PALEOCENE FRESH-WATER MOLLUSKS FROM SOUTHERN MONTANA

BY

TENG-CHIEN, YEN

Shorter Contributions to General Geology, 1947
(Pages 35–50)
CONTENTS

Abstract........................................................................... 35
Introduction..................................................................... 35
Previous work................................................................. 35
Composition and ecologic significance of the fauna............ 36
Stratigraphic distribution and age of the fauna..................... 36
Geographic distribution of the collections......................... 37
Systematic descriptions................................................... 40
Bibliography.................................................................... 44
Index............................................................................... 49

ILLUSTRATION

PLATE 10. Paleocene fresh-water mollusks from southern Montana----------------------------------------- 46
PALEOCENE FRESH-WATER MOLLUSKS FROM SOUTHERN MONTANA

By TENG-CHIEN YEN

ABSTRACT

Twenty-two species of fresh-water mollusks (two new) are described and illustrated from 45 localities in southern Montana. The genera Viviparus, Campeloma, Lioplacodes, Fluminicola, Pleurolimnaea, Physa, Aplexa, Gyraulus, Carinorbis, Sphaerium, and Elliptio are represented. The fauna comes mainly from the Tongue River member of the Fort Union formation and is assigned to the Paleocene, though it seems divisible into an older and a younger group of species and extends into beds that on other grounds are considered to belong to the Wasatch formation and to be of early Eocene age.

INTRODUCTION

During 1940 and 1941 R. P. Bryson, of the U. S. Geological Survey, assisted by W. H. Haas and F. S. MacNeil, obtained an interesting collection of fossil fresh-water mollusks from 45 localities in southern Montana. I have had the privilege of studying this large collection of generally well preserved specimens. The material was collected mainly at places in Powder River and Big Horn Counties, but a few lots were obtained in Rosebud County and a few at places in Wyoming a short distance south of the Wyoming-Montana boundary.

In completing this work, I wish to express my thanks to the administrative officers of the Geological Society of America for their continuous support in making a further grant from the Penrose Bequest to carry on the project. Thanks are also due Dr. John B. Reeside, Jr., of the U. S. Geological Survey, for his valuable suggestions and also for his untiring encouragement. To Dr. H. A. Pilsbry, of the Academy of Natural Sciences of Philadelphia, I am much indebted for his expert advice on my work, and I appreciate his personal interest.

PREVIOUS WORK

The earliest records of molluscan species from the Fort Union formation were made by Meek and Hayden from 1856 to 1861. The following 25 species were reported from what they called then "the Lignite group" of the upper Missouri River. These species were re-described and figured, with the exception of one or two forms, by Meek in 1876. The following list is in systematic order, though the original generic assignment is retained:

Valvata subumbilicata Meek and Hayden 1856
Valvata parvula Meek and Hayden 1856

Except for a few additional forms recorded in recent years, this earliest list of fresh-water mollusks from the Fort Union formation contains almost all the characteristic species of the formation. These species were originally described from several casual collections of material, and the exact stratigraphic position of their occurrence within the formation is unknown. However, by checking with the records made in later years, it would seem that they were obtained from several horizons in North Dakota and Montana.

In 1886 C. A. White recorded most of the above-mentioned species in the vicinity of Wales, Utah, although he assigned the fossiliferous beds to the "Wasatch group," which was then extended, probably unintentionally, to include at that place deposits of Fort Union age and even Cretaceous beds (Spieker, 1946, p. 134). Ten years later a number of these characteristic species were identified by T. W. Stanton among specimens collected from the eastern slope of the Crazy Mountains on Lebo Creek, Mont. (Weed, 1896, p. 216), where they are found in limestone, shale, and sandstone of the Fort Union formation of that area. In 1931 L. S. Russell recorded six of these species from Fort Union strata exposed in Park County, northwestern Wyoming. In 1946 I gave a record of nine species of fresh-water mollusks from a horizon just above the commonly accepted base of the Wasatch formation...
COMPOSITION AND ECOLOGIC SIGNIFICANCE OF THE FAUNA

The generic assignment of some of the species described in the literature needs revision, and a few changes are proposed in this paper. Paleontologic data indicate that many genera of fresh-water mollusks have a long range in geologic history, and some of the common genera of the living fauna may be traced back to much earlier ages. However, it is difficult to make a precise decision as to proper allocation of species when some of the "catch-all" genera are involved. A thorough study of these groups of fresh-water mollusks will provide opportunity for an important contribution by anyone interested in this vast field of knowledge.

A summary list of the species here identified is as follows:

**Viviparidae**
- *Viviparus raynoldsanus* (Meek and Hayden)
- *Viviparus trochoformis* (Meek and Hayden)
- *Viviparus retusus* (Meek and Hayden)
- *Campeloma nebrascensis* (Meek and Hayden)
- *Lioplacodes mariana* Yen
- *Lioplacodes tenuicarinata* (Meek and Hayden)
- *Lioplacodes limnaeiformis* (Meek and Hayden)

**Amnicolidae**
- *Fluminicola protea* Yen, n. sp.

**Pleuroceratidae**
- *Goniobasis nebrascensis* (Meek and Hayden)
- *Goniobasis nebrascensis producta* (White)
- *Pleurocera ivarrenanum* (Meek and Hayden)
- *Lioplacodes tenuicosta* (Meek and Hayden)
- *Lioplacodes mariana* (Meek and Hayden)
- *Viviparus retusus* (Meek and Hayden)
- *Viviparus raynoldsanus* (Meek and Hayden)

**Ancyliidae**
- *Palaeancylus radiatus* Yen, n. gen. and sp.

**Lymnaeidae**
- *Pleurolimnaea tenuicosta* (Meek and Hayden)

**Physidae**
- *Physa cf. P. bridgegensis* Meek
- *Apleza cf. A. longiuscula* (Meek and Hayden)
- *Gyraulus militaris* (White)
- *Gyraulus parvulus* (Meek and Hayden)
- *Carinoria planospiralis* Yen
- *Sphaeriidae*
- *Sphaerium cf. S. formosum* (Meek and Hayden)
- *Elliptio cf. E. priscus* (Meek and Hayden)
- *Elliptio cf. E. silberlingi* Russell
- "Unio" sp. undet.

The abundant occurrence of viviparids and unios implies that the enclosing rocks were fluviatile deposits. These forms in the living fauna exist more commonly in rivers and streams of various sizes. The presence of abundant shells of fresh-water pulmonates in a number of the lots, such as that from locality 17, implies perhaps a shore facies of the river deposits, where the water was shallow and rich aquatic vegetation grew.

STRATIGRAPHIC DISTRIBUTION AND AGE OF THE FAUNA

The accompanying table shows the distribution of the molluscan species in the intervals between the successive coal beds of the region. The generalized section is taken from the report of A. A. Baker (1929, pp. 33-38) on the northward extension of the Sheridan coal field into Big Horn and Rosebud Counties, southern Montana.

It is to be noted that the level commonly accepted as the boundary between the Tongue River member of the Fort Union formation, assigned to the Paleocene, and the Wasatch formation, assigned to the lower Eocene, is the top of the Roland coal bed, though there is every
appearance in southern Montana of continuity of deposition across this level. The reason for using the top of the Roland coal bed is that it is a readily traceable plane and that it is believed to lie near the stratigraphic position of the base of the Kingsbury conglomerate member of the Wasatch formation of the western margin of the Powder River Basin of Wyoming (Thom and Dobbin, 1924). The Kingsbury conglomerate has yielded mammals of the genera *Hyracotherium* and *Coryphodon* (Wegemann, 1918; Brown, 1948), which are accepted as establishing its Eocene age. The extensive flora and vertebrate fauna of the Fort Union formation establish it as of Paleocene age.

Most of the fresh-water mollusks contained in the present collection are species originally described from the Fort Union formation. Characteristic and common Upper Cretaceous species, such as *Tutoloma thompsoni* White, "*Melania* insculpta* Meek, and "*Melania* wyomingensis* Meek, are conspicuously absent. On the other hand, several forms of so-called *Goniobasis*, widely reported from deposits of Wasatch age, are also lacking. The present fauna therefore seems clearly to represent a distinct unit different from that of the Lance formation or that of the Wasatch formation of other areas. Furthermore, both the Lance and the Wasatch formations are probably of fluviatile origin and the differences between the faunas of these two formations and that of the Fort Union would seem to be due to difference in age rather than to some difference in conditions of deposition.

Within the present fauna it is possible to distinguish between the assemblage above the Wall coal bed and that below it. The difference is not striking, however, and it is undetermined whether it is persistent into other regions and will be useful in determining relative stratigraphic position.

The lots recorded from the beds above the Wall coal bed seem to contain a more or less similar group of species. Each lot contains a few of the following characteristic forms:

- *Viviparus raynoldsanus* (Meek and Hayden)
- *Viviparus trochiformis* (Meek and Hayden)
- *Lioplacodes mariana* Yen
- *Lioplacodes limnaeiformis* (Meek and Hayden)
- *Lioplacodes tenuicarinata* (Meek and Hayden)
- *Pleurocera warrenanum* (Meek and Hayden)
- *Goniobasis nebrascensis* (Meek and Hayden)
- *Elliptio minuta* (Meek and Hayden)
- *Pleurociona tenuicosta* (Meek and Hayden)
- *Carinorbis planospiralis* Yen

On the other hand, collections made below the Wall coal bed differ by the presence of *Campeloma nebrascensis* (Meek and Hayden) and *Goniobasis nebrascensis* (Meek and Hayden) and its variety or subspecies *producta* (White), which have not been found in the beds above the Wall coal. In previous records these three forms were described or reported from deposits variously assigned to the Laramie (in the strict sense), Lance, and Fort Union formations without mention of exact stratigraphic position within the several formations, and little help can be obtained from these records for the purpose of correlating the present collections. However, it seems to be a fact that these forms are found only in strata occupying positions lower than the upper part of the Fort Union formation. Whether these forms will justify a separation of the containing rocks as an age unit distinct from the main body of the Fort Union formation will have to depend on further collections of material to demonstrate how persistent their occurrence is in these lower beds.

**GEOGRAPHIC DISTRIBUTION OF THE COLLECTIONS**

The collections represent 45 localities, mainly in Tps. 7, 8, and 9 S., Rs. 44 to 49 E., but with a few farther south and east. The horizons represented extend through a thickness of about 1,000 feet. A description of each locality and a list of the species at each follow:

**Locality 1.—** The NE 1/4 sec. 2, T. 7 S., R. 44 E., Rosebud County; at the base of a steep butte, more than 200 feet above the Anderson clinker.

- *Viviparus cf. V. raynoldsanus* (Meek and Hayden)
- *Lioplacodes mariana* Yen
- *Lioplacodes limnaeiformis* (Meek and Hayden)
- "*Unio*" sp.

**Locality 2.—** Southwest of center sec. 7, T. 9 S., R. 44 E., Big Horn County; exposure just above Roland coal bed.

- *Viviparus sp. undet.*
- *Lioplacodes cf. L. mariana* Yen
- *Lioplacodes limnaeiformis* (Meek and Hayden)
- *Pleurocera warrenanum* (Meek and Hayden)
- *Elliptio cf. E. priscus* (Meek and Hayden)
- "*Unio*" sp.

**Locality 3.—** Southeast of center sec. 7, T. 9 S., R. 44 E., Big Horn County; sandstone ledge below Roland coal bed.

- *Lioplacodes mariana* Yen
- *Elliptio cf. E. priscus* (Meek and Hayden)
- "*Unio*" sp.

**Locality 4.—** The SE 1/4 sec. 8, T. 9 S., R. 44 E., Big Horn County; about 130 feet above the Smith coal bed.

- *Viviparus trochiformis* (Meek and Hayden)
- *Lioplacodes mariana* Yen
- *Elliptio cf. E. silberlingi* Russell

**Locality 5.—** The SE 1/4 sec. 30, T. 9 S., R. 44 E., Big Horn County; about 50 feet above the Roland coal bed.

- *Viviparus trochiformis* (Meek and Hayden)
- *Lioplacodes mariana* Yen
- *Lioplacodes limnaeiformis* (Meek and Hayden)
- *Pleurocera warrenanum* (Meek and Hayden)
- *Elliptio cf. E. priscus* (Meek and Hayden)
Locality 6.—West of center sec. 35, T. 9 S., R. 44 E., Big Horn County; in and below the fossiliferous sandstone ledge above the Roland coal horizon.

Viviparus trochiformis (Meek and Hayden)
Lioplacodes mariana Yen
Elliptio cf. E. priscus (Meek and Hayden)
"Unio" sp. undet.

Locality 7.—Montana-Wyoming boundary line; about ¾ mile southeast from southeast corner of sec. 35, T. 9 S., R. 44 E., Big Horn County; just above a fossiliferous sandstone ledge in soft-buff sand.

Viviparus sp. undet.
Lioplacodes mariana Yen
Lioplacodes tenuicarinata (Meek and Hayden)
Pleurocera warrenanum (Meek and Hayden)
Gyravus militaris (White)
Gyravus parvulus (Meek and Hayden)
Carinotb* planospiralis Yen
"Unio" sp.

Locality 8.—In Sheridan County, Wyo., just across State boundary from SW¼ sec. 23, T. 9 S., R. 45 E., Montana; on hillside 100 feet above the Wall coal bed of Warren.

Viviparus sp.
Lioplacodes sp.
"Unio" sp.

Locality 9.—The NW¼ sec. 25, T. 7 S., R. 45 E., Powder River County; 108 feet above the Wall coal bed.

Lioplacodes mariana Yen
Lioplacodes limnaeiformis (Meek and Hayden)
"Unio" sp.

Locality 10.—The SW¼SE¼SW¼ sec. 9, T. 8 S., R. 45 E., Powder River County; just south of east-west fault and below a stump bed; 25 to 50 feet below the Smith coal bed.

Viviparus trochiformis (Meek and Hayden)
Lioplacodes mariana Yen
"Unio" sp.

Locality 11.—The NW¼ sec. 12, T. 9 S., R. 45 E., Powder River County; sandstone ledge below Roland coal bed.

Lioplacodes cf. L. mariana Yen
Lioplacodes limnaeiformis (Meek and Hayden)
"Unio" sp. undet.

Locality 12.—The SE¼ sec. 13, T. 9 S., R. 45 E., Powder River County; roof of Roland coal bed.

Viviparus sp.
Lioplacodes mariana Yen
Pleurocera warrenanum (Meek and Hayden)
Carinorbis planospiralis Yen

Locality 13.—The SE¼SE¼SW¼ sec. 17, T. 9 S., R. 45 E., Powder River County; about 35 feet above the Roland coal bed.

Viviparus cf. V. trochiformis (Meek and Hayden)
Lioplacodes mariana Yen

Lioplacodes tenuicarinata (Meek and Hayden)
Lioplacodes limnaeiformis (Meek and Hayden)
Pleurocera warrenanum (Meek and Hayden)
Carinorbis planospiralis Yen

Locality 14.—The NW¼ sec. 3, T. 7 S., R. 46 E., Powder River County; about 75 feet below the Wall coal bed.

Viviparus sp. undet.
"Unio" sp.

Locality 15.—South edge of SE¼ sec. 21, T. S., R. 46 E., Powder River County; 20 to 50 feet below the Canyon coal bed.

Viviparus raynoldsanus (Meek and Hayden)
Lioplacodes cf. L. mariana Yen
Elliptio cf. E. priscus (Meek and Hayden)
Elliptio cf. E. silberlingi Russell

Locality 16.—The NE¼SE¼ sec. 32, T. 8 S., R. 46 E., Powder River County; 6 to 12 feet above the Anderson coal bed.

Viviparus trochiformis (Meek and Hayden)
Lioplacodes mariana Yen
Lioplacodes limnaeiformis (Meek and Hayden)
Carinorbis sp. undet.
"Unio" sp.

Locality 17.—300 feet east from the southeast corner sec. 32, T. 8 S., R. 46 E., Powder River County; 100 feet above base of Anderson clinker.

Viviparus sp. undet.
Pluminicola protera n. sp.
Lioplacodes tenuicarinata (Meek and Hayden)
Lioplacodes limnaeiformis (Meek and Hayden)
Lioplacodes sp. undet.
Ferrisia minuta (Meek and Hayden)
Palaeeanegulus radiatus n. sp.
Pleurolinumta tenuicosta (Meek and Hayden)
Physa cf. P. bridgerensis Meek
Aplea cf. A. longisscula (Meek and Hayden)
Carinorbis sp. undet.
Sphaerium sp. undet.

Locality 18.—The SE¼SE¼NW¼ sec. 18, T. 9 S., R. 46 E., Powder River County; about 25 feet above the base of Roland clinker.

Viviparus trochiformis (Meek and Hayden)
Lioplacodes mariana Yen
Lioplacodes limnaeiformis (Meek and Hayden)
Pleurocera warrenanum (Meek and Hayden)
Carinorbis planospiralis Yen
Gyravus parvulus (Meek and Hayden)
"Unio" sp.

Locality 19.—The NW¼NW¼ sec. 28, T. 9 S., R. 46 E., Powder River County; 50 to 75 feet below the Roland coal bed.

Viviparus cf. V. trochiformis (Meek and Hayden)
Lioplacodes mariana Yen
Pleurocera warrenanum (Meek and Hayden)
Gyravus militaris (White)
Gyravus parvulus (Meek and Hayden)
"Unio" sp.
Locality 20.—The SW $\frac{3}{4}$NW $\frac{1}{4}$ sec. 31, T. 9 S., R. 46 E., Powder River County; gray shale, 1 foot above the Roland coal bed.

**Viviparus** cf. *V. trochiformis* (Meek and Hayden)
**Lioplacodes mariana** Yen
**Lioplacodes limnaeiformis** (Meek and Hayden)
**Pleurocera warrenanum** (Meek and Hayden)
**Carinorbis planospiralis** Yen

**Unio** sp.

Lioplacodes mariana

Locality 21.—About 1,100 feet west of southeast corner sec. 30, T. 9 S., R. 46 E., Powder River County; about 10 feet above the Dietz coal bed.

**Lioplacodes tenuicarinata** (Meek and Hayden)
**Lioplacodes limnaeiformis** (Meek and Hayden)

Locality 22.—Near Montana-Wyoming boundary, about 300 feet northeast of southeast corner sec. 32, T. 9 S., R. 46 E., Powder River County; 50 to 75 feet below Roland coal bed.

**Viviparus** sp. undet.
**Lioplacodes** cf. *L. mariana* Yen
**Lioplacodes tenuicarinata** (Meek and Hayden)
**Lioplacodes limnaeiformis** (Meek and Hayden)

"Unio" sp.

Locality 23.—Montana-Wyoming boundary, near southeast corner sec. 36, T. 9 S., R. 45 E.; about 150 feet south of the boundary line and 60 feet below base of Roland coal bed.

**Viviparus** *trochiformis* (Meek and Hayden)
**Lioplacodes** cf. *L. mariana* Yen
**Lioplacodes tenuicarinata** (Meek and Hayden)
**Gyraulus parvulus** (Meek and Hayden)
**Elliptio** cf. *E. prisus* (Meek and Hayden)

Locality 24.—The NE $\frac{1}{4}$ SE $\frac{1}{4}$ sec. 1, T. 7 S., R. 47 E., Powder River County; about 2 miles northeast of Diamond Butte triangulation station; between Dietz and Anderson coal beds.

**Viviparus** *raynoldsanus* (Meek and Hayden)
**Lioplacodes mariana** Yen
**Lioplacodes tenuicarinata** (Meek and Hayden)
**Lioplacodes limnaeiformis** (Meek and Hayden)

"Unio" sp.

Locality 25.—East of center sec. 4, T. 7 S., R. 47 E., Powder River County; 25 to 30 feet below the Dietz coal bed.

**Viviparus** *raynoldsanus* (Meek and Hayden)
**Lioplacodes mariana** Yen

"Unio" sp.

Locality 26.—The NW $\frac{1}{4}$ NE $\frac{1}{4}$ sec. 11, T. 7 S., R. 47 E., Powder River County; about 130 feet above the Anderson coal bed.

"Unio" sp.

Locality 27.—Center sec. 36, T. 7 S., R. 47 E., Powder River County; 40 to 50 feet below the Diamond bed.

**Viviparus** *raynoldsanus* (Meek and Hayden)
**Lioplacodes mariana** Yen

"Unio" sp.
Locality 36.—SE 1/4 SE 1/4 sec. 32, T. 9 S., R. 47 E., Powder River County; about 135 feet above the Anderson coal bed.

Viviparus trochiformis (Meek and Hayden)
Lioplacodes tenuicarinata (Meek and Hayden)

Locality 37.—The NE 1/4 NW 1/4 sec. 32, T. 8 S., R. 48 E., Powder River County; about 100 feet above the base of Canyon coal.

Viviparus cf. V. raynoldsanus (Meek and Hayden)
Lioplacodes mariana Yen
Lioplacodes cf. L. tenuicarinata (Meek and Hayden)
Elliptio cf. E. priscus (Meek and Hayden)

Locality 38.—The SW 1/4 SW 1/4 sec. 6, T. 9 S., R. 48 E., Powder River County; about 100 feet above the base of Canyon coal bed.

Elliptio cf. E. priscus (Meek and Hayden)

Locality 39.—T. 2 S., R. 49 E., Powder River County; about 180 feet above the Brewster-Arnold bed.

Viviparus retusus (Meek and Hayden)
Lioplacodes limnaeiformis. (Meek and Hayden)
Campeloma nebrascensis (Meek and Hayden)
Goniobasis nebrascensis producta (White)
"Unio" sp.

Locality 40.—The NW 1/4 sec. 31, T. 9 S., R. 49 E., Powder River County; about 125 feet above the Anderson coal bed.

Viviparus raynoldsanus (Meek and Hayden)
Lioplacodes mariana Yen
Lioplacodes tenuicarinata (Meek and Hayden)
Lioplacodes limnaeiformis (Meek and Hayden)
Viviparus trochiformis (Meek and Hayden)
Sphaerium sp. undet.
"Unio" sp.

Locality 41.—The SE 1/4 sec. 31, T. 9 S., R. 49 E., Powder River County; about 100 feet above the Anderson coal bed.

Viviparus raynoldsanus (Meek and Hayden)
Lioplacodes mariana Yen
Lioplacodes tenuicarinata (Meek and Hayden)
Lioplacodes limnaeiformis (Meek and Hayden)
Gyraulus martialis (White)
Gyraulus parvulus (Meek and Hayden)
Sphaerium sp. undet.
"Unio" sp.

Locality 42.—The SW 1/4 SE 1/4 sec. 4, T. 7 S., R. 50 E., Powder River County; about 12 feet above a local bed below the Cache coal bed.

Campeloma nebrascensis (Meek and Hayden)
Lioplacodes limnaeiformis (Meek and Hayden)
Goniobasis nebrascensis (Meek and Hayden)
Goniobasis nebrascensis producta (White)
Sphaerium sp. undet.
"Unio" sp.

Locality 43.—West edge sec. 32, T. 1 S., R. 51 E., Powder River County; reworked specimens in a terrace deposit capping a high ridge of uppermost somber beds.

Viviparus retusus (Meek and Hayden)
Campeloma nebrascensis (Meek and Hayden)
Goniobasis nebrascensis producta (White)
"Unio" sp.

Locality 44.—Center S 1/2 sec. 30, T. 9 S., R. 51 E., Powder River County; about 75 feet above the Cache coal bed.

Campeloma nebrascensis (Meek and Hayden)
Lioplacodes limnaeiformis (Meek and Hayden)
"Unio" sp.

Locality 45.—Sec. 24, T. 58 N., R. 77 W., Wyoming; about 50 to 75 feet below the Roland coal bed.

Viviparus trochiformis (Meek and Hayden)
Lioplacodes mariana Yen
"Unio" sp.

SYSTEMATIC DESCRIPTIONS
Family VIVIPARIDAE

Viviparus raynoldsanus (Meek and Hayden)

Plate 10, figure 1

This species is recorded here by rather perfectly preserved specimens from five localities. The whorls are greatly convex and bear growth and spiral lines. The development of spiral striae varies from obscure to faintly traceable, and they are never prominent. It is easily distinguished from the next species by the outline of shell and sculpture. The illustrated specimen measures 45 mm. in altitude and 30 mm. in width of shell, 22 mm. in height and 16.2 mm. in width of aperture, and has 6½ whorls.

Plesiotype, U. S. Nat. Mus. 560162.

Viviparus trochiformis (Meek and Hayden)

Plate 10, figures 2, 2a

This species was described on the basis of an immature specimen. Specimens corresponding to a similar stage of development are found in the present collection, together with a large series of adult specimens. The sculpture is prominent and consists of 4 to 5 primary spiral lines with secondary ones in the interspaces. The shell also bears very distinct lines of growth. The differences of sculpture on the shells of viviparids generally indicate the different development of the marginal processes of the mantle on the embryos of different species, and they are generally considered to be good specific characters, particularly in Viviparus, the species of which vary, often considerably, in general outline, size, and shape of aperture. The figured specimen measures 40.5 mm. in altitude and 23.5 mm. in width of shell, 16.7 mm. in height and 15 mm. in width of aperture, and has 7 whorls.

Plesiotypes, U. S. Nat. Mus. 560163.

Viviparus retusus (Meek and Hayden)

Plate 10, figure 3


This species was described on the basis of an immature specimen. Specimens corresponding to a similar stage of development are found in the present collection, together with a large series of adult specimens. The sculpture is prominent and consists of 4 to 5 primary spiral lines with secondary ones in the interspaces. The shell also bears very distinct lines of growth. The differences of sculpture on the shells of viviparids generally indicate the different development of the marginal processes of the mantle on the embryos of different species, and they are generally considered to be good specific characters, particularly in Viviparus, the species of which vary, often considerably, in general outline, size, and shape of aperture. The figured specimen measures 40.5 mm. in altitude and 23.5 mm. in width of shell, 16.7 mm. in height and 15 mm. in width of aperture, and has 7 whorls.

Plesiotypes, U. S. Nat. Mus. 560163.
A few specimens from localities 39 and 43 are identical with this species. It is characterized by its scarcely convex whorls, angulated periphery, and closed umbilicus. Plesiotype, U. S. Nat. Mus. 560164.

Campeloma nebrascensis (Meek and Hayden)
Plate 10, figures 4, 4a, 5, 5a, b

This species is recorded here from two localities in the lower part of the formation. It is characterized by its shell substance, inflated body whorl, and thickened inner lip margin. Some shells, probably males, have a less inflated body whorl, which gives a narrower outline to the shell. The spiral lines are faintly traceable in a few specimens in this collection. The measurements in millimeters of two specimens are as follows:

<table>
<thead>
<tr>
<th>Altitude of shell</th>
<th>Width of shell</th>
<th>Height of aperture</th>
<th>Width of aperture</th>
<th>Number of whorls</th>
</tr>
</thead>
<tbody>
<tr>
<td>Altitude of shell</td>
<td>Width of shell</td>
<td>Height of aperture</td>
<td>Width of aperture</td>
<td>Number of whorls</td>
</tr>
<tr>
<td>21.7+</td>
<td>11.0</td>
<td>9.0</td>
<td>4.2</td>
<td>7</td>
</tr>
<tr>
<td>15.6</td>
<td>7.8</td>
<td>6.5</td>
<td>4.2</td>
<td>7</td>
</tr>
</tbody>
</table>

Plesiotypes, U. S. Nat. Mus. 560171, 560172.

Lioplacodes limnaeiformis (Meek and Hayden)
Plate 10, figure 11

This is one of the more characteristic forms in the Fort Union formation. It is easily recognized by its narrowly oblong outline, tapering gradually toward the apex, its scarcely convex whorls, and its narrowly perforated umbilicus. One of the well-preserved specimens is 20 mm. in altitude and 8 mm. in width of the shell, 8 mm. in height and 4.1 mm. in its width of aperture, and has 7 whorls.

Plesiotype, U. S. Nat. Mus. 560173.

Family AMNICOLIDAE

Fluminicola protea Yen, n. sp.
Plate 10, figure 12
Shell broadly ovate in outline, of thin substance, having an elevated spire and moderately dilated body whorl. Whorls increasing rapidly in size, convex, and bearing fine but distinct lines of growth and spiral striae. Aperture subovate in outline, apparently having a thin peristomal margin.

The measurements in millimeters of the holotype and paratype are as follows:

<table>
<thead>
<tr>
<th>Altitude of shell</th>
<th>Width of shell</th>
<th>Height of aperture</th>
<th>Width of aperture</th>
<th>Number of whorls</th>
</tr>
</thead>
<tbody>
<tr>
<td>Altitude of shell</td>
<td>Width of shell</td>
<td>Height of aperture</td>
<td>Width of aperture</td>
<td>Number of whorls</td>
</tr>
<tr>
<td>8.5</td>
<td>6.3</td>
<td>4.7</td>
<td>4</td>
<td>4</td>
</tr>
</tbody>
</table>

This form has all the features of Fluminicola, species of which are recorded so far from Pliocene to Recent time in North America. I find no valid reason why Fluminicola could not have preceded the Pliocene, even though the relationship of the present species to others of the genus is not clear at present.

One of the specimens here has its operculum partly preserved in its natural position, and this seems to be much like the type of operculum in Viviparus.

Family PLEUROCERATIDAE

Pleurocera warrenanum (Meek and Hayden)
Plate 10, figure 8

The type of this species has the last 6 whors preserved, and possibly would have 7, if perfect. Some of the larger specimens in the present collection have 8 to 8½ whors, but they are identical with the type in other features. The species is characterized by the scarcely convex or nearly flat surface of the early whors, which are acutely angulated. The angulation is obtuse only along the periphery.

Meek was not certain of the generic position of the species. It was originally described as Melania and subsequently changed to Hydrobia. By its narrowly oblong outline, acute spire, nearly flattened whors, and imperforate shell, it seems more closely related to Pleurocera. One of the well-preserved specimens measures 11.3 mm. in altitude and 4.5 mm. in width of the shell, 3.3 mm. in height and 2.8 mm. in width of aperture, and has the last 7 whors preserved.

Plesiotype, U. S. Nat. Mus. 560176.

Goniobasis nebrascensis (Meek and Hayden)
Plate 10, figure 9

This species was found only at one locality of the present collection, but it is represented by more than 80 specimens. It is characterized by its acute spire, dilated body whorl, scarcely convex whors, and by having its basal lip margin somewhat produced. Judged by the features visible in this series of specimens, this form resembles more closely species of Goniobasis than those of Campeloma and Lioplax, although it may not be a Goniobasis in the restricted sense. One of the adult specimens measures 26.5 mm. in altitude and 13 mm. in width of the shell, 11.1 mm. in height and 7.8 mm. in width of aperture, and has the last 5 whors preserved.

Plesiotype, U. S. Nat. Mus. 560177.

Goniobasis nebrascensis producta (White)
Plate 10, figure 10
Campeloma producta White, U. S. Nat. Mus. Proc., vol. 5, p. 97, pl. 3, figs. 7-9, 1883.

A few specimens seem to agree well with this form, which differs from the typical form of the species by its more elongate outline. However, it agrees well with the typical form in other features. One of the adult specimens measures 31 mm. in altitude and 13.4 mm. in width of the shell, 10.7 mm. in height and 7.1 mm. in width of aperture, and has the last 6 whors preserved.

Plesiotype, U. S. Nat. Mus. 560178.

Family ANCYLIDAE

Ferrissia minuta (Meek and Hayden)
Plate 10, figure 14

A few fairly well preserved specimens are identical with this species. It is characterized by its small size, ovate-oblong outline, anterior apex, which points toward the anterior margin, and fine but distinct concentric lines of growth with occasional undulations over the surface. The anterior right margin seems to be slightly contracted. The average-sized specimen measures 4 mm. in length and 3 mm. in width.

Plesiotypes, U. S. Nat. Mus. 560179.

Palaeancylus, n. gen.

Shell limpet-like, ovate in outline, of thin substance, and of moderate size in Ancylidae. Apex apparently sinistral, slightly coiled, subcentrally posterior in position, and having a distinct dimple-like depression on the apical surface. The dimple is well-defined by an encircling margin. The sculpture consists of distinct but fine concentric lines of growth and radiating lines all over the surface.

Genotype: Palaeancylus radiatus, n. sp.

The new genus now under consideration is differentiated from most of the fresh-water limpets by a small dimple-like depression on its apical surface, which feature has been found on all the well-preserved specimens in the present collection.

The morphological significance of this apical depression is unknown, but it seems to be quite a distinct feature that has been ignored or taken as an individual abnormality by early investigators. In the living fauna, I have noted several species, such as Ancylus fluviatilis Mueller, Ancylus abissinicus Jickeli, Ancylus caliculatus Bourguignat, and "Ferrissia" platypunctatus Walker, described from southern Europe and northern Africa, which also bear this distinct feature, though differing in degree in its development. These species seem to belong to Pseudoancylus Walker 1921, with Ancylus fluviatilis as its genotype, from which Palaeancylus, n. gen., of the Fort Union formation, differs by having an apparently sinistral apex, posteriorly contracted margin on the left side, and more distinct sculpture.

Palaeancylus radiatus, n. sp.
Plate 10, figure 13

Shell essentially the same as described for the genus. The radiating sculpture is stronger than the concentric lines; the apex is apparently sinistral, subcentrally posterior in position, somewhat nearer the left side of the peristomial margin, where the marginal line is somewhat contracted. The right side of the margin is entire.
The measurements in millimeters of the holotype and the paratype are as follows:

<table>
<thead>
<tr>
<th></th>
<th>Holotype</th>
<th>Paratype</th>
</tr>
</thead>
<tbody>
<tr>
<td>Length of shell</td>
<td>4.5</td>
<td>10.3</td>
</tr>
<tr>
<td>Width of shell</td>
<td>3.5</td>
<td>8.0</td>
</tr>
</tbody>
</table>


Family LYMNAEIDAE

Pleurolimnaea tenuicosta (Meek and Hayden)

Plate 10, figure 15


This species is so far known only from the Fort Union formation. A few well-preserved specimens were found at one locality of the present collection.

Both on morphological and on stratigraphical grounds, Pleurolimnaea Meek may well be considered as a distinct genus, but its family assignment may need further consideration. The genus may belong to Ellobiidae and is possibly related to Tortacella.

An adult specimen measures 13.1 mm. in altitude and 4.5 mm. in width of the shell, 6 mm. in height and 2.2 mm. in width of aperture, and has 5 whorls.

Plesiotype, U. S. Nat. Mus. 560182.

Family PHYSIDAE

Physa cf. P. bridgerensis Meek

Plate 10, figure 16


A few specimens seem to resemble closely Physa bridgerensis but differ by having smaller size, lower spire, and more whorls.

The largest specimen measures 27.5 mm. in altitude and 17.1 mm. in width of shell, 18 mm. in height and 9 mm. in width of aperture, and has about 6 whorls.

Figured specimen, U. S. Nat. Mus. 560183.

Aplexa cf. A. longiuscula (Meek and Hayden)

Plate 10, figure 17


A few examples in the collection, which represent different stages of development, resemble closely this species, but they differ by having a more acute and higher spire, and they are of much smaller size, with a similar number of whorls. It may be a new species, but none of the available specimens show the aperture well enough for a satisfactory description. One of the adult specimens measures 11.5 mm. in altitude and 6.1 mm. in width and has 6 to 7 whorls.

Figured specimen, U. S. Nat Mus. 560184.

Family PLANORBIDAE

Gyraulus militarys (White)

Plate 10, figure 18


Only one lot in the present collection contains abundant specimens of this species, and in others it is represented by a few individuals. This species is often found in association with the next species, but it is easily distinguished by the absence of a carina on the basal surface and by a slightly larger size. One of the adult specimens measures 1.4 mm. in altitude and 3 mm. in width and has 3½ whorls.

Plesiotypes, U. S. Nat Mus. 560185.

Gyraulus parvulus (Meek and Hayden)

Plate 10, figures 20, 20a


This species is recorded from four localities in the present collection. It is one of the very few species described by Meek and Hayden without a figure of the type. However, it was originally described as “having near the middle of the upper and lower sides a distinct linear carina,” a feature which is well shown in the specimens in the present collection. One of the adult specimens measures 1 mm. in altitude and 3 mm. in width and has about 3 whorls.

In 1935 Henderson (Geol. Soc. America Spec. Peper 3, p. 191) followed Cossmann (Essais de paleoconchologie compare, livr. 12, p. 170, 1921) in changing the name of this species to Valvata subparvula, because V. parvula had been used by Deshayes for a Thanetian species from France. By examining the original citations of both species, I am obliged to point out that Cossmann’s change cannot be sustained. Meek and Hayden proposed the name in May 1856 and published it some time between June 1856 and April 1857; whereas Deshayes’ name appeared on page 526, volume 2, of his “Descriptions des animaux sans vertebres du Bassin de Paris,” which was not published until May 1862. The name proposed by Meek and Hayden has ample priority over that of Deshayes, and the French species is here renamed Valvata deshayesi, new name.

Plesiotypes, U. S. Nat Mus. 560186.

Carinorbis planospiralis Yen

Plate 10, figure 19

Carinorbis planospiralis Yen, Am. Jour. Sci., vol. 224, No. 1, p. 46, pl. 1, figs. 6a-c, 1946.

This species is one of the characteristic forms of the Fort Union formation, although it is recorded from only six localities in the present collection. It is easily recognized by its carinated outline and nearly flattened spire. One of the adult specimens measures 2.1 mm.
in altitude and 4.4 mm. in width of the shell, 2 mm. in height and 1.2 mm. in width of aperture, and has 4 whorls.

Plesiotype, U. S. Nat. Mus. 560187.

**Family SPHAERIIDAE**

*Sphaerium* cf. *S. formosum* (Meek and Hayden)

*Plate 10, figure 21*


A few specimens from one lot of the present collection resemble this species in general outline, though the hinge structure is not observable. In another lot are three left valves that show the hinge line slightly curved, with two short, parallel cardinals and single anterior and posterior laterals. The posterior lateral is long and slightly truncated in the middle and moderately raised at its end; the anterior lateral is short and is terminated by a prominent tooth of triangular shape.

Figured specimen, U. S. Nat. Mus. 560188.

**Family UNIONIDAE**

*Elliptio* cf. *E. priscus* (Meek and Hayden)

*Plate 10, figures 22, 22a*


Specimens from several localities in the present collection externally resemble this species closely.

The structure of the hinge was not described in the original description. One lot in the present collection contains a large series of single valves that show the hinge plate to be narrow, with two pseudocardinals and two laterals in the left valve; one prominent pseudocardinal and one lateral in the right valve. The anterior muscular impression is of subtriangular shape and large size.

Figured specimens, U. S. Nat. Mus. 560189.

*Elliptio* cf. *E. silberlingi* Russell

*Plate 10, figures 23a, b*


This form differs from the preceding species by its more elongate outline, less prominent pseudocardinals, and shorter laterals on both valves, but their number and arrangement are essentially similar.

The specimens in the present collection are much smaller in size than the type, which was described from the Eagle coal mine, Bear Creek, Carbon County, Mont.

Figured specimens, U. S. Nat. Mus. 560190.

*"Unio"* sp. undet.

*Plate 10, figure 24*

Several specimens were obtained from localities 6 that are decidedly different from other Unios in the collection but are not sufficiently well preserved to permit generic or specific identification. They are characterized by an almost lanceolate outline and are rather pointed toward the posterior end. The valves are closed.

Figured specimen, U. S. Nat. Mus. 560191.

**BIBLIOGRAPHY**


Brown, R. W., The age of the Kingsbury conglomerate is Eocene; Geol. Soc. America Bull. (in press).

Cossman, Maurice, Essais de palaeoconchyliologie comparee, vol. 12, 1921.


Russell, L. S., Early Tertiary Mollusca from Wyoming; Am. Paleontology Bull., vol. 18, No. 64, 1931.


White, C. A., On the relation of the Laramie molluscan fauna to that of the succeeding fresh-water Eocene and other groups; U. S. Geol. Survey Bull. 34, 1886.


PLATE 10

(Figures natural size unless otherwise designated)

1. Viviparus raynoldsanus (Meek and Hayden), Locality 24 .................................................. 40
2. Viviparus trochiformis (Meek and Hayden), Locality 25 .................................................. 40
3. Viviparus retusus (Meek and Hayden), Locality 39 .................................................. 40
4, 5. Campeloma nebrascensis (Meek and Hayden), 4, 4a, Locality 42. 5, 5a, 5b, Locality 43 .......... 41
6. Lioplacodes mariana Yen, X 2. 6, Locality 7. 6a, Locality 35. 6b, Locality 40 ..................... 41
7. Lioplacodes tenuicarinata (Meek and Hayden), X 2. 7, 7a, Locality 24. 7b, 7c, 7d, Locality 40 .......... 41
8. Pleurocerus warrensum (Meek and Hayden), X 2. Locality 13 ........................................ 42
9. Goniobasis nebrascensis (Meek and Hayden), X 2. Locality 42 ........................................ 42
10. Goniobasis nebrascensis producta (White), X 2. Locality 42 ........................................ 42
11. Lioplacodes limnaeiformis (Meek and Hayden), X 2. Locality ....................................... 41
12. Fluminicola protea Yen, n. sp. holotype, X 2. Locality 17 ........................................ 41
13. Palaeancylus radiatus Yen, n. gen. and sp., holotype, X 10. Locality 17 ............................ 42
14. Ferrissia minuta (Meek and Hayden), X 10. Locality 17 .................................................. 42
15. Pleurolimnaea tenuicosta (Meek and Hayden), X 2. Locality 17 ....................................... 43
16. Physa cf. P. bridgerensis Meek. Locality 17 ................................................................. 43
17. Aplexa cf. A. longiuscula (Meek and Hayden), X 2. Locality 17 ....................................... 43
18. Gyraulus militaris (White), X 4. Locality 29 ................................................................. 43
19. Carinorbis planospiralis Yen, X 4. Locality 12 ................................................................. 43
20. Gyraulus parvulus (Meek and Hayden), X 4. Locality 29 .................................................. 43
21. Sphaerium cf. S. formosum (Meek and Hayden), X 4. Locality 42 ........................................ 44
22. Elliptio cf. E. priscus (Meek and Hayden), Locality 29 ...................................................... 44
23. Elliptio cf. E. silberlingi Russell. Locality 29 ................................................................. 44
24. Unio sp. undetermined. Locality 6 .................................................................................. 44
PALEOCENE MOLLUSKS
## INDEX

<table>
<thead>
<tr>
<th>Page</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lioplax</td>
<td>47</td>
</tr>
<tr>
<td>longicarinata, Aplexa</td>
<td>36, 38, 41, pl. 17</td>
</tr>
<tr>
<td>Physa</td>
<td>35, 43</td>
</tr>
<tr>
<td>miliaris, Lophinae</td>
<td>36, 37, 39, 40, 41, pl. 17</td>
</tr>
<tr>
<td>Melania</td>
<td>47</td>
</tr>
<tr>
<td>anthonyi</td>
<td>35</td>
</tr>
<tr>
<td>insculpta</td>
<td>37</td>
</tr>
<tr>
<td>minutula</td>
<td>35</td>
</tr>
<tr>
<td>multimorpha</td>
<td>35</td>
</tr>
<tr>
<td>nebrascensis</td>
<td>35, 42</td>
</tr>
<tr>
<td>tenuicarinata</td>
<td>36, 41</td>
</tr>
<tr>
<td>wyomingensis</td>
<td>37</td>
</tr>
<tr>
<td>Planorbis</td>
<td>43</td>
</tr>
<tr>
<td>minuta, Melania</td>
<td>35</td>
</tr>
<tr>
<td>Vallesia (Anchusa)</td>
<td>35, 42</td>
</tr>
<tr>
<td>minutula, Melania</td>
<td>35</td>
</tr>
<tr>
<td>Mollusks, age of</td>
<td>36-37</td>
</tr>
<tr>
<td>earliest records of</td>
<td>35</td>
</tr>
<tr>
<td>ecologic significance of</td>
<td>36</td>
</tr>
<tr>
<td>species of summary of</td>
<td>36</td>
</tr>
<tr>
<td>stratigraphic distribution of</td>
<td>36-37</td>
</tr>
<tr>
<td>montanaensis, Valvata</td>
<td>37</td>
</tr>
<tr>
<td>multimorpha, Melania</td>
<td>35</td>
</tr>
<tr>
<td>nebrascensis, Bulinus</td>
<td>35, 41</td>
</tr>
<tr>
<td>Campeloma</td>
<td>36, 37, 39, 41, pl. 17</td>
</tr>
<tr>
<td>Goniobasis</td>
<td>36, 37, 39, 41, pl. 19</td>
</tr>
<tr>
<td>Melania</td>
<td>35, 41</td>
</tr>
<tr>
<td>North Dakota, mollusks from</td>
<td>37</td>
</tr>
<tr>
<td>Palaeanthina</td>
<td>35, 42</td>
</tr>
<tr>
<td>radiatus</td>
<td>36, 38, 42-43, pl. 13</td>
</tr>
<tr>
<td>Palacea, Lymnaea</td>
<td>37</td>
</tr>
<tr>
<td>leidy</td>
<td>37</td>
</tr>
<tr>
<td>Pseudanaculina</td>
<td>37</td>
</tr>
<tr>
<td>peculiaris</td>
<td>37</td>
</tr>
<tr>
<td>recessus</td>
<td>35-43</td>
</tr>
<tr>
<td>trochiformis</td>
<td>35-43</td>
</tr>
<tr>
<td>parvula, Valvata</td>
<td>35-41</td>
</tr>
<tr>
<td>parvulus, Gyrinula</td>
<td>36, 38, 39, 40, 43, pl. 17</td>
</tr>
<tr>
<td>peculiaris, Paludina</td>
<td>37</td>
</tr>
<tr>
<td>Planorbis</td>
<td>35-43, pl. 13</td>
</tr>
<tr>
<td>tenuicarnata, Planorbis</td>
<td>36, 37, 39, 40, 43, pl. 19</td>
</tr>
<tr>
<td>phytophagus, Ferrisia</td>
<td>42</td>
</tr>
<tr>
<td>Pleuroceris</td>
<td>35-42</td>
</tr>
<tr>
<td>warennuim</td>
<td>35-43</td>
</tr>
<tr>
<td>Pseudechinus</td>
<td>35-41</td>
</tr>
<tr>
<td>tecraeus</td>
<td>36, 37, 38, 43, pl. 19</td>
</tr>
<tr>
<td>Powder River County, fossils from</td>
<td>36-43</td>
</tr>
<tr>
<td>praeclaus, Elliptio</td>
<td>36, 37, 38, 40, 44, pl. 19</td>
</tr>
<tr>
<td>Unio</td>
<td>41</td>
</tr>
<tr>
<td>products, Goniobasis nebrascensis</td>
<td>36, 37, 40, 41, pl. 17</td>
</tr>
<tr>
<td>Pseudanaculina</td>
<td>37</td>
</tr>
<tr>
<td>radiatus, Palaeanthina</td>
<td>36, 38, 42-45, pl. 13</td>
</tr>
<tr>
<td>radiatus, Viviparus</td>
<td>35-41</td>
</tr>
<tr>
<td>radiatus, Viviparus</td>
<td>36, 37, 38, 40, 41, pl. 17</td>
</tr>
<tr>
<td>recessus, Viviparus</td>
<td>35-41</td>
</tr>
<tr>
<td>retusus, Viviparus</td>
<td>35-41</td>
</tr>
<tr>
<td>rhomboides, Physa</td>
<td>35</td>
</tr>
<tr>
<td>Roland coal bed, mollusks from</td>
<td>35-31</td>
</tr>
<tr>
<td>Rosebud County, fossils from</td>
<td>37</td>
</tr>
<tr>
<td>Pseudoanaculina</td>
<td>37</td>
</tr>
<tr>
<td>radiatus, Palaeanthina</td>
<td>36, 38, 42-45, pl. 13</td>
</tr>
<tr>
<td>radiatus, Viviparus</td>
<td>35-41</td>
</tr>
<tr>
<td>radiatus, Viviparus</td>
<td>36, 37, 38, 40, 41, pl. 17</td>
</tr>
<tr>
<td>recessus, Viviparus</td>
<td>35-41</td>
</tr>
<tr>
<td>retusus, Viviparus</td>
<td>35-41</td>
</tr>
<tr>
<td>rhomboides, Physa</td>
<td>35</td>
</tr>
<tr>
<td>Roland coal bed, mollusks from</td>
<td>35-31</td>
</tr>
<tr>
<td>Rosebud County, fossils from</td>
<td>37</td>
</tr>
<tr>
<td>Pseudoanaculina</td>
<td>37</td>
</tr>
</tbody>
</table>
INDEX

Page

silberlingi, Elliptio ................................................. 36, 37, 38, 39, 44, pl. 10
Sphaerium .......................................................... 35, 36, 40
formosum ............................................................. 36, 41, pl. 10
sp ................................................................. 40
subellipticus, Cyclas ................................................. 35
subparvula, Valvata .................................................. 43
subumbilicata, Valvata .............................................. 35

tenuicarinata, Liophacodes ........................................... 36, 37, 38, 39, 40, 41, pl. 10
Melania ............................................................... 35, 41
tenuicosta, Limnaea .................................................. 35, 43
Pleurolimmus ........................................................... 36, 37, 38, 43, pl. 10
thompsoni, Tulotoma ............................................... 37
Tongue River member and Wasatch formation, boundary between .... 36-37
Trocaella ............................................................... 43
trochiformis, Paludina ................................................ 35, 40
Viviparous ............................................................. 36, 37, 38, 40, pl. 10
Tulotoma thompsoni .................................................. 37
Unio priestii ............................................................ 44
sp ................................................................. 36, 37, 38, 39, 40, 44, pl. 10
Utah, mollusks from ............................................... 35

Valvata deshayei ...................................................... 43
montanaensis .......................................................... 35
parvula ............................................................... 35, 43
subparvula ............................................................ 43
subumbilicata .......................................................... 35
Volletia (Ancylus) minutula .......................................... 35, 42
Vivipara raynoldiana .................................................. 35, 40
Vivipara ............................................................... 35, 38, 39, 40, 41
Vivipara leidyi formosus ............................................. 35
raynoldiana ......................................................... 36, 37, 38, 39, 40, pl. 10
retusus ............................................................... 36, 39-41, pl. 10

trochiformis ........................................................... 36, 37, 38, 39, 40, pl. 10
sp ................................................................. 37, 39

warrenana, Melania ................................................... 35, 42
.warrenana, Pleuroea .................................................. 36, 37, 38, 39, 42, pl. 10
Wasatch formation and Tongue River member, boundary between .... 36-37
Wasatch group, fossiliferous beds of ................................ 35
Wyoming, mollusks from ........................................... 35-36, 38, 39, 40
Wyomingensis, Melania ............................................... 37