes, there are four different miacids present through the sequence, *Miacis*, *Uintacyon*, *Vulpavus*, and *Oödectes*. Within each of the first three taxa there is a great deal of morphological and size variation. Figure 17 demonstrates some of the size variability present in the Bridgerian sample.

For *Miacis*, there is a single small species (*M. parvivorus*) but evidence in Br-2 and Br-3 of a larger species as well. The larger species may represent *M. hargeri* but there are several other poorly defined species of *Miacis* from the Bridgerian that could be represented by these larger specimens. Matthew (1909) separated the smaller individuals into two species, *M. parvivorus* and *M. sylvestris*, based on minor differences in premolar and molar proportions. It remains to be seen if both of these species are, in fact, valid.

The situation is similar for *Uintacyon*. There is a single, medium sized species (*U. vorax*) present in Br-1b, and evidence of at least three different species of *Uintacyon* from Br-2 (*U. jugulans*, *U. vorax*, and *U. major*). It is not certain that *U. jugulans* and *U. vorax* represent distinct species as variability in tooth size and morphology in available samples is not always coincident with each other. *U. major* is distinct in size but it remains to be seen if it, in fact, actually is a species of *Uintacyon*.

Vulpavus presents an even more confusing picture. There is evidence for two *Vulpavus* species in Br-1b (*V. farsonensis* and *Vulpavus* sp., cf. *V. palustris*), but it isn't clear that either represent species known from Br-2. There are four described species from Br-2 (*V. palustris*, *V. profectus*, *V. completus*, and *V. ovatus*) but it isn't certain which of these species is valid. Based on size alone, there are at least two species of *Vulpavus* present in Br-2, but morphology suggests that the smaller individuals probably belong to two distinct species (*V. palustris* and *V. profectus*), while the larger specimens may represent yet another new species. The same situation holds for Br-3 where two distinct size groupings seem to harbor at least three different morphological groups.

As a final word on the frustrating complexity of miacids, it is also unclear that the taxa assigned to *Vulpavus* from the early Eocene Wasatchian Land Mammal Age, actually represent that genus at all. There are striking differences in molar morphology between *Vulpavus* species from the Wasatchian and Bridgerian such that it is almost certain that at least two different genera are represented.

Order PERISSODACTYLA Owen, 1848
Family EQUIDAE Gray, 1821
Orohippus Marsh, 1872
Orohippus sp., cf. *O. pumilus*
(Fig. 18A)

Distribution. — Localities BB-1, 3, 4, 7, 10, 13, 19, 20, 29, 50, 64, 71, 75, 124; BI-3, 13, 26, 30, 31, 38, 40.

Referred specimens. — **BB-1**: 92876, left M_1. **BB-3**: 95683, right dentary P_{3-4}; 98589, right dentary M_{1-2}; 99681, right maxilla M^{2-3}, postcrania. **BB-4**: 101049, left dentary P_3, M_{1-2}. **BB-7**: 98740, right M^x fragment. **BB-10**: 95489, right dP^4. **BB-13**: 98666, right M^x fragment. **BB-19**: 94890, left dentary P_3, M_1. **BB-20**: 95717, postcrania. **BB-29**: 95570, right P_4-M_3. **BB-50**: 95675, left dentary M_{2-3}, right dentary dP_{2-3}, M_{1-3}, right maxilla dP^4-M^2, left maxilla M^{1-2}, postcrania. **BB-64**: 98614, left maxilla M^{1-2}, associated fragments. **BB-71**: 98701, right M^3. **BB-75**: 98727, right astragalus. **BB-124**: 101605, right ectocuneiform. **BI-3**: 100413, left dentary P_4-M_1 (broken). **BI-13**: 100470, right calcaneum. **BI-26**: 100648, right maxilla P^{3-4} (broken); 100651, right

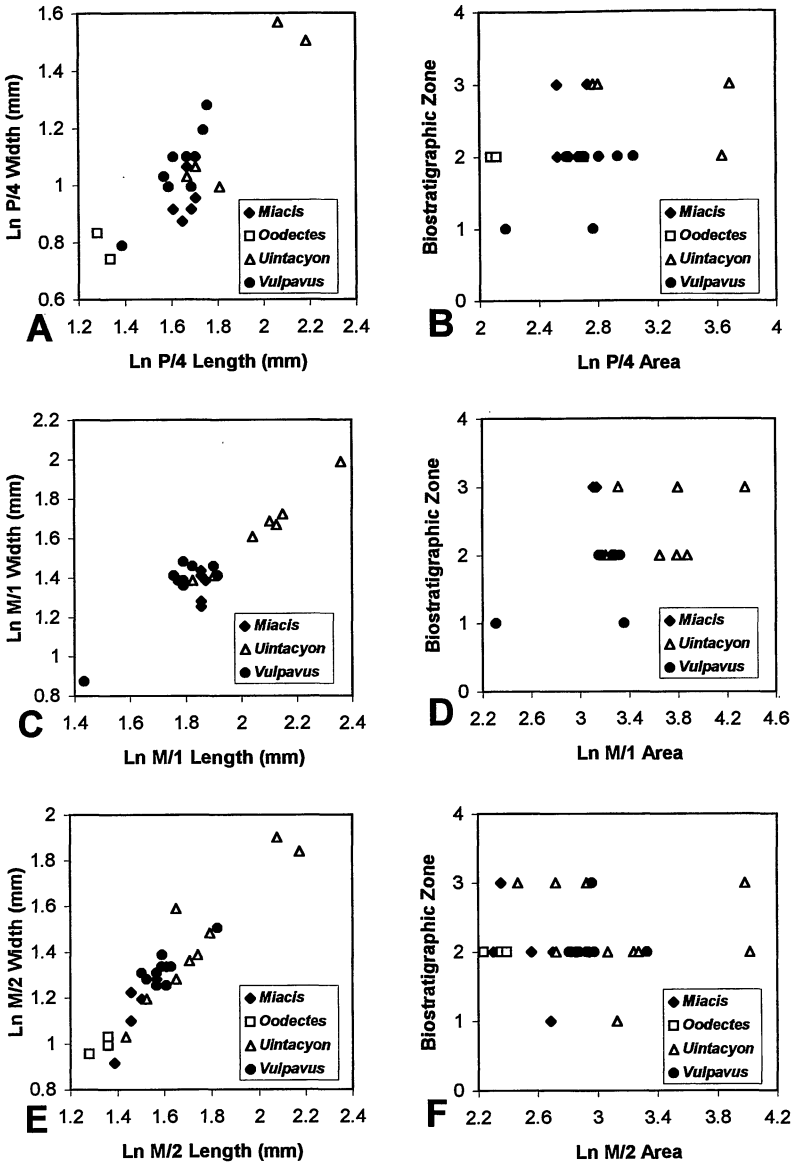

FIG. 17 — Tooth size and stratigraphic distribution of Bridgerian Miacidae. A, C, E are bivariate plots of length versus width for P_4-M_2 based on specimens from UM, AMNH, USNM, and YPM collections. B, D, F are stratigraphic distributions of P_4-M_2 size through Bridgerian sequence. Note presence of four different miacid genera in the Bridgerian. There is evidence to suggest the presence of at least three *Vulpavus* species, three *Uintacyon* species, and two, possibly three, *Miacis* species.

M^x fragment. **BI-30**: 100836, left dentary M_2 (broken); 101402, postcrania. **BI-31**: 100725, right M^1 or M^2; 100847, tooth fragments. **BI-38**: 100814, left M^1. **BI-40**: 100913, right dentary, P_3 (erupting); 101477, left dP^4 (broken); 101479, left M^1 or M^2; 101501, left M^1.

Discussion. — Kitts (1957) noted the presence of two *Orohippus* species from Br-2, *O. pumilus* and *O. major*. All of the specimens of *Orohippus* from Br-1b are similar in size to *O. pumilus* and are tentatively assigned to that species. Some minor differences in morphology exist between the Br-1b specimens and those of *O. pumilus* from Br-2 and it is possible that the Br-1b sample

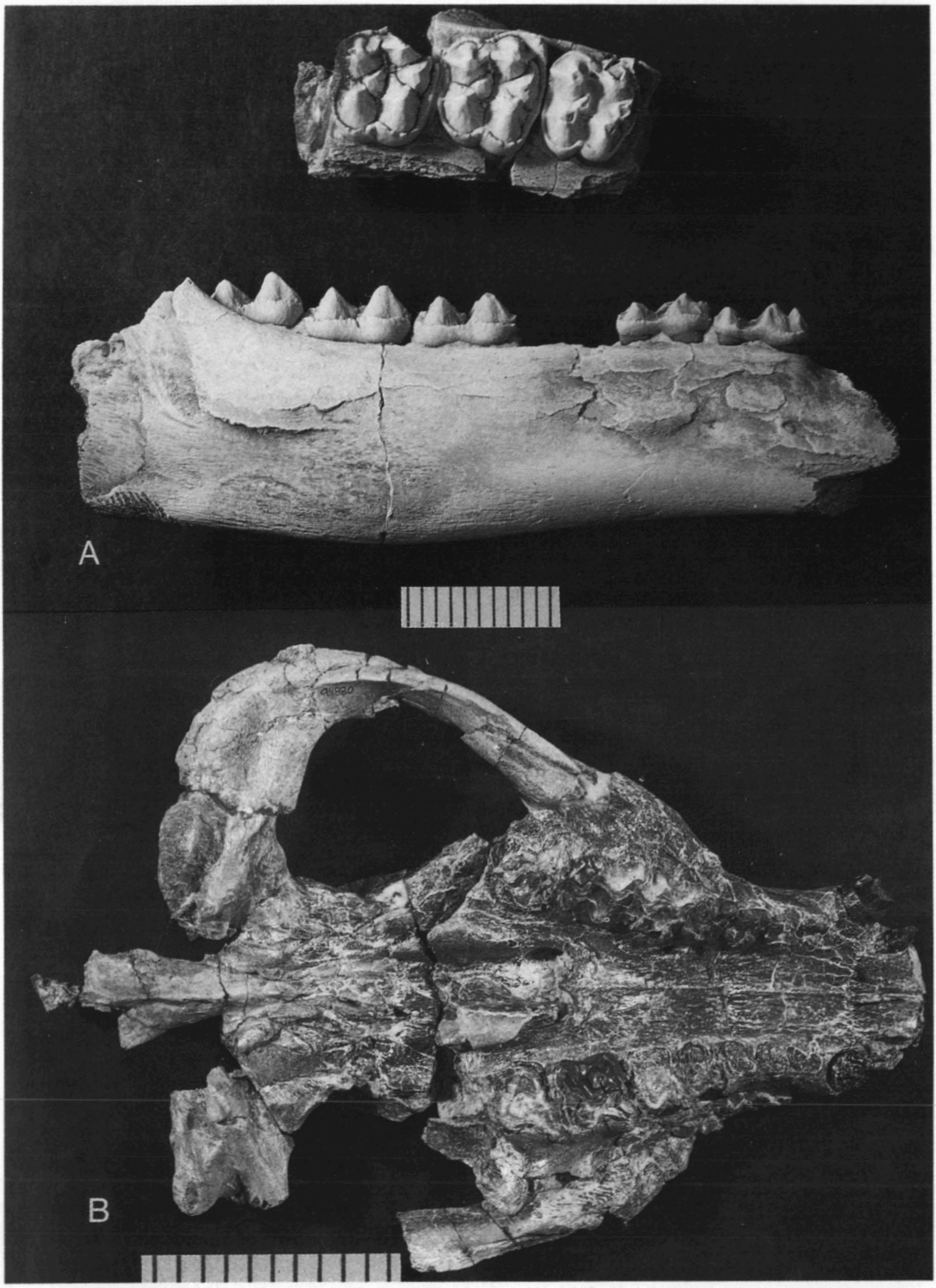

FIG. 18 — Perissodactyla from Br-1b. A, *Orohippus* sp., cf. *O. pumilus*, UM 95675, right maxilla dP^4-M^2 in occlusal view (above), right dentary dP_{2-3}, M_{1-3} in buccal view (below), from locality BB-50. B, *Palaeosyops fontinalis*, UM 94880, partial skull from locality BB-15, in palatal view.

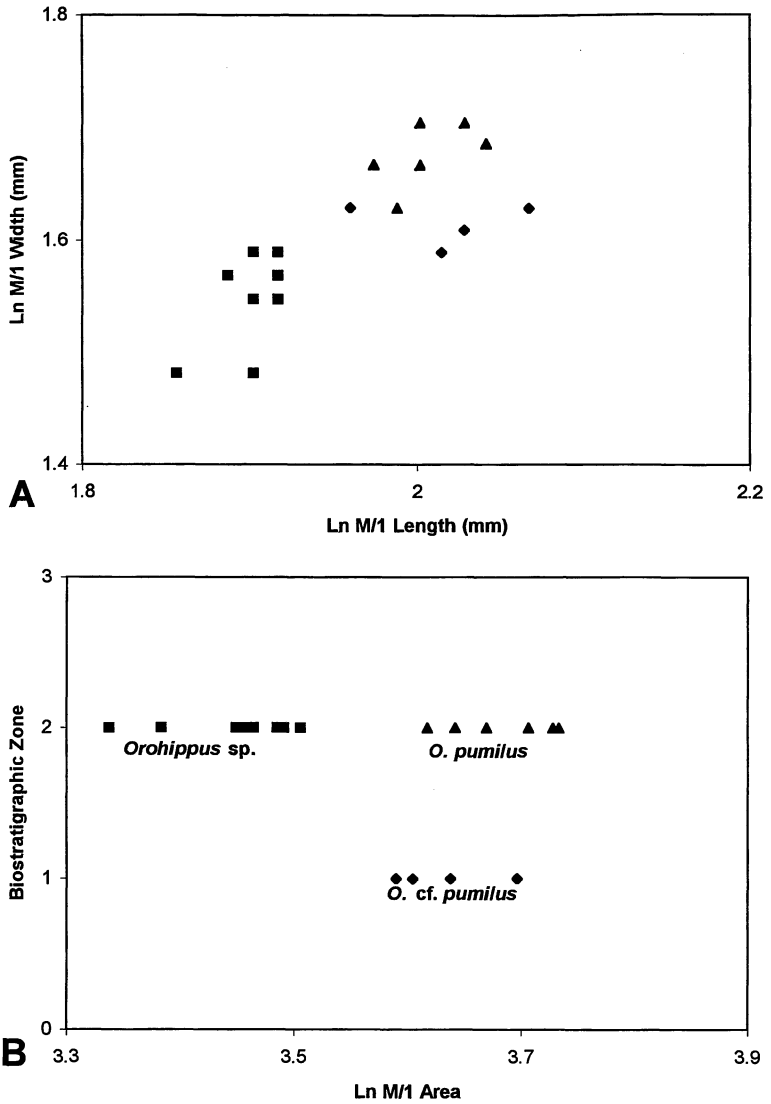

FIG. 19 — Tooth size and stratigraphic distribution of Bridgerian *Orohippus*. A, Bivariate plot of length versus width for M_1 based on specimens from UM collections. B, Stratigraphic distribution of M_1 size through Bridgerian sequence. Note presence of a single *Orohippus* lineage in Br-1b and the presence of two, possibly three, lineages in Br-2.

represents a new species, but the evidence is not compelling enough yet to warrant naming a new taxon. It should be noted that there is evidence from the West collection to suggest that a third, smaller species of *Orohippus* may also exist in Br-2 (Fig. 19). This possible new species is similar in size to *Orohippus proteros* from the Wind River Basin (Korth and Evander, 1982) but differs in having a much more molariform upper fourth premolar.

Measurements. — 94890: $P_3 = 6.6 \times 4.2$, $M_1 = 7.1 \times 5.1$; 95489: $dP^4 = 6.2 \times 6.8$; 95570: $P^4 = 6.4 \times 8.0$, $M^1 = 6.9 \times 8.1$, $M^2 = 7.4 \times 8.9$, $M^3 = 7.3 \times 9.4$; 95675: $dP^2 = 7.0 \times 3.1$, $dP^3 = 6.9 \times 3.8$, $dP^4 = 7.1 \times 8.0$, $M^1 = 7.5 \times 9.0$, $M_1 = 7.5 \times 4.9$, $M_2 = 7.8 \times 5.3$, $M_3 = 9.7 \times 4.9$; 98614: $M^1 = 7.4$

× 8.0, M^2 = 8.1 × 8.4; 98701: M^3 = 6.5 × 7.8; 100725: M^1 = 7.1 × 8.3; 100814: M^1 = 7.6 × 8.0; 100913: P_3 = 6.9 × 4.5; 101049: P_3 = 7.5 × 4.4, M_1 = 7.9 × 5.1, M_2 = 7.8 × 5.4; 101479: M^1 = 7.3 × 8.3; 101501: M^1 = 7.3 × 8.3.

Family BRONTOTHERIIDAE Marsh, 1873
Palaeosyops Leidy, 1870
Palaeosyops fontinalis Cope, 1873
(Fig. 18B)

Distribution. — Localities BB-15, 45, 66, 96, 121; BI-3, 13, 14, 16, 28, 29, 39-41.

Referred specimens. — **BB-15**: 94880, skull with right I^3-M^2, associated fragments. **BB-45**: 95636, metacarpals. **BB-66**: 98623, tooth fragments. **BB-96**: 99815, tooth fragments. **BB-121**: 101567, postcrania. **BI-3**: 100414, postcrania. **BI-13**: 100471, metacarpal. **BI-14**: 100478, tibia. **BI-16**: 100865, tooth and dentary fragments, postcrania. **BI-28**: 100660, tooth fragments. **BI-29**: 100669, tooth fragments, postcrania. **BI-39**: 100878, postcrania. **BI-40**: 100904, postcrania. **BI-41**: 100920, postcrania.

Discussion. — Br-1b brontotheriids are represented by relatively poorly preserved specimens. Most consist of a few broken postcranial elements and/or broken teeth. One crushed skull (UM 94880) shows that these brontotheriids were relatively small and can be assigned to *Palaeosyops fontinalis*, the type specimen of which also comes from Br-1b. Early Bridgerian brontotheriids are being reviewed and will be reported on in more detail elsewhere (Yarborough and Gunnell, 1997; Gunnell and Yarborough, in preparation).

Measurements. — 94880: P^3 = 13.2 × 18.3, P^4 = 16.4 × 21.5.

Family HELALETIDAE Osborn, 1892
Helaletes Marsh, 1872
Helaletes nanus (Marsh), 1872
(Fig. 20A)

Distribution. — Localities BB-54; BI-20, 30, 32, 37, 51.

Referred specimens. — **BB-54**: 95694, left maxilla P^{1-4}, postcrania. **BI-20**: 100599, right P_3. **BI-30**: 101404, right P_4. **BI-32**: 100755, left M_2. **BI-37**: 100795, tooth fragments. **BI-51**: 101381, left dentary P_{3-4}, associated fragments.

Discussion. — *Helaletes* is poorly represented from Br-1b and most of the specimens are not well preserved. Of the specimens that do preserve substantial morphology (UM 95694, UM 101381), no discernable differences can be detected between these specimens and *Helaletes nanus* (Radinsky, 1963), best known from Br-2.

Measurements. — 95694: P^1 = 5.9 × 3.3, P^2 = 7.0 × 7.1, P^3 = 7.5 × 9.5, P^4 = 8.8 × 10.9; 100599: P_3 = 8.6 × 5.3; 100755: M_2 = 10.4 × 6.6; 101381: P_3 = 8.3 × 5.5, P_4 = 9.3 × 6.9.

Family HYRACODONTIDAE Cope, 1879
Hyrachyus Leidy, 1871
Hyrachyus sp.

Distribution. — Localities BB-2, 3, 6, 9-11, 17, 18, 20, 22, 24, 37, 44, 47, 50, 52, 63, 74, 77, 79, 95, 104; BI-1, 10, 11, 14, 15, 17, 20, 24, 25, 29, 31, 32, 37, 38, 40, 47, 50, 57, 59, 60.

Referred specimens. — **BB-2**: 94848, right P_3; 95463, skull, associated fragments. **BB-3**: 98588, left P^3; 98595, right M^x. **BB-6**: 101554, tooth fragments. **BB-9**: 95654, postcrania. **BB-10**: 94857, tooth fragments; 95488, teeth and associated fragments; 95508, teeth; 98680, right maxilla. **BB-11**: 94873, right maxilla P^2-M^1; 98688, left and right dentaries. **BB-17**: 95619, postcrania;

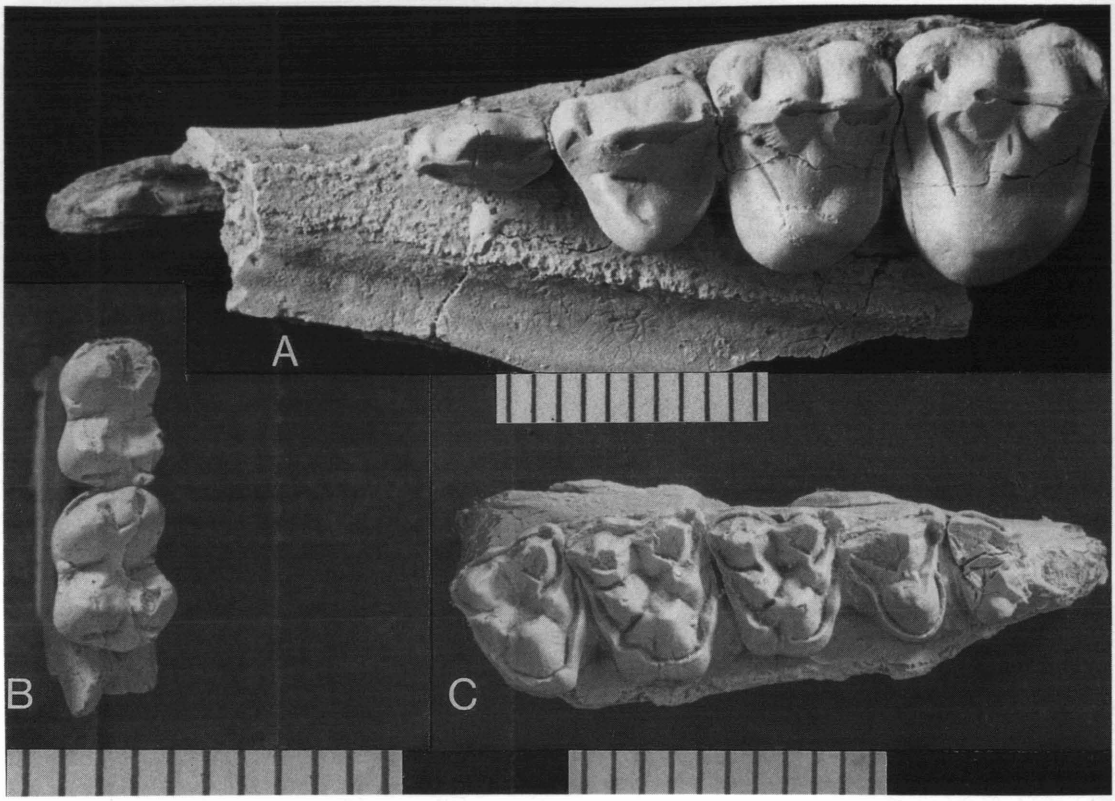

FIG. 20 — Perissodactyla and Artiodactyla from Br-1b. A, *Helaletes nanus*, UM 95694, left maxilla P^{1-4} from locality BB-54, in occlusal view. B, *Microsus cuspidatus*, UM 99697, left dentary M_{1-2} from locality BB-6, in occlusal view. C, *Antiacodon* sp., cf. *A. pygmaeus*, UM 100818, right maxilla P^3-M^3 from locality BI-38, in occlusal view.

101547, tooth fragments; 102006, left dentary P_4, M_{2-3}. **BB-18**: 98669, tooth fragments. **BB-20**: 94893, tooth fragments, associated postcranial fragments; 95705, left dentary dP_4. **BB-22**: 98585, postcrania. **BB-24**: 95468, postcrania; 95469, right dentary M_{2-3}; 95554, two lower incisors. **BB-37**: 101023, postcrania. **BB-44**: 95635, tooth fragments. **BB-47**: 95641, postcrania. **BB-50**: 95665, left dentary M_1; 95666, tooth fragments; 95667, left dentary M_x. **BB-52**: 95672, postcrania. **BB-63**: 98610, tooth fragments. **BB-74**: 101035, postcrania. **BB-77**: 98734, right maxilla. **BB-79**: 98761, right P^4. **BB-95**: 98953, skull, postcrania. **BB-104**: 99668, tooth fragments. **BI-1**: 100407, palate, associated fragments. **BI-10**: 100452, tooth fragments. **BI-11**: 100462, distal tibia. **BI-14**: 100477, left M^3. **BI-15**: 100885, tooth fragments. **BI-17**: 101509, right tibia. **BI-20**: 100568, right dentary. **BI-24**: 100631, right astragalus. **BI-25**: 100638, metapodials. **BI-29**: 100668, postcrania. **BI-31**: 100723, tooth fragments; 101363, tooth fragments. **BI-32**: 100853, left and right maxillae, associated fragments. **BI-37**: 100788, left M^1, associated fragments; 100797, left and right dentaries, postcrania. **BI-38**: 100807, left dentary; 101375, incisor. **BI-40**: 100906, left maxilla P^3-M^2, associated fragments; 100911, postcrania; 101504, left M^3. **BI-47**: 101371, tooth fragments. **BI-50**: 101379, postcrania. **BI-57**: 101460, tooth fragments. **BI-59**: 101489, right astragalus; 101491, right tibia. **BI-60**: 101499, left M^x.

Discussion. — The UM sample of *Hyrachyus* it is currently under study (Childress, in preparation) and will be reported on elsewhere.

Order ARTIODACTYLA Owen, 1848
Family HOMACODONTIDAE Marsh, 1894
Microsus Leidy, 1870
Microsus cuspidatus Leidy, 1870
(Fig. 20B)

Distribution. — Localities BB-5, 6, 9, 31, 79; BI-32, 40.

Referred specimens. — **BB-5**: 94849, left P_4, M_2. **BB-6**: 98599, left dentary P_{3-4} (broken); 98602, left dentary M_3; 99697, left dentary M_{1-2}. **BB-9**: 95655, left dentary M_{1-2}, right dentary M_3. **BB-31**: 95787, right M_x (broken). **BB-79**: 98760, right dentary P_3 (broken), left M^1 or M^2. **BI-32**: 100743, left M_1. **BI-40**: 101506, left M^3.

Discussion. — Of the two homacodontids known from Br-1b *Microsus cuspidatus* is the smaller taxon and it is represented by a few broken teeth and dentary fragments. *Microsus* remains a poorly known genus and the few specimens from Br-1b do not add new information about its morphology.

Measurements. — 94849: $P_4 = 4.1 \times 2.3$, $M_2 = 4.2 \times 3.0$; 95655: $M_1 = 3.9 \times 2.8$, $M_3 = 5.0 \times 3.0$; 98602: $M_3 = 4.2 \times 2.8$; 98760: $M^{1 \text{ or } 2} = 4.2 \times 5.1$; 99697: $M_1 = 4.3 \times 2.8$, $M_2 = 4.6 \times 3.4$; 100743: $M_1 = 3.8 \times 2.8$; 101506: $M^3 = 3.8 \times 4.8$.

Antiacodon Marsh, 1872
Antiacodon sp., cf. *A. pygmaeus*
(Fig. 20C)

Distribution. — Localities BI-15, 17, 20, 32, 33, 38.

Referred specimens. — **BI-15**: 100531, right maxilla M^{1-2}. **BI-17**: 100543, left M^3. **BI-20**: 100572, left P_4; 100615, right M_2. **BI-32**: 100743, left M_1; 100759, left P_4. **BI-33**: 100762, left P_3. **BI-38**: 100818, right maxilla P^3-M^3; 100824, left P_3.

Discussion. — Robinson (1966) described a new subspecies of *Antiacodon pygmaeus*, *A. p. huerfanensis* from the Gardnerbuttean in Huerfano Park, Colorado. Robinson noted that the new subspecies was slightly larger than typical *A. pygmaeus* from the Bridgerian and that it had a P_4 with the paraconid and metaconid imperfectly separated from the protoconid as in *Hexacodus*. Comparison of tooth measurements from the small Br-1b sample of *Antiacodon* with measurements provided by Robinson (1966) and West (1984) shows that the Br-1b sample is slightly larger than typical *Antiacodon pygmaeus* from the later part of the Bridgerian. In the two Br-1b specimens preserving P_4 (UM 100572, UM 100759), the morphology is somewhat variable with UM 100572 showing good protoconid-paraconid-metaconid separation, while UM 100759 has clear protoconid-paraconid separation but not protoconid-metaconid separation. Until better samples are available these specimens have been tentatively assigned to *Antiacodon pygmaeus*.

Measurements. — 100531: $M^1 = 4.8 \times 5.4$, $M^2 = 4.9 \times 5.8$; 100572: $P_4 = 4.6 \times 2.5$; 100615: $M_2 = 5.1 \times 3.9$; 100759: $P_4 = 4.5 \times 2.4$; 100818: $P^4 = 4.2 \times 4.4$, $M^1 = 5.0 \times 5.5$, $M^2 = 5.1 \times 6.1$, $M^3 = 4.7 \times 5.7$; 100824: $P_3 = 4.2 \times 2.2$.

Homacodontidae, *indet.*

Distribution. — Localities BB-6, 10, 17, 20, 49, 80; BI-7, 15, 20.

Referred specimens. — **BB-6**: 98631, left astragalus; 99686, right astragalus. **BB-10**: 95465, left astragalus. **BB-17**: 99719, right astragalus. **BB-20**: 95704, left astragalus. **BB-49**: 95650, left astragalus. **BB-80**: 98763, right astragalus. **BI-7**: 100430, left astragalus. **BI-15**: 100532, left astragalus. **BI-20**: 100588, left astragalus; 100591, left astragalus; 100594, left calcaneum; 100799, right astragalus.

Discussion. — There are twelve astragali and one calcaneum of homacodontids from the Br-1b sample. Comparisons of astragalar length measurements with the one astragalar length provided by West (1984) show that all but one of the astragali are smaller than that described as representing *Antiacodon pygmaeus* by West. The single calcaneum is only slightly smaller than the one described by West (1984) for *A. pygmaeus*. It may be that all of the smaller astragali represent *Microsus* but there is little understanding of size variability in homacodontid astragali so all are placed indeterminately in homacodontids.

Measurements. — 98631: Astragalar length = 11.8; 98763: Astragalar length = 8.9; 99686: Astragalar length = 9.9; 99719: Astragalar length = 9.1; 100430: Astragalar length = 9.6; 100588: Astragalar length = 9.4; 100591: Astragalar length = 10.7; 100594: Calcaneal length = 22.3; 100799: Astragalar length = 9.4.

DISCUSSION

When Matthew (1909) published his Bridger monograph there was only a single identifiable mammal known from sediments he described as Bridger A, the holotype skull of *Palaeosyops fontinalis*. McGrew and Sullivan (1970) described 22 genera and 23 species from Bridger A. Gunnell and Bartels (1994) included 39 genera and 40 species of mammals in their faunal list from Bridger A. The mammalian fauna from Bridger lithostratigraphic interval A, biostratigraphic zone Br-1b, now includes 43 genera and 54 species (see Table 1). Among the new records and developments since the faunal list of Gunnell and Bartels (1994) was published are: recognition of four species of *Peratherium*, recognition of three species of *Scenopagus*, new records for *Armintodelphys*, *Centetodon*, *Nyctitherium*, *Gazinius*, *Antiacodon*, and *Brachianodon*, and refinement of the taxonomy of several groups including carnivores, rodents, creodonts, primates, and artiodactyls.

Comparisons between mammalian faunas from lithostratigraphic intervals A and B reveal some notable differences as well as many similarities. In terms of taxonomic diversity, Bridger B mammalian faunas include approximately 13 more genera (56) and 39 more species (93). Some of these differences in diversity can be explained by a lack of recent systematic treatment of many groups of Bridger B mammals. Miacid carnivores and pantolestid insectivores were mentioned above as groups in need of thorough revision. Other groups of Bridger B mammals needing attention include perissodactyls, particularly brontotheriids and equids, and rodents, especially paramyids.

In terms of faunal constituents, 39 of 43 Br-1b genera (91%) also are present in Br-2 and 39 of 54 Br-1b species (72%) also are found in Br-2. Of the four genera present in Br-1b that are not present in Br-2, only *Brachianodon* appears to be unique to that zone. Two others (*Armintodelphys* and *Bathyopsis*) are known from preceding intervals, while *Gazinius* is poorly known, otherwise being represented only by two specimens from the Aycross Formation in northwestern Wyoming (Bown, 1979) and by a single tooth from Br-3 (Gunnell, 1995).

Of the 15 species known from Br-1b that are not found in Br-2, six (*Notharctus robinsoni*, *Smilodectes mcgrewi*, *Anaptomorphus westi*, *Brachianodon westorum*, *Vulpavus farsonensis*, and *Bathyopsis middleswarti*) may be unique to Br-1b (although *N. robinsoni* and *A. westi* may be known from preceding and succeeding intervals respectively). Three species (*Trogolemur amplior*, *Uintanius rutherfurdi*, and *Antiacodon huerfanensis*) are only known from the preceding Gardnerbuttean (Br1a). The others are either poorly represented (Cf. *Armintodelphys* sp.) or appear intermediate between Gardnerbuttean and Br-2 species (*Microsyops* sp., cf. *M. elegans*, *Microparamys* sp., cf. *M. minutus*, *Thinocyon* sp., cf. *T. velox*, *Vulpavus* sp., cf. *V. palustris*, and *Orohippus* sp., cf. *O. pumilus*).

Figure 21 presents a graphic representation of the Simpson Coefficient of Faunal Similarity (Simpson, 1943; Flynn, 1986) comparing the composition of mammalian faunas from the latest early Eocene (Lostcabinian, Wa-7), the earliest middle Eocene (Gardnerbuttean, Br-0/Br-1a), Br-1b, and Br-2. Among mammalian families, the Simpson Coefficient (SC) remains high through the

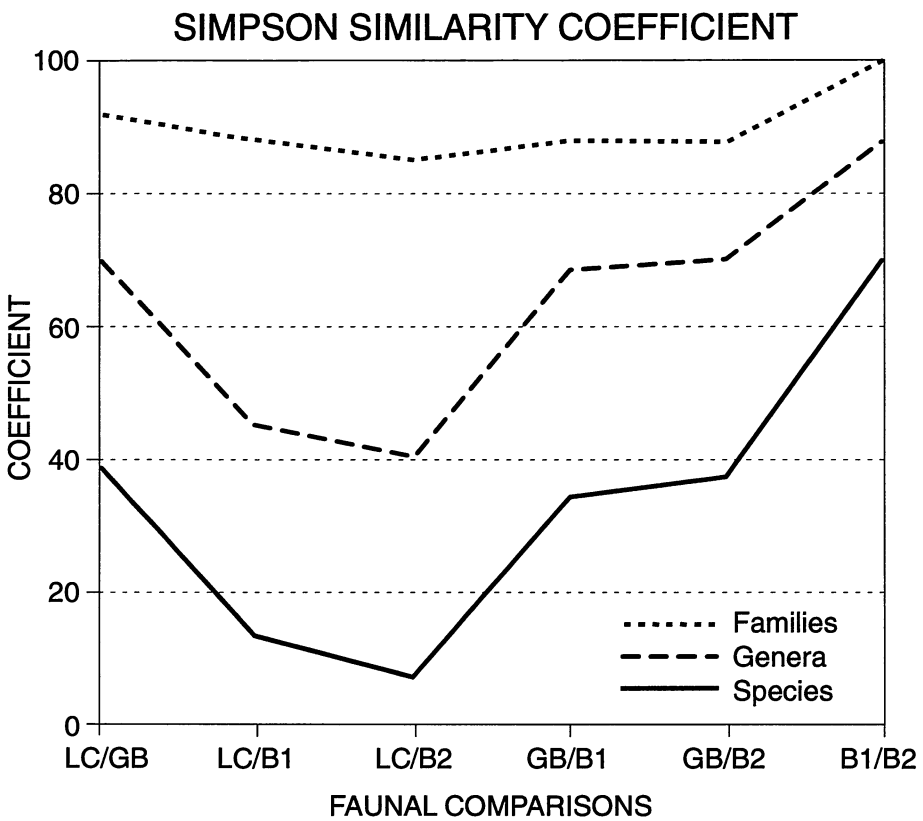

FIG. 21 — Chart comparing Lostcabinian, Gardnerbuttean (Br-0/Br-1a), Bridgerian zone Br-1b, and Bridgerian zone Br-2 using Simpson Coefficient of Faunal Similarity (SC) at the family, genus, and species levels. SC = C/N_1 x 100, where C = the number of taxa (at any chosen taxonomic level) shared between two faunas or samples and N_1 = the total number of taxa present (at the same taxonomic level as C) in the smaller fauna or sample. X-axis represents pairs of compared faunas with LC = Lostcabinian, GB = Gardnerbuttean, B1 = Br-1b, and B2 = Br-2. Y-axis is Simpson Coefficient for any given pair of compared faunas at one of three taxonomic levels (family, genus, species).

entire interval, reaching 100 in comparisons between Br-1b and Br-2 (that is, all families known from Br-1b are also known from Br-2).

Comparing mammalian genera, Lostcabinian and Gardnerbuttean mammalian faunas have an SC of 70 while, as one might expect, Lostcabinian comparisons with Br-1b (SC = 45) and the subsequent Br-2 (SC = 40) reflect less similarity. Gardnerbuttean genera also shared relatively high similarity with mammalian faunas from the subsequent Br-1b (SC = 68) and Br-2 (SC = 70) zones. The relatively high generic similarity between the Gardnerbuttean and both the Lostcabinian and Br-1b/Br-2 reflects the transitional nature of Gardnerbuttean mammalian faunal assemblages. Br-1b shares its highest similarity with Br-2 (SC = 88).

The same pattern of similarity that is seen among genera is also present in comparisons of species. Lostcabinian faunas are most similar to Gardnerbuttean faunas at the species level (SC = 39) and less similar to Br-1b (SC = 13) and Br-2 (SC=7) faunas. The Gardnerbuttean is again transitional, sharing nearly equivalent species similarity with Br-1b (SC= 34) and Br-2 (SC = 37) as it does with the Lostcabinian. Br-1b again shares its highest similarity with Br-2 (SC = 70). While similar in pattern to the generic distribution, the species distribution differs substantially in degree, reflecting the relatively high level of species change across the early to middle Eocene boundary.

Overall Br-1b mammalian faunas resemble Br-2 faunas more closely than they do the preceding Gardnerbuttean assemblages. However, there are differences between mammalian assemblages from Br-1b and Br-2, particularly at the species level. These differences indicate that Br-1b mammals represent an intermediate stage in the transition from an earliest middle Eocene fauna to the more "classic" middle Eocene faunas represented by the well known Bridgerian mammalian assemblages from Br-2 and Br-3. For this reason, it is useful and proper to maintain a distinctive biostratigraphic zone, Br-1b, to designate this mammalian assemblage from the lowest part of the Bridger Formation.

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LITERATURE CITED

BEARD, K.C., L. KRISHTALKA, and R.K. STUCKY. 1992. Revision of the Wind River faunas, early Eocene of central Wyoming. Part 12. New species of omomyid primates (Mammalia: Primates: Omomyidae) and omomyid taxonomic composition across the early-middle Eocene boundary. Annals of Carnegie Museum, 61: 39-62.

BOWN, T.M. 1979. New omomyid primates (Haplorhini, Tarsiiformes) from middle Eocene rocks of west-central Hot Springs County, Wyoming. Folia Primatologica, 31: 48-73.

COUPAR, C.G. 1996. Dental variation in *Omomys carteri*. Masters Thesis, California State University, Sacramento, 188 pages.

DAWSON, M.R. 1968. Middle Eocene rodents (Mammalia) from northeastern Utah. Annals of Carnegie Museum, 39: 327-370.

FLYNN, J. J. 1986. Faunal provinces and the Simpson Coefficient. Contributions to Geology, University of Wyoming, Special Paper, 3: 317-338.

GAZIN, C.L. 1953. The Tillodontia: An early Tertiary order of mammals. Smithsonian Miscellaneous Collections, 121: 1-110.

———. 1968. A study of the Eocene condylarthran mammal *Hyopsodus*. Smithsonian Miscellaneous Collections, 153: 1-90.

———. 1976. Mammalian faunal zones of the Bridger middle Eocene. Smithsonian Contributions to Paleobiology, 26: 1-25.

GINGERICH, P.D. 1979. Phylogeny of middle Eocene Adapidae (Mammalia, Primates) in North America: *Smilodectes* and *Notharctus*. Journal of Paleontology, 53: 153-163.

GUNNELL, G.F. 1989. Evolutionary history of Microsyopoidea (Mammalia, ?Primates) and the relationship between Plesiadapiformes and Primates. University of Michigan, Papers on Paleontology, 27: 1-157.

———. 1995. Omomyid primates (Tarsiiformes) from the Bridger Formation, middle Eocene, southern Green River Basin, Wyoming. Journal of Human Evolution, 28: 147-187.

——— and W.S. BARTELS. 1994. Early Bridgerian (middle Eocene) vertebrate paleontology and

paleoecology of the southern Green River Basin, Wyoming. Contributions to Geology, University of Wyoming, 30: 57-70.

——— and P.D. GINGERICH. 1993. Skeleton of *Brachianodon westorum*, a new middle Eocene metacheiromyid (Mammalia, Palaeanodonta) from the early Bridgerian (Bridger A) of the southern Green River Basin, Wyoming. Contributions from the Museum of Paleontology, University of Michigan, 28: 365-392.

GUTHRIE, D.A. 1971. The mammalian fauna of the Lost Cabin Member, Wind River Formation (early Eocene) of Wyoming. Annals of Carnegie Museum, 43: 47-113.

KITTS, D.B. 1957. A revision of the genus *Orohippus* (Perissodactyla, Equidae). American Museum Novitates, 1864: 1-40.

KORTH, W.W. 1984. Earliest Tertiary evolution and radiation of rodents in North America. Bulletin of Carnegie Museum of Natural History, 24: 5-71.

——— and R.L. EVANDER. 1982. A new species of *Orohippus* (Perissodactyla, Equidae) from the early Eocene of Wyoming. Journal of Vertebrate Paleontology, 2: 167-171.

KRISHTALKA, L. 1976. Early Tertiary Adapisoricidae and Erinaceidae (Mammalia, Insectivora) of North America. Bulletin of Carnegie Museum of Natural History, 1: 4-40.

——— and R.K. STUCKY. 1983a. Revision of the Wind River faunas, early Eocene of central Wyoming. Part 3. Marsupialia. Annals of Carnegie Museum, 52: 205-227.

——— and R.K. STUCKY. 1983b. Paleocene and Eocene marsupials of North America. Annals of Carnegie Museum, 52: 229-263.

——— and R.K. STUCKY. 1984. Middle Eocene marsupials (Mammalia) from northeastern Utah and the mammalian fauna from Powder Wash. Annals of Carnegie Museum, 53: 31-45.

———, R.M. WEST, C.C. BLACK, M.R. DAWSON, J.J. FLYNN, W.D. TURNBULL, R.K. STUCKY, M.C. MCKENNA, T.M. BOWN, D.J. GOLZ, and J.A. LILLEGRAVEN. 1987. Eocene (Wasatchian through Duchesnean) biochronology of North America. In M.O. Woodburne (ed.), Cenozoic Mammals of North America — Geochronology and Biostratigraphy, University of California Press, Berkeley, pp. 77-117.

LILLEGRAVEN, J.A., M.C. MCKENNA, and L. KRISHTALKA. 1981. Evolutionary relationships of middle Eocene and younger species of *Centetodon* (Mammalia, Insectivora, Geolabididae) with a description of the dentition of *Ankylodon* (Adapisoricidae). University of Wyoming Publications, 45: 1-115.

——— and L. M. OSTRESH, JR. 1988. Evolution of Wyoming's early Cenozoic topography and drainage patterns. National Geographic Research, 4: 303-327.

MATTHEW, W.D. 1909. The Carnivora and Insectivora of the Bridger Basin, middle Eocene. Memoirs of the American Museum of Natural History, 9: 291-567.

———. 1915. A revision of the lower Eocene Wasatch and Wind River faunas. Part I. Order Ferae (Carnivora). Bulletin of the American Museum of Natural History, 34: 1-103.

MCGREW, P.O. and R. SULLIVAN. 1970. The stratigraphy and paleontology of Bridger A. Contributions to Geology, University of Wyoming, 9: 66-85.

RADINSKY, L. 1963. Origin and early evolution of North American Tapiroidea. Bulletin, Peabody Museum of Natural History, 17: 1-106.

ROBINSON, P. 1966. Fossil Mammalia of the Huerfano Formation, Eocene, of Colorado. Bulletin, Peabody Museum of Natural History, 21: 1-95.

———. 1968. Nyctitheriidae (Mammalia, Insectivora) from the Bridger Formation of Wyoming. Contributions to Geology, University of Wyoming, 7: 129-138.

SCHOCH, R.M. 1984. Revision of *Metacheiromys* Wortman, 1903 and a review of the Palaeanodonta. Postilla, 192: 1-28.

———. 1986. Systematics, functional morphology and macroevolution of the extinct mammalian order Taeniodonta. Bulletin, Peabody Museum of Natural History, 42: 1-307.

——— and S.G. LUCAS. 1981. The systematics of *Stylinodon*, a middle to late Eocene taeniodont (Mammalia) from western North America. Journal of Vertebrate Paleontology, 1: 175-183.

SIMPSON, G.G. 1931. *Metacheiromys* and the Edentata. Bulletin of the American Museum of Natural History, 59: 295-381.

———. 1943. Mammals and the nature of continents. American Journal of Science, 241: 1-31.

———. 1959. A new middle Eocene edentate from Wyoming. American Museum Novitates, 1960: 1-8.

WEST, R.M. 1973. An early middle Eocene Epoicotheriid (Mammalia) from southwestern Wyoming. Journal of Paleontology, 47: 929-931.

———. 1979a. Paleontology and Geology of the Bridger Formation, southern Green River Basin, southwestern Wyoming. Part 3. Notes on *Hyopsodus*. Contributions in Biology and Geology, Milwaukee Public Museum, 25: 1-52.

———. 1979b. Apparent prolonged evolutionary stasis in the middle Eocene hoofed mammal *Hyopsodus*. Paleobiology, 5: 252-260.

———. 1984. Paleontology and Geology of the Bridger Formation, southern Green River Basin, southwestern Wyoming. Part 7. Survey of Bridgerian Artiodactyla, including description of a skull and partial skeleton of *Antiacodon pygmaeus*. Contributions in Biology and Geology, Milwaukee Public Museum, 56: 1-47.

——— and J.H. HUTCHISON. 1981. Paleontology and Geology of the Bridger Formation, southern Green River Basin, southwestern Wyoming. Part 6. The fauna and correlation of Bridger E. Contributions in Biology and Geology, Milwaukee Public Museum, 46: 1-8.

WHEELER, W.H. 1961. Revision of the Uintatheres. Bulletin, Peabody Museum of Natural History, 14: 1-93.

WOOD, A.E. 1962. The early Tertiary rodents of the family Paramyidae. Transactions of the American Philosophical Society, 52: 3-261.

WOOD, H. E., 2nd. 1934. Revision of the Hyrachyidae. Bulletin of the American Museum of Natural History, 67: 181-295.

WORTMAN, J.L. 1901-1902. Studies of Eocene Mammalia in the Marsh Collection, Peabody Museum. Part I. Carnivora. American Journal of Science, 9: 333-348; 11: 437-450; 12: 143-154, 193-206, 281-296, 377-382, 421-432; 13: 39-46, 115-128, 197-206, 433-448; 14: 17-23.

YARBOROUGH, V. L. and G. F. GUNNELL. 1997. New specimens of *Palaeosyops fontinalis* (Perissodactyla) from the southern Green River Basin, Wyoming - Morphology and temporal range of early Bridgerian brontotheriids. Journal of Vertebrate Paleontology, 17: 86A.