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Geology and Paleontology of the Bridger Formation,
Southern Green River Basin, Southwestern Wyoming.
Part 6. The Fauna and Correlation of Bridger E.

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**Geology and Paleontology of the Bridger Formation,
Southern Green River Basin, Southwestern Wyoming. Part 6.
The Fauna and Correlation of Bridger E.**

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Abstract: The upper part of the Bridger Formation, Bridger E, is shown to be of Bridgerian age. Fossil vertebrates, both reptiles and mammals, have been collected from two localities in the Bridger E. Because of its lithologic distinctiveness, the Bridger E is here formally designated the Cedar Mountain Member of the Bridger Formation.

Introduction

In his comprehensive description of the Bridger Formation, W. D. Matthew (1909) divided the formation into five lithostratigraphic units, the uppermost of which was designated Bridger E. He typified this 500 foot (154 meter) thick part of the formation as being composed of "soft banded tuffs with heavy volcanic ash layers. Nearly barren of fossils and with large gypsum content" (1909, p. 296). The stratigraphically most significant nearby marker bed, the Upper White Layer, was determined to be 75 feet (23 meters) below the base of Bridger E and thus well down in underlying Bridger D. The Bridger E is unconformably overlain by the "Bishop Conglomerate" (Bradley, 1964). Matthew attempted a paleontologic definition of Bridger E, stating (1909, p. 296) that the "uppermost [E] beds are very barren of fossils but a few fragmentary mammal remains sufficiently prove that they belong to the Bridger Age." Whatever fossils formed the basis of this statement cannot be distinguished in the collection of the American Museum of Natural History (M.C. McKenna, personal communication, 1980).

Subsequent to Matthew's work, Osborn (1929, p. 85) commented on the biostratigraphic position of Bridger E. "Bridger E is theoretically correlated with Washakie B and Uinta B (Upper Eocene). The topmost beds of the Bridger Formation, 500 feet thick, include sediments that are almost barren of fossils, but the few fragments of mammals they have yielded are of undoubted Bridger Age The correlation of Bridger E with Washakie B, to the east, is purely conjectural, for neither shows determinable remains of mammals." Osborn seemed to be quite uncertain about the fossil content of Bridger E, and his correlation placed the Bridger E considerably later in time than did those of other authors.

By 1933 Simpson (p. 91) stated that "Bridger E contains no identifiable fossils," and showed on his correlation chart (Fig. 4, p. 85) the same correlation as did Osborn, Bridger E being the temporal equivalent of late Eocene Washakie B and Uinta B. Wood *et al.* (1941) stated that "the unfossiliferous Bridger 'E' may, or may not, be equivalent to some portion of the Uinta" (p. 51), with the further caveat that "the exact relation of Bridger E to this hypothetical interval [Bridger D - Uinta A] and to the earlier Uinta must remain entirely speculative until recognizable fossil mammals are found" (p. 34). Wheeler (1961, p. 12) commented that "the Bridgerian or Uintan age of Bridger E is unproved and unknown." Gazin (1976, p. 2) regarded Bridger E as "essentially barren of fossil mammals."

Uppermost Bridger Formation Strata

Milwaukee Public Museum (MPM) field groups have investigated two of the westernmost accessible areas of Bridger E; the first is at the southern end of Sage Creek Mountain (NW 1/4, sec. 10, and SW 1/4, sec. 3, T. 13 N., R. 113W.) and the second is at the western end of Cedar Mountain (SE 1/4, sec. 24, T. 13 N., R. 113W. and N 1/2, sec. 30, and S 1/2, sec. 19, T. 13 N., R. 112W.) (Fig. 1). The area near Sage Creek Mountain is that where Bradley (1964, p. A52) mapped the Upper White Layer; the section numbers on his map are offset by one (e.g., sec. 9 shown on Bradley's map is actually sec. 10, sec. 4 is actually sec. 3, etc.). The area west of Cedar Mountain has a much thicker section of Bridger E than does the area at the southern end of Sage Creek Mountain and has a much greater stratigraphic distance between the Upper White Layer and the lowermost banded sediments. It probably is the location which Matthew used to typify the unit.

In addition to these two sections studied in detail, the Bridger E can be traced about three miles eastward along the southern face of Cedar Mountain to section 27, T. 13 N., R. 112 W., where it disappears into scree- and vegetation-covered steep slopes. It is not recognizable along the northern side of Cedar Mountain, nor can it be distinguished at the easternmost exposure of the upper part of the Bridger Formation at Twin Buttes (see map in West, 1976). As it is traced along the southern face of Cedar Mountain, the color bands become more prominent, the white bands are reduced, and greenish and orangish units appear. These exposures are too steep to permit detailed examination or collection. The westernmost occurrence of Bridger E lithology is a small red and white banded mudstone exposure in the center of section 31, T. 13 N., R. 114 W. This cannot be traced into Hickey Mountain, where the uppermost beds do not show Bridger E lithology, and thus not to Sage Creek Mountain.

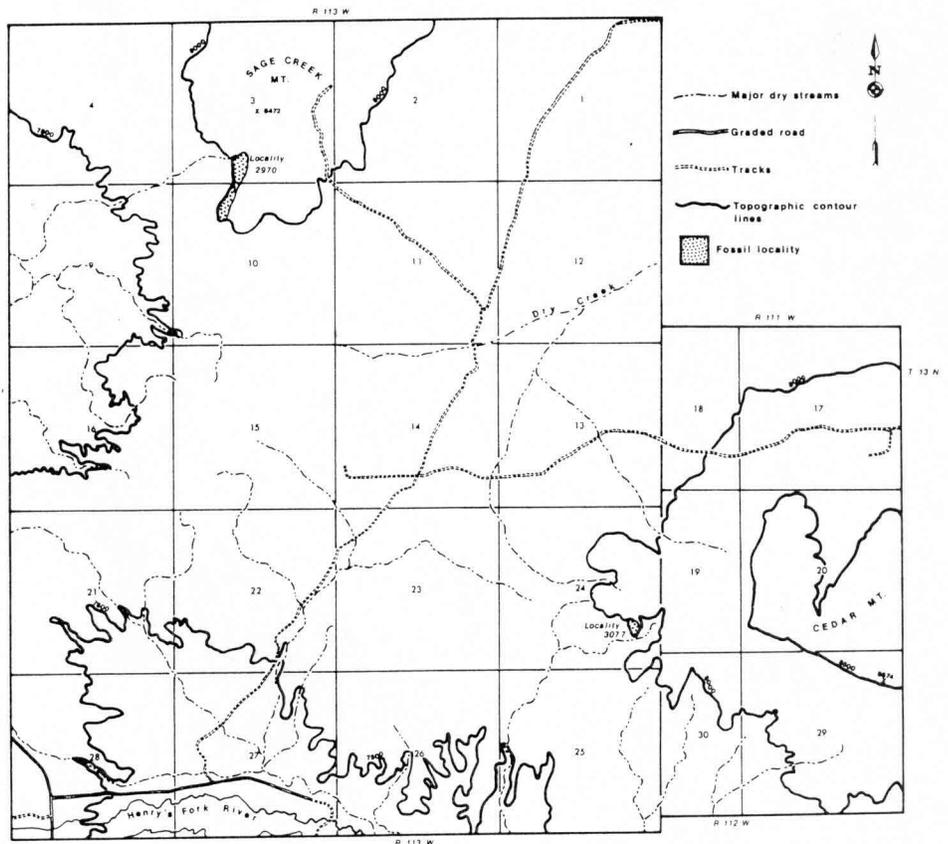


Figure 1. Sketch map showing MPM localities 2970 and 3077. This is traced from the U.S. Geological Survey 1:24,000 Lonetree, Burntfork, Reed Reservoir and Soap Holes Reservoir topographic maps.

The section at the southern end of Sage Creek Mountain is only 211 feet (65 meters) thick from the top of the Upper White Layer to the base of the overlying "Bishop Conglomerate." The lowest of the prominently red-banded soft tuffaceous siltstones is only 1.3 meters above the uppermost bed of the Upper White Layer. At this site, as well as at the Cedar Mountain site, the individual color bands do not persist laterally. The Bridger E at Cedar Mountain approximates the 500 foot (154 meter) thickness given by Matthew and checked by Wheeler, and the lowest red-banded unit occurs at least 75 feet (23 meters) above the distinctive Upper White Layer.

When both outcrop areas are considered, the criteria listed by Matthew as definitive of the Bridger E (i.e., thickness, gypsum content and color banding) are incompatible. It now seems best to define the Bridger E primarily on the basis of its lithologic distinctiveness from the generally gray to greenish-gray Bridger D, rather than its distance above the Upper White Layer. Therefore, we now regard the base of Bridger E to occur at the base of the first red- to orange-banded soft tuffaceous siltstone above the Upper White Layer.

The thin Bridger E section south of Sage Creek Mountain does not show the evaporite-rich strata which are so prominent high in the Cedar Mountain section. It is probable that the Sage Creek Mountain area was eroded somewhat more deeply prior to deposition of the blanket of "Bishop Conglomerate" which covered the southern part of the Green River Basin in post-Bridgerian time (Bradley, 1964).

Vertebrate and invertebrate fossils are now documented from through the Bridger E. The most productive levels are low in the unit, in the prominently red-banded siltstones in each sampled section. The higher and more evaporitic levels, well exposed in the upper part of the Cedar Mountain section, have fewer organic remains. Most of those are flat-coiled gastropods, although a few indeterminate bone fragments and enamel chips have been noted. MPM locality 2970 is on a west-facing scarp in the central part of sec. 10 and the SE 1/4, SW 1/4, sec. 3, T. 13N., R. 113W., at an elevation of 8000 to 8100 feet. It includes several different color bands. MPM locality 3077 is on the north side of a deep east-west drainage from the western end of Cedar Mountain in the NW 1/4, SE 1/4, SE 1/4, sec. 24, T. 13N., R. 113W., at an elevation of 7900 to 8000 feet.

The Bridger E Fauna

The fragmentary vertebrate fossils that make up the only documented assemblage from rocks of the Bridger E were gathered by surface collecting at localities 2970 and 3077 and by screen-washing at loc. 2970. Although the assemblage is small and of low diversity, both reptilian and mammalian taxa occur which are biochronologically definitive. All the specimens discussed below are in the collection of the Milwaukee Public Museum (MPM).

Reptilia

Testudines

Trionychidae

Trionyx sensu lato

Fragments of plastron and carapace (MPM 6063, 6082 and 6083, all loc. 2970) of a non-*Plastomenus* trionychid agree in morphology to similar parts in specimens referred to *Trionyx s. l.* The systematics of species referred to this genus are in chaos (Gaffney, 1979) and no stratigraphic significance is attached to the presence of the genus, which ranges in age from Cretaceous to Recent.

Dermatemydidae

Baptemys wyomingensis Leidy 1870

A few fragments of the pygal (MPM 7068, loc. 2970), suprapygals (MPM 6079, loc. 3077), hypoplastron (MPM 6081, loc. 2970), and various peripherals (MPM 6064, loc. 2970) are referable to this species, the type of which is from the Bridger Formation (Hay, 1908). The narrow gap between the inguinal and femoral scales and large size (carapace length about 45 cm) are diagnostic of *B. wyomingensis*. The genus appears first in the Wasatchian (Hutchison, 1980) and is unknown from any deposits of Uintan age or later despite good collections from Uintan deposits in Wyoming and Utah (Hay, 1908; Gilmore, 1916; Hutchison, personal observations). The species *B. wyomingensis* is restricted to Bridgerian age deposits.

Emydidae

"Rhinoclemys" terrestris (Cope) 1872

Shell fragments attest to the presence of a small emydine identical to a species found elsewhere lower in the Bridger Formation. This taxon is presently undergoing revision (Hutchison, in preparation). Three names have been applied to representatives of this species: *Palaeothea terrestris* Cope 1872; *Clemmys morrisiae* Hay 1908; and *Echmatemys pusilla* Hay 1908. McDowell (1964) referred *E. pusilla* to the extant genus *Rhinoclemys* (= *Callopsis*). Provisionally, all these may be referred to a *"Rhinoclemys" terrestris* (Cope), although reference to *Rhinoclemys sensu stricto* is not possible. The epiplastra (MPM 6099, loc. 3077, and MPM 6100, loc. 2970) of this species have a distinct epiplastral lip as in advanced testudinids and usually have distinct growth ridges. The entoplastron (MPM 6101, loc. 2970) lacks gular sulci and hypoplastron and hyoplastron (MPM 6103 and 6062, loc. 2970) have less well developed plastral buttresses than those of *Echmatemys*. The free-margined peripherals (MPM 6064 and 6102, loc. 2970) possess a sharp step developed viscerally where the scale meets the visceral cavity. The above character states along with the relatively small size (estimated shell length of under 15 cm) are diagnostic of *"R." terrestris*. *"R." terrestris* is known only from Bridgerian deposits.

Echmatemys septaria (Cope) 1873

Fragments of the shell of *Echmatemys* are the most common turtle specimens in the collection. Epiplastra with long dorsal coverage by the gular scales and converging gular projections (MPM 6080, 6083 and 6086, loc. 2970, and MPM 6073, loc. 3077), laterally expanded anterior lobe margins (MPM 6062 and 6083, loc. 2970), thick bones and strong plastral buttresses (MPM 6061, 6066, 6067, 6085, 6086 and 6089, loc. 2970, and MPM 6068, 6070-6073, 6090-6093, 6095, loc. 3077) and large size (carapace length somewhat less than 40 cm) are all consistent with *E. septaria* as revised by Roberts (1962). *E. septaria* is found as low as Bridger B and well up into the Uintan.

Archosauria

Crocodilia

Crocodylidae

Alligatorinae

Genus and Species indeterminate

A dentary fragment from the anterior part of the mandible behind the caniniform tooth (MPM 6106, loc. 2970) contains the roots of three teeth and an unerupted crown of another. The crown is button-shaped with fine irregular ridges radiating from the apex. In cross-section this part of the dentary is broader than deep. Both of these features indicate alligatorine affinities.

Mammalia

Marsupicarnivora

Didelphidae

Herpotherium marsupium (Troxell, 1923)

A single upper molar (MPM 5888, loc. 2970) accords well with *H. marsupium*, characterized by pronounced dilambdodonty and strong development of styler cusps B, C and D. *Herpotherium* is used here following Crochet (1977), who regards *Peratherium* as solely European in distribution. The Paleogene didelphids are poorly known, primarily because of their small size, and are of little use biochronologically.

Rodentia

Paramyidae

Paramys cf. *P. delicatior* Leidy 1873

Eight isolated rodent teeth (MPM 5882-5887, 5892, 5893) from the screenwashing of locality 2970 are clearly paramyid and have the greatest similarity with the Bridgerian species *Paramys delicatior*. The teeth are only little crenulated, have relatively marginal cusps, and the lower teeth lack the crest from the entoconid typical of *Reithoparamys*. The Bridger E teeth are somewhat smaller than are those in the samples from lower in the formation (B, C and D) measured by Wood (1962). In addition to the identified cheek teeth, there are several uncatalogued incisors of appropriate size for assignment to *P. delicatior*.

Perissodactyla

Brontotheriidae

Several fragments of large bone from loc. 2970 are limb elements of brontotheres. MPM 6179 is a proximal radius of an individual similar to *Palaeosyops* or *Manteoceras*, common Bridgerian brontotheres.

Conclusions

The presence of this vertebrate assemblage allows the Bridger E to be biochronologically regarded as part of the Bridgerian land mammal age. This assignment necessitates that the definition of the Bridgerian (Wood

et al., 1941) be expanded to include the time of deposition of Bridger E. Although the fossil contents of the Bridger E are indeed Bridgerian, the lithologic nature is suitably distinctive that Bridger E should be maintained as a separate member of the Bridger Formation. In keeping with Wood's (1934) grouping of Bridger A and B into the Black's Fork Member and the C and D into the Twin Buttes Member, we now propose that the Bridger E be treated in parallel fashion and be designated the Cedar Mountain Member, with its type section in the S 1/2, sec. 19, T. 13N., R. 112W. and the SE 1/4, sec. 24, T. 13N., R. 113W.

The Bridgerian land mammal age is presently considered to have lasted from 47.5 my to 49.5 my (McKenna *et al.*, 1974; West *et al.*, in press). The determination of this particular time span is based on biochronologic correlations of the Bridger Formation fauna with fossils from the nearby Washakie Basin and with radiometrically-dated fossiliferous rocks in the Yellowstone-Absaroka area (West *et al.*, in press). The oldest Uinta Basin rocks assigned to the Uintan land mammal age, the lower part of the Wagonhound Member of the Uinta formation, have not produced a vertebrate fauna. At this time, there are no radiometric dates available from the latest Bridgerian (Cedar Mountain Member) rocks within the Green River Basin, and none from presumed temporal equivalents in either the Uinta Basin (lower Wagonhound Member of the Uinta Formation) or Washakie Basin (upper Kinney Rim Member and lower Adobe Town Member of the Washakie Formation). Although the Bridgerian faunal affinities of the Cedar Mountain Member have now been established, its duration has yet to be determined. Therefore the question of possible overlap between the Bridgerian and Uintan land mammal ages will not be resolved until precise temporal equivalents of the Cedar Mountain Member are identified and their fossils studied. The present study does confirm, however, the apparent absence of Uintan rocks in the southern part of the Green River Basin.

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