From this limited evidence it may be speculated that the high water content of the sediments containing *C. floridana* may be important in facilitating the life functions between daily inundations in the marsh areas where it lives. The high volatile content of the sediments inhabited by *C. floridana* should be examined more closely for its possible nutritive role.

The stem densities in the *D. spicata* and dwarf *S. alterniflora* zones are far greater than those in the tall *S. alterniflora*. This may be very important in stabilizing the sediment and lessening the effect of light and temperature on marsh surface containing the clam (Kraeuter and Wolf, 1974).

At the suggestion of Dr. R. Tucker Abbott, who kindly verified the identification (Del. Mus. Nat. Hist., No. 102,538), we offer a figure to supplement the illustration in Abbott (1974). We would like to thank our colleague, Mr. Phil Averill, who collected and brought these specimens to our attention.

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TWO NEW SPECIES OF NON-MARINE MOLLUSCA FROM THE FORT UNION GROUP (PALEOCENE) OF NORTH DAKOTA AND MONTANA

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ABSTRACT

Two new species of fossil freshwater mollusks are described from the Paleocene Tongue River and Sentinel Butte Formations of North Dakota and Montana. Eupera missouriensis *n. sp. is a pisidiid clam related to* E. formosa *(Meek and Hayden).* Bellamya campaniformis *n. sp., a viviparid snail, occurs in the lower and middle Tongue River Formation and possibly in the Paskapoo Formation of Alberta.*

INTRODUCTION

Pioneering work on Fort Union mollusks and stratigraphy was done by F. B. Meek and F. V. Hayden between 1856 and 1860. Meek (1876) summarized the paleontology of the region and listed about 25 non-marine species of mollusks then known to occur in the Paleocene of the Williston Basin. With the exception of studies in the Saskatchewan portion of the basin summarized by Russell (1974) and other, scattered reports, most data on Paleocene mollusks of the Northern Great Plains has come from work in other sedimentary basins.

This report of two new species is part of a study of Williston Basin mollusks initiated in 1971 and due for publication in the near future. The results are based on collections from about 130 localities in eastern Montana and western North Dakota selected to provide the best stratigraphic and geographic coverage of the Fort Union Group.

The Fort Union Group along with the lowest

member of the predominantly Eocene Golden Valley Formation includes all the strata of Paleocene age in the Williston Basin. The Ravenscrag; Formation is the synonymous lithostratigraphic term for the northern margin of the Fort Union sequence in Saskatchewan (Russell, 1974). In eastern Montana the earliest Paleocene is included in the Tullock Formation which sets on top of dinosaur-bearing beds of the Cretaceous Hell Creek Formation and is overlain by the Lebo Formation. Together, the two reach thicknesses of over 600 ft. In North and South Dakota these two rock units cannot be easily separated and the sequence is termed the Ludlow Formation with possible subdivision into Tullock and Lebo Members in some areas. The Ludlow Formation in North Dakota and southeastern Saskatchewan intertongues with a marine equivalent, the Cannonball Formation, which represents a last resurgence of the Cretaceous epicontinental sea that crossed North America. Up to 700 ft. of the non-marine Tongue River Formation overlays the Lebo-Ludlow formation in Montana and westernmost North and South Dakota, and the Cannonball Formation over much of western North Dakota. The Saskatchewan portion of the basin includes only the lowest part of the Tongue River Formation and older rocks. Over much of North Dakota and parts of eastern Montana up to 650 ft. of the Sentinel Butte Formation overlays the Tongue River Formation and represents the most extensive unit of Upper Paleocene strata in the basin. At scattered localities in western North Dakota remnants of the lower member of the Golden Valley Formation reach maximum thicknesses of 65 ft. The Paleocene-Eocene boundary is placed at the contact of the upper and lower members of this formation based on paleobotanical evidence (Hickey, 1972).

Sediments comprising Fort Union Group strata, with the exception of the Cannonball Formation, were deposited in an alluvial system of numerous streams flowing generally eastward across broad coastal lowlands left from the mid-continent seaway. The sediments occur generally as semi-consolidated silts, clays, fine sandstones, and the lignite beds that command current attention as a source of abundant coal. The strata are often calcareous although true limestone and marlstone units are rather infrequent. Jacob's (1973) discussion of depositional environments of the Tongue River Formation provides a basic insight into the environments responsible for much of the non-marine Fort Union sequence.

Register of localities—The species described here occur at only 8 of the many localities examined, thus both are infrequent or rare in the Williston Basin.

Locality 1.—NW 1/4, SW 1/4, sec. 7, T. 143 N., R. 79 W., Burleigh Co., N. Dak., middle Tongue River Formation. 2.—NW 1/4, sec. 30, T. 142 N., R. 78 W., Burleigh Co., N. Dak., lower Tongue River Formation. 3.—SW 1/4, sec. 12, T. 144 N., R. 84 W., Mc Lean Co., N. Dak., upper Tongue River Formation. 4.—NE 1/4, SW 1/4, sec. 1, T. 140 N., R. 81 W., Burleigh Co., N. Dak., lower Tongue River Formation. 5.—SE 1/4, NW 1/4, sec. 28, T. 148 N., R. 100 W., Mc Kenzie Co., N. Dak., upper Sentinel Butte Formation. 6.—SE 1/4, NE 1/4, sec. 26, T. 148 N., R. 100 W., Mc Kenzie Co., N. Dak., upper Sentinel Butte Formation. 7.—NE 1/4, NW 1/4, sec. 10, T. 12 N., R. 51 E., Prarie Co., Mont., lower Lebo Formation. 8.—sec. 7, T. 135 N., R. 88 W., Grant Co., N. Dak., upper Tongue River Formation.

Family Pisidiidae
Genus *Eupera* Bourguignat

Eupera is represented in the non-marine Paleocene of the Williston Basin by the following taxon and *"Sphaerium" formosum* (Meek and Hayden). Yen (1946) referred a Lower Cretaceous species from Alberta and Wyoming to the genus and noted that *Eupera* also occurs in the Eocene of North America.

Eupera missouriensis *new species*

Figs. 1-4

Description—Shell medium size, elongate, inflated, greatest thickness along mid-length; beaks large, raised, umbo extending forward to anterior one-fourth of length; hinge extending over most of shell length; dorsal margin convex, joining posterior margin at a rounded angle; posterior high; posterior margin truncate, joining ventral margin at a prominent but rounded angle; ventral margin convex, merging with rounded anterior margin; anterior margin meeting hinge

anterior portion merging into hinge; cardinal teeth (LV) two, short, slender, situated below umbo; posterior lateral tooth (RV) slender, length about one-fourth of shell length; anterior lateral teeth (RV) two, short, cusps forming lip-like border for pocket, inner lateral curved, bulging into shell cavity; anterior and posterior laterals (LV) single, thick, raised, cusps prominent and situated near mid-length.

Types and measurements—Holotype USNM 220078 a right valve measuring, length 7.1 mm., height 5.5 mm.; Paratype USNM 220079 a left valve measuring, length 8.1 mm., height 6.4 mm.

Type locality—SE 1/4, NW 1/4, sec. 28, T. 148 N., R. 100 W., Mc Kenzie Co., N. Dak. North Unit of Theodore Roosevelt Memorial Park at 2340 ft. above mean sea level. Sentinel Butte Formation.

Age and range—Middle through late Paleocene age. *Eupera missouriensis* occurs in the Tongue River Formation along its eastern margin and in the Sentinel Butte Formation in the Little Missouri Badlands of western North Dakota. It is a dominant element only in the assemblages from the Sentinel Butte localities. Specimens have been collected at Localities 3, 4, 5, 6, and 8.

Remarks—*Eupera missouriensis* can only be confused with the equally uncommon but smaller species, *Eupera formosa* (Meek and Hayden). It is more elongate than *E. formosa* and possesses a rounded posterior ridge that is flanked by areas that appear flattened relative to the rest of the shell surface. The posterior surface of *E. formosa* is not broken by a ridge and its posterior margin is more rounded and merges with the ventral margin in a gentle curve. *Eupera formosa* appears ovate in outline while *E. missouriensis* appears more triangular. Growth lines on *E. formosa* are more regular than those of *E. missouriensis*. *Eupera formosa* has a slightly more fragile shell, and Williston Basin localities indicate that it inhabited rather heavily vegetated and quiet water in floodbasin areas. *Eupera missouriensis* has been collected from units interpreted as channel, point bar, levee or crevasse splay deposits. It appears that the two species occupied different habitats in the alluvial system, with *E. missouriensis* more closely associated with stream channels, possibly living in quiet reaches along shore. Specimens suited to adequate study of hinge structure are seldom recovered from the fine enclosing matrix, however the hinge structures of *E. formosa* are generally more delicate that those of *E. missouriensis* and the cusp of the posterior lateral (LV) is toward the posterior while on *E. missouriensis* it is central on the tooth.

Family Viviparidae
Subfamily Bellamyinae
Genus *Bellamya* Jousseaume

Examination of numerous lots of living African and Asian Bellamyinae in the U. S. National Museum and Field Museum of Natural History confirms Dwight Taylor's assignment of this and many other Late Cretaceous and Paleocene forms to the Bellamyinae.

Bellamya campaniformis *new species*

Figs. 5–8

Description—Shell medium to large, trochiform, heavy; spiral angle 70°-90° on first five whorls, declining to 50° on later whorls; shell width about three-fourths of height, width and height nearly equal in juveniles; whorls 4 to 6½, juvenile whorls nearly flat to slightly convex, adult whorls slightly to moderately convex; juncture of whorl base and periphery angular, marked by a narrow raised carina on juvenile whorls, whorl base convex; sutures lightly impressed, often slightly to distinctly below keel of preceding whorl; body whorl large, comprising more than two-thirds of shell height; aperture

TABLE 1. *Ranges of measurements and proportions of three size groups of* Bellamya campaniformis *n. sp. Upper, middle, and lower rows of Figure 8 show measured specimens arranged in the respective groups.*

Number of specimens	Height (mm.)	Width (mm.)	Number of whorls	Width / Height
7	10.8-18.4	12.9-17.0	4.0-4.7	1.19-.92
7	21.0-29.8	18.6-23.7	4.7-5.3	.88-.77
7	31.2-42.6	25.1-28.9	5.1-6.5	.81-.67

ovate to roundly triangular, large, equal to about 60% of shell height in juveniles, about 45% in mature specimens; peristome and growth lines prosocline, forming a 40° angle with spire axis; peristome periphery and base simple, convex, columellar lip attached, thickened, slightly reflected near base; columella imperforate; growth lines prominent, straight or slightly sinuous, and crossed by 1 to 6 or more fine, evenly spaced, spiral ridges.

Types and measurements—Holotype USNM 220080 height 32.7 mm., width 25.1 mm., aperture height 15.5 mm., whorls 6; Paratype USNM 220081 height 25.1 mm., width 20.8 mm., aperture height 12.4 mm., whorls 5. Nineteen other paratypes (Figure 8 and Table 1) are retained in the author's collection.

Type locality—Ball Butte, NE 1/4, SW 1/4, sec. 1, T. 140 N., R. 81 W., Burleigh Co., N. Dak. Gray buff sandstone about 2090 ft. above mean sea level. Tongue River Formation.

Age and range—Mid Paleocene, lower 300 ft. of the Tongue River Formation along its eastern margin in North Dakota (Localities 1, 2, 4, and possibly 7) and the Paskapoo Formation of Alberta.

Remarks—Bellamya campaniformis differs from *Bellamya retusa* in having a higher spire, a greater number of whorls, and whorls that are much less convex. *Bellamya retusa* lacks the spiral sculpture and keeled periphery of *B. campaniformis*. Both species have similar peristomes and share the tendency for shoulders to be formed on the first three whorls.

Bellamya campaniformis has a thicker walled and heavier shell than *Paludotrochus trochiformis*. It lacks the two prominent and equally spaced spiral ridges that are consistent features on the spire whorls of *P. trochiformis*. The spiral angle of *P. trochiformis* varies only from 80° to 70° during ontogeny giving the spire a straight-sided, trochoid shape while the spiral angle of *B. campaniformis* decreases during ontogeny producing a spire with convex sides. The number of whorls are about the same for the two species. A distinct shoulder at the top of early whorls persists onto the fourth whorl of *P. trochiformis* while the shoulder on *B. campaniformis* is generally less distinct and fades out on the second or third whorl. *Paludotrochus trochiformis* has a perforate collumella and generally a thinner columellar lip than *B. campaniformis*.

Tozer (1956) referred to *Bellamya retusa* specimens from the Paskapoo Formation (Paleocene) of Alberta that agree with *B. campaniformis*. The description and illustrations of the diagnostic characters of this species, however, his material was not examined.

The species has been collected from sand and clayey silt units interpreted as channel, point bar, and floodbasin deposits. Its limited occurrence does not permit a full analysis of its ecology, however it apparently lived in habitats associated with larger streams or at least flowing water as opposed to ponded floodbasin habitats.

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