Nonmarine Mollusks of Late Cretaceous Age From Wyoming, Utah and Colorado

GEOLOGICAL SURVEY PROFESSIONAL PAPER 254-B

Nonmarine Mollusks of Late Cretaceous Age From Wyoming, Utah and Colorado

By TENG-CHIEN YEN

A SHORTER CONTRIBUTION TO GENERAL GEOLOGY

GEOLOGICAL SURVEY PROFESSIONAL PAPER 254-B

Part 1: A fauna from western Wyoming
Part 2: Faunas from eastern Utah and western Colorado

UNITED STATES GOVERNMENT PRINTING OFFICE, WASHINGTON : 1954

UNITED STATES DEPARTMENT OF THE INTERIOR

Douglas McKay, *Secretary*

GEOLOGICAL SURVEY

W. E. Wrather, *Director*

For sale by the Superintendent of Documents, U. S. Government Printing Office
Washington 25, D. C. - Price 60 cents (paper cover)

CONTENTS

	Page
Part 1. A fauna from western Wyoming	45
Abstract	45
Introduction	45
Localities at which mollusks were collected	45
Geographic and ecologic interpretations	46
Distribution of characteristic species	48
Age of the sequence near Cokeville	49
Systematic descriptions	50
References cited	59
Part 2. Faunas from eastern Utah and western Colorado	59
Abstract	59
Introduction	59
Collection localities and their molluscan assemblages	59
Systematic descriptions	61
References cited	64
Index	65

ILLUSTRATIONS

PLATE 17. Upper Cretaceous nonmarine mollusks from Wyoming	Following index
18, 19. Upper Cretaceous nonmarine mollusks from Utah and Colorado	Following index

NONMARINE MOLLUSKS OF LATE CRETACEOUS AGE FROM WYOMING, UTAH, AND COLORADO

By TENG-CHIEN YEN

PART 1: A FAUNA FROM WESTERN WYOMING

ABSTRACT

A series of shales and limestones is exposed in the vicinity of Cokeville, Wyo., which yields a rich molluscan fauna of nonmarine habitat. The molluscan fauna consists of species of pelecypods: *Ostrea, Brachydontes, Corbula, Corbicula* and *Unio;* and of gastropods: *Mesoneritina, "Helicina", Viviparus, Campeloma, Lioplacodes, Valvata, Mesocochliopa, Parateinostoma, Parhydrobia, Pyrgulifera, Pachychiloides, Zaptychius, Melampoides, Rhytophorus, Physa, Lymnaea, Gyraulus,* and *Anisopsis.* The lower part of the sequence contains a few species in common with the strata of the Bear River, together with several new species congeneric with those of that formation. The upper part yields fewer species in common with the Bear River, but more forms resembling closely those of the overlying deposits. One new genus and 16 new species and subspecies are described.

INTRODUCTION

The succession and differentiation of molluscan species during geologic time are well demonstrated by fossils collected in sequences of Cretaceous units within an area about 80 miles long near the western margin of Wyoming. The fossil contents are rich, adequate stratigraphic data are available, and, most important, the general habitat conditions are nearly uniform and do not seriously affect the faunal distribution.

These fossil-bearing zones are represented by beds of the Bear River formation exposed in the vicinity of Evanston, and by an unnamed sequence of fossiliferous limestones and shales exposed within 20 miles of Cokeville. The unnamed sequence, provisionally called Unit C by Rubey (1950), is the chief basis of the present study.

This richly fossiliferous series of strata occupies a position overlying and underlying thick sequences of essentially nonfossiliferous variegated shales. The fossiliferous sequence has a maximum thickness of about 2,500 feet near Cokeville, but thins northward to about 450 feet near Auburn, Wyo. The variegated shales above and below the series increase in thickness in the opposite direction, from several hundred feet in the south to several thousand feet in the north.

Most of the fossiliferous rocks studied in the present paper are exposed within or near the Cokeville quadrangle, which was mapped by W. W. Rubey of the U. S. Geological Survey. To him I am very much indebted for his generosity in supplying field information, including his original data on the thickness and lateral relations of the rock units.

Some fossil specimens used in the present work are from the collections of U. S. Geological Survey, and others were collected by the author in the summers of 1949 and 1950. All are preserved in the paleontological collections of the U. S. National Museum.

The author greatly appreciates the grant received from the Office of Naval Research to carry on the present research. The work is conducted under ONR contract N9–onr–92601 with the Smithsonian Institution, Washington, D. C. To the authorities of the Smithsonian Institution, I am also grateful for their business management of the contract.

LOCALITIES AT WHICH MOLLUSKS WERE COLLECTED

The 12 localities treated in this work are assigned to three stratigraphic divisions, each of which contains a number of molluscan species. The distribution of the nonmarine species is given in the table on page 46.

Division I. The lowest and southernmost sequence chosen for comparison here is the Bear River formation in and near its type locality. Collections were made at two places, at several levels within the formation. These collections represent the Bear River molluscan fauna as it is now known and they include many more species than were listed by C. A. White in 1895.

Locality 11—NE¼SW¼ sec. 29, T. 14 N., R. 119 W., at the "Fossil Cut," in southeast of Evanston, Uinta County, Wyo. It is about 45 miles south-southeast of Sage Junction.

Locality 12—SE¼SE¼ sec. 1, T. 16 N., R. 121 W., at the Shell Hollow, about 8 miles north of Evanston, Wyo. It is about 18 miles northwest of locality 11.

Division 2. The intermediate sequence, well exposed for a number of miles north to south of Cokeville, was called Unit C by Rubey (1950). The exposures in the following six localities yielded nonmarine mollusks. Localities 9 and 10 may represent the lower part of

the sequence, which yield a slightly different molluscan fauna as shown under column A of division 2 in the table.

Locality 5—SE¼SE¼ sec. 17, T. 22 N., R. 119 W., about 2 miles south of Antelope Creek, Lincoln County, Wyo. It is 5 miles north of and about 500 feet stratigraphically below the bed at locality 4.

Locality 6—SE¼SW¼ sec. 7, T. 26 N., R. 118 W., on north side near the mouth of the third Creek, Lincoln County, Wyo. It is 26 miles north of and about 1,000 to 1,100 feet stratigraphically lower than the bed at locality 5.

Locality 7—Near center sec. 32, T. 28 N., R. 118 W., Lincoln County, Wyo. It is 9 miles north of and about 100 feet stratigraphically below the bed at locality 6.

Locality 8—SE¼SW¼ sec. 25, T. 28 N., R. 119 W., Graham coal mine, about 41 miles north of Sage Junction, Lincoln County, Wyo. It is 2 miles WNW of and 200 stratigraphically lower than the bed at locality 7.

Locality 9—SW¼SE¼ sec. 7, T. 26 N., R. 118 W., east of the Muddy Creek, opposite mouth of Third Creek, Lincoln County, Wyo. It is in the same section and about 550 feet below the bed at locality 6.

Locality 10—SW¼SW¼ sec. 36, T. 25 N., R. 119 W., on north side of Smiths Fork, 2 miles northeast of Cokeville, Lincoln County, Wyo. It is 11 miles south of and at approximately the same stratigraphic position as the bed at locality 9, and 15 miles north of and approximately 1,600 feet stratigraphically lower than the bed at locality 5.

Division 3. The upper sequence, and provisionally called Unit E by Rubey (1950), consists of about 3,400 feet of shales, limestones, and siltstones, locally interbedded with several bands of porcellanites. These strata crop out more or less continuously from near the head of Thomas Fork, 20 miles north of Cokeville, southward to the east side of the Crawford Mountains, 25 miles south of Cokeville. In the northern half of its area, this sequence overlies red and variegated siltstones which in turn overlie the beds of division 2. Richly fossiliferous beds occur at several levels within this division 3 sequence, and the faunas indicate that the sediments were mainly of continental origin, with a few thin marine intercalations. The exposures of the following four localities yield rich faunas representing the nonmarine facies of the sequence.

Locality 1—West-central sec. 7, T. 21 N., R. 119 W., road cut at Sage Junction, Lincoln County, Wyo. (Yen 1952a, p. 349.)

Locality 2—Near center sec. 7, T. 21 N., R. 119 W., near Sage Junction, Lincoln County, Wyo. It is about 700 feet stratigraphically lower than the bed at locality 1. (Yen, 1952a, p. 344.)

Locality 3—Near center sec. 17, T. 22 N., R. 119 W., 2 miles south of Antelope Creek and about ¾ of a mile east of U. S. Highway 30 N, Lincoln County, Wyo. It is 5 miles north of and 300 feet stratigraphically lower than the bed at locality 2. (Yen, 1951, p. 11.)

Locality 4—SE¼ sec. 7, T. 21 N., R. 119 W., old coal mine near Sage Junction, Lincoln County, Wyo. It is in the same section and about 1,400 feet stratigraphically lower than the bed in locality 2. (Yen, 1952c, p. 1317.)

Stratigraphic distribution of molluscan faunas

	Division			
	1	2		3
		A	B	
Gastropoda, Prosobranchiata				
Neritidae				
Mesoneritina naticiformis	×		×	×
M. stantoni	×		×	×
Helicinidae				
"Helicina" cretacea, n. sp	×			
"H." cokevillensis, n. sp			×	
Cyclophoridae				
Pseudarinia uniplica, n. sp	×			
Viviparidae				
Viviparus couesi	×			
V. cokevillensis, n. sp			×	
Campeloma macrospira	×			
C. rubeyi, n. sp		×		
C. cokevillensis, n. sp			×	
Lioplacodes stachei	×	×	×	×
L. s. attentuata, n. subsp		×	×	
L. s. inflatus, n. subsp			×	
L. endlichi	×?			
Valvatidae				
Valvata praecursoris	×	×	×	×
Amnicolidae				
Mesocochliopa bearensis, n. sp	×			
M. cokevillensis, n. sp			×	
"Tornatellina?" isoclina			×?	
Parateinostoma altispirale	×			×
P. convexum				×
P. contractum				×
P. latentis			×	
P. occulta			×	
Parhydrobia cylindrica				×
Trochispira wyomingensis, n. gen., n. sp	×			
Pleuroceritidae				
Goniobasis leedsensis				×
Pyrgulifera humerosa	×			
P. humerosa *cokevillensis*, n. subsp		×		
P. stantoni		×		
P. s. elongata, n. subsp		×		
Pachychiloides cleburni	×		×	
P. cokevillensis, n. sp			×	
P. turricula				×
P. chrysalis	×	×		
P. chrysalloidea	×			
P. macilenta	×		×	
P. m. minuta, n. subsp			×	
Gastropoda, Pulmonata				
Ellobiidae				
"Auricula" neumayri			×?	
Zaptychius haldemanni	×		×	×
Melamoides clarki	×		×	×
Rhytophorus priscus	×			
R. meeki	×			
R. cf. *R. meeki*			×	×
Physidae				
Physa usitata	×		×	×
P. cokevillensis, n. sp			×	
P. globosa, n. sp			×	
Lymnaeidae				
Lymnaea nitidula	×?			
Planorbidae				
Gyraulus sp. undet	×	×		
Anisopsis minutis				×
Pelecypoda				
Ostraeidae				
Ostrea haydeni	×		×	
Mytilidae				
Brachydontes peali	×		×	
Corbulidae				
Corbula pyriformis	×	×	×	
C. engelmanni	×	×		
Corbiculidae				
Corbicula durkeei	×	×	×	
Unionidae				
Unio vetustus	×	×	×	
U. belliplicatus	×	×	×	

GEOGRAPHIC AND ECOLOGIC INTERPRETATIONS

The molluscan faunas of the three major divisions reveal that southwestern Wyoming in the beginning of Late Cretaceous time (Cenomanian)—our division 1—probably consisted of an estuarine area banked by low coastal land in the vicinity of Evanston and adjacent to a sea that lay to the southeast. Such estuarine conditions prevailed farther north in the Cokeville area at

a later time (division 2), and brief marine invasions extended as far north as Antelope Creek, 12 miles south of Cokeville. This estuarine area changed gradually and became lowland on the coast through most of the time when division 3 was deposited. Probably woodland was plentiful, rivers and small lakes were present, with mountains and possibly volcanoes in the uplands to the west. There is evidence that the sea advanced northward and westward to Sage Junction (20 miles south of Cokeville) in the early part of this time, but such invasions were of brief duration and they had no noticeable effect on the distribution of molluscan fauna of the low coastal land nearby.

However, ecological conditions, as revealed by a study of molluscan faunas, seem to have formed somewhat more complicated patterns.

Division 1 is here represented by the Bear River formation. Both drifted assemblages and habitat assemblages of the molluscan faunas are common in these richly fossiliferous beds. Habitat assemblages are emphasized in the present study because drifted assemblages are much less significant.

The Bear River formation is made up of a series of beds that indicate frequent oscillation between freshwater and brackish-water conditions. A detailed investigation of the paleoecology of the entire formation is beyond the scope of the present paper, and I confine my interpretation merely to a single band of soft gray calcareous shale, located in the lower third of the sequence exposed at the "Fossil Cut," which is overlain and underlain by dark shales containing coquinalike beds of *Corbula*, *Corbicula*, and *Pyrgulifera*. The molluscan elements are so abundant as almost to be rock-forming, and the contents of both shale beds clearly indicate drifted assemblages of estuarine forms.

The soft gray calcareous shale yields an assemblage of molluscan species that is rich both in varieties and individuals. It contains the following species:

Mesoneritina naticiformis
M. stantoni
"Helicina" cretacea
Pseudarinia uniplica
Viviparus couesi
Campeloma macrospira
Lioplacodes stachei
L. s. attenuata
Valvata praecursoris
Mesocochliopa bearensis
Parateinostoma altispirale
Trochispira wyomingensis
Pyrgulifera humerosa
Pachychiloides macilenta
Melampoides clarki
Rhytophorus priscus
Physa usitata
Gyraulus sp. undet.

In addition to the above assemblage of gastropods there are several imperfectly preserved specimens which are identified as species of *Mesoglypterpes* Yen, however, their definite specific status cannot be established on the specimens available at present. There are also a few imperfect examples of *Corbula engelmanni*, and fragments of *Unio belliplicatus*, and traces of *Brachydontes*. The oögonia of Charophycea are present in this soft gray calcareous shale deposit, but they are not abundant.

This assemblage is of fresh-water origin and is clearly one that might be expected in a natural community. Most of the species are represented by numerous individuals of both adult and younger stages; 12 of the 18 species are aquatic prosobranchians, which are generally adapted to deeper water; the presence of 2 terrestrial species and 4 aquatic pulmonates, which are represented by far fewer individuals, may indicate an admixture of nearshore and land forms.

The theory that the fossil bed represents an original habitat area, where most of the above mentioned molluscan species lived and were buried, is supported by the mode of preservation of the shells. Compared with the mollusks found in the beds above and below, which are considered to be drifted assemblages, the shell remains in this bed are not so crowded as to be coquinalike, although they are numerous and most of them are of smaller size. Large-shelled species such as *Viviparus cousei* and *Campeloma macrospira* are represented in the present collection by only 4 individuals of small size. It may be that the smaller shells are more readily buried in finer sediments at the bottom.

The components contained in this assemblage seem to indicate, further, that their habitat area was in the lower part of the littoral zone in a more or less closed and quiet bay. On a gently sloping bottom, a rich growth of vegetation would flourish and soft mud would accumulate about the roots. These conditions would suit the living conditions of viviparoid and rissoid gastropods. Within this belt of littoral zone, the water was possibly about 20 to 30 feet deep, and probably saturated with calcium carbonate. Plenty of food and oxygen was available, and the temperature was nearly constant throughout the year. The vegetation had almost continuous growth, and the habitat was extremely favorable for mollusks.

However, these conditions continued only a short time before the environment changed back nearly to what it had been earlier. This is indicated by the overlying and underlying dark shales, which contain coquinalike assemblages. The bay was probably again open as it had been before, and the area was within the reach of high tide, which probably brought brackish-water forms in

quantity to be accumulated in this nearshore zone. At the same time, the movement of fresh water from inland streams became more rapid, and strong currents changed the kind of bottom sediments and destroyed the rich growth of vegetation, and therefore also the conditions favorable for the animal community.

Secondly, let us examine division 2, which is represented by the sequence exposed in the vicinity of Cokeville. This is an unnamed unit of 2,000 to 2,500 feet thickness. For the present purposes, a particular bed of dark argillaceous shale may be selected for comparison. This bed, which is within the upper part of the sequence, contains the following molluscan species, all of freshwater origin:

Unio vetustus
Mesoneritina naticiformis
M. stantoni
"Helicina" cokevillensis
Viviparus cokevillensis
Campeloma cokevillensis
Lioplacodes stachei
L. s. attentuata
L. s. inflatus
Valvata praecursoris
Mesocochliopa cokevillensis
Parateinostoma latentis
Pyrgulifera humerosa cokevillensis
P. stantoni elongata
Pachychiloides macilenta
P. m. minuta
Zaptychius haldemanni
Physa usitata
Physa cokevillensis
Physa globosa

This deposit yields a molluscan fauna similar in types to that previously described from division 1. Such similarity suggests that the paleoecological conditions were probably much the same. The presence of *Unio vetustus* and one more species of *Lioplacodes* indicate that the bottom was muddier and enabled these mollusks to survive. However, this assemblage contains a considerable number of congeneric species of *Viviparus*, *Campeloma*, *Lioplacodes*, *Mesoneritina*, *Parateinostoma*, *Pyrgulifera*, and *Physa* that are different from those in the soft gray calcareous shale of the Bear River formation. A comparison of the two assemblages indicates an evolutionary succession of the fauna, because only 6 species are common to both assemblages, and most of the species are different. These differences in the two faunas seem to reflect a difference in age, as that might be expected on purely stratigraphic evidence.

Thirdly, we may consider, as representative of division 3, a limestone bed exposed south of Leeds Creek, which occupies a stratigraphic position in the lower part of a 3,400-foot unit, at present unnamed but numbered L–5 in a recent publication (Yen, 1951, p. 11). This fossiliferous bed yields the following assemblage of molluscan species:

Mesoneritina naticiformis
M. stantoni
Lioplacodes stachei
Valvata praecursoris
Parateinostoma altispirale
P. convexum
P. contractum
Parhydrobia cylindrica
Goniobasis leedsensis
Zaptychius cf. *Z. haldemanni*
Rhytophorus cf. *R. meeki*
Melampoides clarkii
Anisopsis minutis
Physa usitata
Physa sp. undet. A
Physa sp. undet. B

The variation of the above assemblage from those of the other two deposits seems to indicate a different habitat. However, all three habitats were undoubtedly fresh water and in the quiet littoral zone. More species of pulmonates and more numerous individuals, together with an abundance of rissoid gastropods, clearly imply shallower water or an inshore environment. These gastropods were associated with the aquatic plants of a lenitic or stillwater society, possibly of lacustrine origin. The two beds in divisions 1 and 2 have yielded broken shells of brackish-water species which suggests some marine connection, but no trace of such elements was found in the limestone bed of division 3; and probably the water here was entirely free of marine influence.

DISTRIBUTION OF CHARACTERISTIC SPECIES

The major sequences compared in the present study were included by geologists in earlier days in the Bear River formation. The conclusion was then sound enough, when collections had yielded many identical and seemingly identical species of mollusks from exposures within a distance of about 80 miles in southwestern Wyoming. Geological work in the western interior was then in its early stage and probably time did not permit detailed analysis and comparison of collections from such richly fossiliferous areas. A record of a few species in common, and in rocks of similar lithologic character, were generally take as sufficient evidence for an age assignment. Possibly differentiation of the faunas and of their environmental conditions was probably not then taken into serious consideration.

The foundation work was laid to which the present study is a supplement. On the basis of the molluscan species known at present, each of the three sequences has its own characteristic species. No doubt the number of such species may change with further studies

now in progress, but the differences among the three assemblages will remain as a fact not to be overlooked. Summarizing the species of each sequence, present records show 18 species common to and 32 species different between divisions 1 and 2; 8 species common to and 35 species different between divisions 2 and 3. If we choose to emphasize only the characteristic species in each sequence, those not present in the other two, the differences are as follows:

Division 1, from the Bear River formation, yielded the following species not found in the other two sequences:

"Helicina" cretacea
Viviparus couesi
Campeloma macrospira
Mesocochliopa bearensis
Trochispira wyomingensis
Pyrgulifera humerosa
Pachychiloides chrysalloidea
Rhytophorus priscus
R. meeki
Lymnaea nitidula

Division 2, the sequence exposed in the vicinity of Cokeville, yielded the following characteristic species of mollusks:

"Helicina" cokevillensis
Viviparus cokevillensis
Campeloma cokevillensis
C. rubeyi
Lioplacodes stachei
L. s. inflatus
Mesocochliopa cokevillensis
Tornatellina?" isoclina
Parateinostoma latentis
Pyrgulifera humerosa cokevillensis
P. stantoni
P. s. elongata
Pachychiloides cokevillensis
P. macilenta minuta
"Auricula" neumayri
Physa cokevillensis
P. globosa

Division 3, the sequence exposed in the Leeds Creek area and near Sage Junction, contains the following species of gastropods which are not thus far known in the other two sequences:

Parateinostoma convexum
P. contractum
Parhydrobia cylindrica
Goniobasis leedsensis
Pachychiloides turricula
Anisopsis minutis

The difference between divisions 1 and 2 is clear. Most of the species are congeneric, and the differences are probably the result of evolutionary changes. Nearly one thousand specimens of *Pyrgulifera humerosa*, collected in and near the type locality of the Bear River formation, have been examined, and not a single specimen resembling *P. stantoni* has been found. Several hundred specimens of *Pyrgulifera* have been studied from collections made in the Cokeville area, and only *P. stantoni* and one variety of *P. humerosa* have been found in the lower part of the sequence, and of *P. s. elongata* in the upper part of the sequence. Moreover, four species of *Pachychiloides* occur in the Bear River, and one species and one subspecies are added to that genus in the upper part of the sequence in the Cokeville area. Moreover, the differences from divisions 2 and 3 are readily apparent, although the characteristic species in division 3 are not nearly so numerous as those in the other two divisions. The difference in habitat conditions must once more be stated in addition to the difference in species and in the size of the assemblages. Of course the entire sequence of division 3 has not been completely investigated, and additional data from further study may provide records that will reveal even greater differences.

AGE OF THE SEQUENCE NEAR COKEVILLE

In a recent paper (Yen, 1952 b, p. 761), I maintained and now still maintain that the Bear River formation was contemporary with the Cenomanian (Late Cretaceous) of standard European usage.

I have also related under previous headings of the present paper that the sequence exposed in the vicinity of Cokeville yields a molluscan assemblage very similar in kind and in ecological conditions to that of the Bear River formation. In examining all the known records, it is found that they have 18 species in common and 32 species different. Most of the different species are congeneric. The total number of species compared is aggregated from those collected at various levels in each sequence; that is, they are not the contents of any single fossil bed, such as that selected for purposes of the ecological interpretation just made. Moreover, Cokeville is only about 60 miles north of Evanston.

Available information indicates that the Bear River formation and the sequence exposed in the vicinity of Cokeville represent deposits of different ages. The Cokeville deposit does not seem to be a lateral extension of any part of the Bear River formation. Similar ecological conditions evidently produced similar kinds of molluscan assemblages, but they are considerably different in species. Such difference in species can most reasonably be explained by a difference in age, especially when the short distance between the two localities and the presence of a number of congeneric and closely related species is considered. However, the 18 species common to the two sequences seems to imply that they are not of greatly different ages.

269438—53——2

A black ferruginous shale, which is exposed on Smiths Fork, 30 miles north of Cokeville at a stratigraphic position 2,100 feet below the base of division 2 beds, yields nonmarine mollusks that represent the top of the Lower Cretaceous in this area, as interpreted by me. This bed contains a few forerunners of the Bear River fauna, together with some Lower Cretaceous species. It seems logical to assume that the basal part of division 2 is probably contemporary with the upper part of the Bear River formation; that the major part of the division 2 sequence is probably younger than the Bear River; and that during this time interval the new elements were evolved. However, the division 2 sequence is likely to be still within the Cenomanian stage (which constitutes the basal part of Upper Cretaceous) though possibly in its upper part.

SYSTEMATIC DESCRIPTIONS

GASTROPODA

Family NERITIDAE

Mesoneritina naticiformis (White), 1878

Plate 17, figure 24

Neritina naticiformis White, U. S. Geol. Survey Bull. 128, p. 49, pl. 6, figs. 10–12, 1895; *Mesoneritina naticiformis*, Yen, U. S. Geol. Survey Prof. Paper 233–A, p. 14, pl. 2, fig. 2, 1951.

White's figures 10 and 11 were based on a specimen collected "20 miles north of Cokeville," which is probably the same as locality 8 of Division 2 mentioned in the present paper. His figure 12 was based on a specimen obtained near the mouth of Sulphur Creek of the Bear River formation. The Cokeville specimens show a laterally descending and somewhat dilated final part of the body whorl, but the Bear River specimens are more naticoid in outline. Additional specimens obtained from the two areas confirm such differences in shell features. However, because the forms of *Neritina*-like groups are known to be variable in shell features within specific limits they are treated here as one species. The specimens collected from Leeds Creek area resemble closely those from the Cokeville localities.

Figured specimen: USNM 108411.

Mesoneritina stantoni (White), 1895

Plate 17, figure 23

Mesoneritina stantoni, Yen, U. S. Geol. Survey Pro. Paper 233–A, p. 14, pl. 2, fig. 3, 1951.

This species and M. *naticiformis* were found in a soft gray calcareous shale in the Bear River formation and also at the localities of the Leeds Creek area. The type specimens were collected "20 miles north of Cokeville."

The single supra-peripherial carina seems to be a constant feature of the species and differentiates it from the associated *M. naticiformis*.

Figured specimen: USNM 108409.

Family HELICINIDAE

"Helicina" cretacea Yen, n. sp.

Plate 17, figures 25–27

Shell of helicoid outline and small size, imperforate, having a moderately elevated spire and laterally descending body whorl. Whorls increasing moderately rapidly in size, scarcely convex and obtusely angulated along the periphery. Apex obtuse and prominent, initial whorl rather smooth, and subsequent ones marked by distinct sharp and slightly curved riblines. Basal surface convex and bearing a similar kind of sculpture. Aperture subovate in outline. Curving riblines of growth probably indicate it was sinuated posteriorly. Umbilical callosity well developed.

Measurement (in millimeters): Altitude of shell 3.0, width 4.0; height of aperture 2.0, width 1.5; 4 whorls.

This species is characterized by its scarcely convex whorls, distinctly sharp riblines, and well-developed umbilical callosity. It resembles *Helicina evanstonensis* (White), from the Evanston formation of Paleocene age, but it differs by its smaller size and its distinct sculpture.

Holotype: USNM 108415; paratype: USNM 108416.

"Helicina" cokevillensis, n. sp.

Plate 18, figures 5–7

Shell helicoid in outline and of small size, perforate in the young and imperforate in the adult, having a slightly elevated spire and laterally inflated body whorl. Whorls increasing rather rapidly in size, moderately convex and rounded at the periphery. Apex obtuse and prominent, initial whorl smooth and its subsequent ones bearing close and fine riblines. Basal surface moderately convex. Aperture subovate in outline and the unbilical callosity well thickened.

Measurements (in millimeters): Altitude of shell 3.2, width 5.5; height of aperture 2.0, width 3.0; 3¼ whorls.

This species is readily separated from the preceding one by its large size, more convex whorls, more depressed spire, and finer sculpture.

Holotype: USNM 108417; paratype: USNM 108418.

Family CYCLOPHORIDAE

Pseudarinia uniplica Yen, n. sp.

Plate 17, figure 50

Shell sinistral, imperforate, subovate in outline, with elevated spire and narrowly dilated body whorl. Spire greater than the body whorl. Whorls increase moderately rapidly in size, roundly convex and slightly shouldered below the suture. Aperture subovate in outline, descending in front, outer lip simple, parietal

margin thin but well defined, and columellar margin with twisted appearance at the lower end and bearing a well-developed plica.

Measurements (in millimeters): Altitude of shell 2.1, width 1.1; height of aperture 1.0, width 0.6; 4½ whorls.

The species resembles *Pseudarinia convexa* Yen (1952, p. 352, pl. 1, fig. 21, 22, 24) in size and outline of shell, but it differs by the twisted appearance of its columellar margin and by bearing a well-developed plica on the inner lip.

This species is so far known only from the Bear River formation, but congeneric species have been described from locality 2 of division 3.

Holotype: USNM 108419; paratypes: USNM 108420.

Family VIVIPARIDAE

Viviparus couesi White, 1878

Plate 17, figure 1

Viviparus couesi White, U. S. Geol. and Geog. Survey Terr. Bull. 4, p. 717, 1878; U. S. Geol. Survey Bull 128, p. 59, pl. 10, fig. 1, 1895.

White states (1895, p. 59) that this species was known only from the Bear River formation near the mouth of Sulphur Creek and at 7 miles north of Evanston, and this still holds true. It is often found in association with *Campeloma macrospira*, but it differs from that species by its more ventricose outline of shell, more convex whorls and roundly curved lines of growth. The specimens in the present collection were obtained at the Shell Hollow, locality 12 of division 1.

Figured specimen: USNM 108421.

Viviparus cokevillensis Yen, n. sp.

Plate 18, figure 8

Shell of moderate size for the genus, subovate in outline and apparently of thin shell substance, having a nearly mucronate apex, elevated spire, descending and moderately inflated body whorl; the spire is higher than the body whorl. Whorls increasing rather gradually in size, early ones gently and later ones more strongly convex. Surface marked by evenly and roundly curved lines of growth. Aperture pyriform, lip margin simple and thin, columellar margin slightly reflected. Umbilicus narrowly opened.

Measurements (in millimeters): Altitude of shell 37.0, width 23.2; height of aperture 15.6, width 13.0; 7 whorls.

It differs from the preceding species by its smaller size, with about same number of whorls, less convex whorls and less inflated body whorl.

Holotype: USNM 108426; paratypes: USNM 108427.

Campeloma macrospira (Meek), 1873

Melantho (Campeloma) macrospira Meek, U. S. Geol. and Geog. Survey Terr. Ann. Rept. for 1872, p. 487, 1873; U. S. Geol. Explor. 40th Par., Rept. v. 4, p. 179, pl. 17, figs. 17a b, 1877.

The type collections of the U. S. National Museum contain two lots for this species. A single specimen, which is marked as from the mouth of Sulphur Creek, has only a few early whorls preserved; another lot of 2 specimens, recorded from the Bear River Valley, Wyo., but which I think were probably obtained from Shell Hollow 7 miles north of Evanston, because its matrix matches well with the examples I have collected from locality 12. This species is known only from the Bear River formation.

Campeloma rubeyi Yen, n. sp.

Plate 17, figure 3

Shell narrowly oblong and subfusiform in outline, having a highly elevated spire, and slightly oblique descending body whorl. Spire higher than the body whorl. Whorls increasing rapidly in size, coiling slightly obliquely in the later ones. Whorl surface gently convex and bearing fine and sinuous lines of growth. Aperture decidedly descending, ovately oblong in outline, somewhat produced at the base. Parietal margin well defined and moderately thickened.

Measurements (in millimeters): Altitude of shell 46.0, width 20.0; height of aperture 20.6, width 13.7; 6 whorls preserved (apical ones missing).

This species is readily distinguished from the preceding one by its more or less fusiform outline of shell, ovately oblong shape of aperture, and slightly obliquely coiling of the larger whorls.

Holotype: USNM 108424; paratypes: USNM 108425.

Campeloma cokevillensis Yen, n. sp.

Plate 17, figure 2

Shell broadly oblong in outline, having a conically elevated spire, descending and moderately inflated body whorl. The spire is greater than the body whorl. Whorls increasing rather gradually in size, and coiling transversally and below the periphery of the preceding whorl. Whorl surface gently convex and bearing distinct sinuous lines of growth, which are clear indication of the presence of the characteristic curvature of the outer lip margin. Aperture subovate in outline, peristomal margin continuous if well preserved, and parietal wall thickened.

Measurements (in millimeters): Altitude of shell 42.6, width 24.4; height of aperture 18.0, width 13.0; 6 whorls preserved (apical ones missing).

This species is easily differentiated from the preceding one by much broader outline of shell, less convex whorls and subovate aperture. It differs from *Campeloma macrospira* by its smaller size, at least one whorl more, less convex whorls and its less broad outline of shell.

Holotype: USNM 108428; paratypes: USNM 108429.

Lioplacodes stachei (White) 1895

Plate 17, figures 17, 20, 21

Lioplacodes stachei, Yen, U. S. Geol. Survey Prof. Paper 223–A, p. 14, pl. 2, figs. 4a–g, 1951.

This species seems to be common in the early Late Cretaceous formations in southwestern Wyoming. Average specimens found in the Bear River are smaller than those from the Cokeville and Leads Creek localities. The significance of this difference cannot be ascertained until the Bear River fauna is completely studied.

This species was assigned by White (1895, p. 58) to *Charydrobia* Stache, which constitutes a group of *Hydrobia*-like forms from the higher Upper Cretaceous rocks in the Balkans. However, the group of species found in southwestern Wyoming seems to resemble more closely in shape, size, and apertural features the genus *Lioplacodes* Meek, species of which are known from Lower Cretaceous to lower Tertiary rocks in the western interior.

Figured specimens: USNM 108430.

Lioplacodes stachei attenuata Yen, n. subsp.

Plate 17, figure 18

This subspecies is readily separated from the typical form by its narrowly oblong outline of shell, more highly elevated spire, and less inflated body whorl. These features are well shown in the young examples as well as in the fully matured stages and therefore it is considered to represent a distinct form, although it is obviously related to the typical form of the species.

Measurements (in millimeters): Altitude of shell 14.5, width 6.0; height of aperture 5.7, width 3.1; 7 whorls.

Measurements (in millimeters) of a figured specimen of *Lioplacodes stachei:* Altitude of shell 14.5, width 6.8; height of aperture 5.0, width 3.7; 7 whorls.

Holotype: USNM 108437; paratypes: USNM 108438.

Lioplacodes stachei inflatus Yen, n. subsp.

Plate 17, figure 19

This subspecies is characterized by its broadly subovate outline of shell, with early whorls increasing gradually and later ones more rapidly in size, conically elevated spire and dilated body whorl. These features are well shown in both young and adult stages and distinguish this form from *L. s. attenuata.*

Measurements (in millimeters): Altitude of shell 10.7, width 6.0; height of aperture 5.0, width 3.7; 7 whorls.

Holotype: USNM 108440; paratypes: USNM 108441.

Lioplacodes endlichi (White), 1878

Goniobasis endlichi White, U. S. Geol. and Geog. Survey Terr. Bull. 4, p. 716, 1878; *Lioplax? endlichi*, White, U. S. Geol. Survey Bull. 128, p. 60, pl. 10, figs. 4, 5, 1895.

The type lot contains four specimens, three of which represent this species; and a fourth one (fig. 6) of White, with only a few early whorls preserved, does not belong to the species. White noted that this species is distinct from all other species of the Bear River fauna, but I have not yet been able to find identical specimens from the type locality.

Family VALVATIDAE

Valvata praecursoris (White), 1895

Valvata praecursoris, Yen, U. S. Geol. Survey Prof. Paper 233–A, p. 14, pl. 2, figs. 1a-g, 1951.

This species is common in the Upper Cretaceous sequences in southwestern Wyoming. The present collection contains a series of developmental stages that show the descending coiling of the later whorls and the deepening of the umbilicus. In some beds this species is associated with a species of *Gyraulus*, but is easily distinguished by its tubular form of the whorls, circular aperture with continuous peristome, wide and deep umbilicus.

There are four specimens in the type lot, which were obtained 20 miles north of Cokeville. None of the four closely resembles a species of *Gyraulus.*

Family AMNICOLIDAE

Mesocochliopa bearensis Yen, n. sp.

Plate 17, figures 36–38

Shell small, subglobose in outline, with elevated spire and narrowly inflated body whorl. Whorls increasing gradually in size in early ones and more rapidly in later ones, and separated by impressed suture. Whorl surface gently convex, but roundly convex on the base. Aperture subovate in outline, outer lip simple, parietal wall thin but defined, columellar margin short and bearing a prominent plica in a middle position on inner lip margin. Plica lying obliquely upward on the inner wall. Umbilicus deep and widely open.

Measurements (in millimeters): Altitude of shell 3.0, width 2.8; height of aperture 1.5, width 1.6; 4⅛ whorls. Altitude of shell 2.1; width 2.1; height of aperture 1.2, width 1.2; 4 whorls.

This species is readily distinguished from *Mesocochliopa cretacea* Yen (1951, p. 5, pl. 1, figs. 6a-c) by its larger size and fewer whorls and its oblique and higher plica.

Holotype: USNM 108445; paratypes: USNM 108446.

Mesocochliopa cokevillensis Yen, n. sp.

Plate 17, figures 34, 35

Shell small, and subglobose outline, with highly elevated spire and dilated body whorl. Spire higher than body whorl. Whorls increasing rapidly in size, slightly shouldered below the suture. Surface roundly convex and bearing fine lines of growth. Aperture descending, ovate in outline; outer lip thin and simple, inner lip bearing a plica at the junction of parietal and columellar margins. Umbilicus deep and widely open.

Measurements (in millimeters): Altitude of shell 3.2, width 2.7; height of aperture 1.5, width 1.5; 5⅓ whorls.

Holotype: USNM 108447; paratypes: USNM 108448.

"Tornatellina?" isoclina (White), 1895

Tornatellina? isoclina White, U. S. Geol. Survey Bull. 128, p. 48, pl. 4, figs. 14, 15, 1895.

This is another rare species found only at the type locality, 20 miles north of Cokeville. The shape, size, and elevation of spire are much different from those of *Mesocochliopa* Yen, although the parietal wall is similarly dentated. More specimens are needed to determine the variation of its shell features and permit a generic assignment, although it seems certain that the species does not belong to *Tornatellina* Beck, which is a genus of Recent terrestrial gastropods distributed through the Pacific islands.

Parateinostoma altispirale Yen, 1951

Plate 17, figure 22

Parateinostoma altispirale Yen, U. S. Geol. Survey Prof. Paper 233–A, pl. 2, figs. 5a–d, 1951.

The specimens obtained in the Bear River formation at Fossil Cut (locality 11) agree well with this species, which was originally described from the Leeds Creek area north of Sage Junction. So far it has not been found at the Cokeville localities, where congeneric species are not uncommon. Its absence from the present record is probably due to incompleteness of collecting.

Figured specimen: USNM 108449.

Parateinostoma convexum Yen, 1951

Parateinostoma convexum Yen, U. S. Geol. Survey Prof. Paper 233–A, p. 15, pl. 2, figs. 63a–c, 1951.

This species is known at present only from the beds exposed in the Leeds Creek area.

Parateinostoma contractum Yen, 1951

Parateinostoma contractum Yen, U. S. Geol. Survey Prof. Paper 233–A, p. 15, pl. 2, figs. 7a–c, 1951.

This species is known only from the Leeds Creek area. Both this and the preceding species seem to be related to *P. latentis* (White), but they are decidedly different from each other.

This genus has been recorded only from the lower Upper Cretaceous rocks of southwestern Wyoming.

Parateinostoma latentis (White), 1895

Bythinella latentis White, U. S. Geol. Survey Bull. 128, p. 58, pl. 10, figs. 10, 11, 1895.

The type specimens were collected 20 miles north of Cokeville.

This species differs from *P. contractum* (Yen, 1951, p. 15), but they are congeneric. Specimens from locality 8 of division 2, show the unexpanded outer lip margin and less inflated body whorl.

Parateinostoma occulta (White), 1895

Hydrobia occulta White, U. S. Geol. Survey Bull. 128, p. 57, pl. 10, figs. 12, 13, 1895.

This species also was known only from "20 miles north of Cokeville," and I have found no additional specimens in more recent collections. Examination of the type specimens of this species and the preceding one reveals no reason for their generic separation, although *P. occulta* has a slightly more slender outline of shell and more convex whorls.

Parhydrobia cylindrica Yen, 1951

Parhydrobia cylindrica Yen, U. S. Geol. Survey Prof. Paper 233–A, p. 15, pl. 2, figs. 8a–b, 1951.

This species is known only from its type locality, that is, locality 3 of division 3. It is a very striking form and may represent a distinct genus, but the available specimens do not justfy such a description.

Trochispira Yen, new genus

Shell more or less trochoid in outline, having elevated spire and inflated body whorl; whorls few, bearing sculpture and increasing rapidly in size, coiling with the suture more or less along the periphery of the preceding whorl; aperture pyriform, descending, peristomal margin more or less continuous and thickened; umbilicus more or less open but not deep.

Genotype: Trochispira wyomingensis Yen, n. sp.

Trochispira wyomingensis Yen, n. sp.

Plate 17, figures 39–44

Shell trochoid in outline, small, with acutely elevated spire and laterally inflated body whorl. Spire about

equal in height to the body whorl. Whorls increasing rapidly in size, apex elevated and prominent, early whorls gently convex and later ones obtusely shouldered, bearing a set of 3 to 4 distinct spiral ridges on and below the periphery; basal surface slightly convex and appearing to be smooth. Aperture descending, ovately pyriform in outline; outer lip slightly angulated above, inner lip arched in the middle, parietal margin well defined, and columella somewhat oblique. Umbilicus narrowly open but not deep.

Measurements (in millimeters): Altitude of shell 4.0, width 3.8; height of aperture 2.1, width 2.1; 4¼ whorls.

This species is characterized by its small size, trochoid outline of shell, and the few but distinct spiral ridges. The younger individuals have the umbilicus more widely open but not deep.

This species has so far been found only at locality 11 of the Bear River formation where it was found in association with species of *Mesoneritina*, *Viviparus*, *Campeloma*, *Lioplacodes*, *Valvata*, *Mesocochliopa*, *Physa*, *Gyraulus*, etc.

Holotype: USNM 108452; paratypes: USMN 108453.

Family PLEUROCERATIDAE

Goniobasis leedsensis Yen, 1951

Goniobasi leedsensis Yen, U. S. Geol. Survey Prof. Paper 233–A, p. 16, pl. 2, figs. 9a–3, 1951.

This species has been so far recorded only from the localities of division 3, where it occurs abundantly in impure limestone beds. The shell features are very distinct and resemble those of some species of *Melanoides*. Its existence in a true fresh-water habitat seems to be well demonstrated by its association with other fresh-water molluscan species and the complete lack of admixture of either brackish-water species or their fragmentary shells.

Pyrgulifera humerosa (Meek), 1860

Plate 17, figures 12, 13

Melania humerosa Meek, Acad. Nat. Sci. Phila. Proc., v. 12, p. 313, 1860; *Pyrgulifera humerosa* White, U. S. Geol. Survey Bull. 128, p. 55, pl. 8, figs. 1–3.

This typical form of the species has been recorded from the Bear River at localities 11 and 12. It has been found at several levels within the formation and its occurrence is most abundant. A preliminary field investigation shows that some varieties of this species were evolved at the times of deposition. However, a monographic study is probably the only means of working out the problem, interesting and important as may it be, but that is not within the scope of the present work.

Figured specimens: USNM 108454.

Pygulifera humerosa cokevillensis Yen, n. subsp.

Plate 18, figure 1

This subspecies differs from the typical form of the species by its much smaller size, finer and more closely spaced nodular constructions along the shoulder. This form has been found only at locality 10 in lower part of division 2, in association with the following species and another larger but unnamed variety of *P. humerosa*.

Pyrgulifera stantoni White, 1895

Plate 17, figures 14, 15

Pyrgulifera stantoni White, U. S. Geol. Survey Bull. 128, p. 57, pl. 9, figs. 1–3, 1895.

This species, as White has already pointed out, differs from *P. humerosa* by its greater elongation and other features. He notes also that this species and some varieties of *P. humerosa* were collected by Stanton in the Cokeville area. My investigations indicate that the typical form of *P. humerosa* seems to be found only in the strata exposed in vicinity of Evanston.

Available collections, including White's material, do not contain typical *P. humerosa* marked with a Cokeville locality, nor *P. stantoni* in the Bear River formation. The type lot of *P. stantoni* is marked "The Bear River, Cokeville," and the very young specimen figured by White is labelled as coming from 20 miles north of Cokeville. This very young example is very different from the young specimens of *P. humerosa* I have collected from locality 11 of the Bear River formation.

Figured specimens: USNM 108456.

Pyrgulifera stantoni elongata Yen, n. subsp.

Plate 17, figure 16; plate 18, figure 2

Shell elongately subfusiform in outline, imperforate, having an acutely turrited spire and narrowly inflated and descending body whorl. Whorls increasing rapidly in size, apical ones roundly convex and subsequent ones shouldered above. The shoulder is obtusely angulated. Surface smooth on the early whorls and bearing rib and spiral lines on later ones. The rib lines are stronger than the spiral lines, and they are in intersection over the surface of the whorls except on base of the body whorl. Aperture subovate, somewhat produced and slightly sinuous on the basal margin.

Measurements (in millimeters): Altitude of shell 18.0, width 7.0; height of aperture 7.5, width 5.0; 5 preserved whorls (apical part missing).

This subspecies has been found at both localities 6 and 8 of division 2. At locality 8, it is represented mostly by young specimens, and at locality 6, it was found in association with varieties of *P. stantoni* that were unfortunately very much distorted and cannot be used for

definite identifications. This subspecies differs from the typical form by its much smaller size, more elongate outline of shell, and less prominent sculpture.

Holotype: USNM 108459; paratypes: USNM 108460.

Pachychiloides cleburni (White), 1895

Plate 17, figures 4, 5

Goniobasis cleburni White *in* Powell's Rept. Geol. Uinta Mts., p. 122, 1876; *Pachymelania cleburni*, White, U. S. Geol. Survey Bull. 128, p. 51, pl. 7, figs. 1–3, 1895.

This is a characteristic Bear River species, and easily recognized by its large size of shell. It is abundant at locality 12. The sculpture is somewhat variable, but, in general, the rib ridges are rather distantly spaced, and in places are partly or entirely obsolete.

Figured specimens: USNM 108463.

Pachychiloides cokevillensis Yen, n. sp.

Plate 18, figures 3, 4

Shell narrowly elongate in outline, having a highly turrited spire, tapering toward apex gradually, and descending at the aperture. Whorls increasing rapidly in size, coiling much below the periphery. Surface gently convex, slightly shouldered below the suture, and bearing strong and well-spaced rib ridges. Aperture subovate in outline, and the peristomal margin is probably somewhat expanded at the base when it is perfectly preserved.

Measurements (in millimeters): Altitude of shell 38.0, width 11.0; height of aperture 9.0, width 8.0; about 10 whorls.

This species is readily separated from the preceding one by its smaller size, more elongate shape, and more closely spaced rib ridges. It has so far been found at locality 6 in the upper part of division 2.

Holotype: USNM 108465; paratypes: USNM 108466.

Pachychiloides turricula (White), 1895

Pachymelania turricula White, U. S. Geol. Survey Bull. 128, p. 53, pl. 7, figs. 14, 15, 1895.

The type lot consists of a single specimen labelled from "Bear River near Sage." I have found no other specimens of this species in the early collection marked as coming from the mouth of Sulphur Creek. This seems to be a common species found in the lower part of the sequence exposed in the Leeds Creek area.

Pachychiloides chrysalis (Meek), 1871

Plate 17, figures 8, 9

Goniobasis chrysalis Meek, U. S. Geol. and Geog. Survey Terr. Ann. Rept. for 1870, p. 316, 1871; *Pachymelania chrysalis*, White, U. S. Geol. Survey Bull. 128, p. 53, pl. 7, figs. 6, 7, 1895.

The type lot consists of two specimens figured by White, labelled as coming from Sulphur Creek. Another lot of three examples collected near Sage probably represent a different form. I have obtained specimens from locality 10 in the lower part of division 2, which seem to be identical with this species, although the sculpture is much worn.

Figured specimen: USNM 108468.

Pachychiloides cf. P. chrysalloidea (White), 1876

Plate 17, figures 6, 7

Goniobasis chrysalloidea White *in* Powell's Rept. Geol. Uinta Mts., p. 123, 1876; *Pachymelania chrysalloidea*, White, U. S. Geol. Survey Bull. 128, p. 52, pl. 7, figs. 4, 5, 1895.

This species was previously recorded only from its type locality, the Bear River near the mouth of Sulphur Creek. The one specimen from 7 miles north of Evanston, mentioned by White, is an immature example of *Pachychiloides cleburi*. I have obtained several closely comparable specimens from locality 12, but identification can be settled only by having a few more perfectly preserved examples from the type locality to show the range of variation for comparison.

Pachychiloides macilenta (White), 1880

Plate 17, figures 10, 11

Goniobasis macilenta White, U. S. Geol. and Geog. Survey Terr. 12th Ann. Rept., p. 93, pl. 30, figs. 10, 10a, 1880; *Pachymelania macilenta*, White, U. S. Geol. Survey Bull. 128, p. 54, pl. 7, fig. 9, 1895.

The early collections contain specimens of this species both from the "Bear River Valley near mouth of Sulphur Creek," and the locality "8 miles north of Evanston." One young example is labelled "20 miles north of Cokeville." The type locality is 8 miles north of Evanston. I have obtained specimens from locality 8 of division 2, and localities 11 and 12 of the Bear River formation.

Figured specimens: USNM 108472.

Family ELLOBIIDAE

Zaptychius haldemanni (White), 1878

Plate 17, figures 48, 49

Acella haldemanni, White, U. S. Geol. and Geog. Survey Terr. Bull. 4, p. 714, 1878; *Fortacella haldemanni*, White, U. S. Geol. Survey Bull. 128, p. 44, pl. 5, figs. 8–12, 1895.

The specimens of the type lot were collected from "Sulphur Creek, Bear River," and those of two other lots were from 20 miles north of Cokeville. I have obtained specimens from locality 11 of the Bear River formation, also at locality 8 of division 2 and locality 3 of division 3. It seems to be a very common species in these zones.

Figured specimens: USNM 108474 and USNM 108476.

"Auricula" neumayri White, 1895

Auricula neumayri White, U. S. Geol. Survey Bull. 128, p. 41, pl. 5, fig. 1, 1895.

The type lot consists of a single specimen labeled "Cretaceous Bear River, 20 miles north of Cokeville, Wyoming." It is readily distinguished from species of *Melampoides* and *Rhytophorus* by its higher spire, narrower outline of shell, and two distinct plicae on the more or less straight collumellar margin. No additional specimens from this general area belong to this species.

Melampoides clarki (White), 1895

Plate 17, figure 51

Melampus clarki White, U. S. Geol. Survey Bull. 128, p. 42, pl. 5, figs. 2, 3, 1895; *Melampoides clarki*, Yen, U. S. Geol. Survey Prof. Paper 233–A, p. 16, pl. 2, fig. 12, 1951.

This species was originally described from a locality 20 miles north of Cokeville. One of the two original lots (USNM 22335) contains two *Physa*-like specimens and one resembling an imperfect "*Auricula*" *neumayri*, in addition to 5 specimens of *M. clarki*.

Figured specimen: USNM 108478.

Rhytophorus priscus (Meek), 1860

Melampus priscus Meek, Acad. Nat. Sci. Phila. Proc., v. 12, p. 315, 1860; *Rhytophorus priscus*, White, U. S. Geol. Survey Bull. 128, p. 43, pl. 5, figs. 4, 5, 1895.

The type lot was collected from the Bear River near mouth of Sulphur Creek. This species is so far known only from the Bear River formation.

Rhytophorus meeki White, 1876

Rhytophorus meeki White *in* Powell's Rept. Geol. Uinta Mts. p. 118, 1876; White, U. S. Geol. Survey Bull. 128, p. 43, pl. 5, figs. 6, 7, 1895.

The type lot was collected from the Bear River near mouth of Sulphur Creek. It differs from *R. priscus* by its narrower outline of shell, its columellar plica being less strongly twisted and slightly higher in position.

Rhytophorus cf. R. meeki White, 1876

Rhytophorus cf. R. meeki, Yen, U. S. Geol. Survey Prof. Paper 233–A, p. 16, pl. 2, fig. 11, 1951.

Specimens from locality 6 in the upper part of Division 2 and locality 3 of division 3, resemble *R. meeki* White. The specimens are too poorly preserved for a definite identification.

Family PHYSIDAE

Physa usitata White, 1895

Physa usitata White, U. S. Geol. Survey Bull. 128, p. 47, pl. 6, figs. 8, 9, 1895; Yen, U. S. Geol. Survey Prof. Paper 233–A, p. 17, pl. 2, fig. 14, 1951.

The type locality of this species is 20 miles north of Cokeville. Two lots in the early collections represent this species; one is the type lot, another is labelled from "Bear River." I have obtained specimens at locality 11 of the Bear River formation, and locality 8, of division 2, which is probably the same as the type locality.

Physa cokevillensis Yen, n. sp.

Plate 17, figure 52

Shell ovately oblong in outline, of medium size for the genus, having an elevated spire and narrowly dilated body whorl. The spire is a little less than one-third the height of the entire shell. Whorls increasing rather gradually in early stages and rapidly in later stages; narrowly dilated at the body whorl, having its surface gently convex and bearing fine lines of growth. Aperture narrowly oblong in shape, outer lip thin and simple, parietal wall very thin and columellar margin slightly reflected.

Measurement (in millimenters): Altitude of shell 6.5+, width 3.2; height of aperture 4.5, width 2.1; 4 whorls preserved.

This species differs from *P. usitata* by its much smaller size, ovately oblong outline and narrower aperture. Specimens were collected from locality 8 of division 2, but most of them are of immature individuals.

Holotype: USNM 108483; paratypes: USNM 108484.

Physa globosa Yen, n. sp.

Plate 17, figure 53

Shell ovately globose in outline, of small size, having a conically elevated spire and dilated body whorl; the spire is smaller than the body whorl. Whorls increasing rather gradually on the spire but dilated on body whorl, which has the surface gently convex, slightly shouldered and bearing fine lines of growth. Aperture small, pyriform in shape, outer lip thin and simple, inner lip thin and columella slightly reflected.

Measurements (in millimeters): Altitude of shell 3.8, width 2.8; height of aperture 2.2, width 1.8; 5 whorls.

The species differs from *P. cokevillensis* by its ovately globose outline, slightly shouldered whorls and small pyriform aperture.

Holotype: USNM 108485; paratypes: USNM 108487.

Family LYMNAEIDAE

Lymnaea nitidula (Meek), 1860

Melania? nitidula Meek, Acad. Nat. Sci. Phila. Proc., v. 12, p. 314, 1860; *Limnaea nitidula*, White, U. S. Geol. Survey Bull. 128, pl. 6, figs. 1–3, 1895.

This species must be considered as doubtfully referred to *Lymnaea*. There are three lots in the early collection, two of them from "Bear River near mouth of Sulphur Creek" and one from "Bear River Valley, Wyoming." I am unable to locate the lot White noted as collected by Stanton from "20 miles north of Cokeville." After examining the available specimens, I found them to differ from *Lymnaea* even in its broad sense. The lot collected from "Bear River Valley" contains specimens that may be referred to *Lioplacodes*.

Family PLANORBIDAE

Gyraulus sp. undet.

Two lots of specimens, one from locality 11 of the Bear River formation, and another from locality 8 of division 2, represent this form. It is found in association with *Valvata praecursoris*, and both of them are rather common in these beds. *Gyraulus* is easily distinguished from *Valvata* in that the whorls are closely coiled above the periphery, the body whorl is raised higher than the apical whorls and the aperture is semilunate in outline.

The specimens available do not reveal features that would distinguish them from several species of *Gyraulus*, a genus known from late Jurassic to Recent times. I prefer to leave their specific status as undetermined.

Anisopsis minutis Yen, 1951

Anisopsis minutis Yen, U. S. Geological Survey Prof. Paper 233–A, p. 16, figs. 13a–c, 1951.

This species is known only from the beds exposed south of Leeds Creek. It is readily recognized by its more or less sunken apical whorls, nearly flattened or slightly concave base, and its bicarinated body whorl.

Several specimens collected from locality 8 of division 2 may be congeneric with this species, but differ by having the apical whorls more exposed. Only one of the specimens is well preserved in that lot, and it is preferable, therefore, to leave them as undetermined at present.

PELECYPODA

Family OSTREIDAE

Ostrea haydeni White, 1895

Ostrea haydeni White, U. S. Geol. Survey Bulletin 128, p. 32, pl. 2, figs. 1, 2, 1895.

This species has been recorded from the Bear River formation and the sequence exposed north of Cokeville. It is generally found in beds of brackish-water origin, but fragments are also found in true fresh-water beds. The admixture is evidently caused by drift from an estuarine area.

This one of the Bear River species that has never been well defined on account of the lack of well-preserved specimens, and the records of it must be considered as provisional. White's figure was based on an imperfect specimen, and I have found only fragments. However, it seems to have been a rather common species.

Family MYTILIDAE

Brachydontes peali White, 1895

Brachydontes peali White, U. S. Geol. Survey Bull. 128, p. 33, pl. 2, fig. 3, 1895.

The type specimen was probably from the sequence exposed "near Sage," south of Cokeville. It represents a young stage of the species. Most of the specimens identified as this species in the later collections consist of fragments of shells of various sizes, and they were identified largely on the presence of radiating lines of sculpture. I have collected one specimen of an internal mold in association with some fragments of shell from locality 6 of division 2, which measures 37.0 mm in length of shell and 21.0 mm in width. It apparently represents this species.

Family CORBULIDAE

Corbula pyriformis Meek, 1860

Plate 17, figures 59–61

Corbula (Potamomya) pyriformis Meek, Acad. Nat. Sci. Phila. Proc., v. 12, p. 312, 1860; *Corbula pyriformis*, White, U. S. Geol. Survey Bull. 128, p. 38, pl. 4, figs. 5–9, 1895.

This species is commonly found at various levels within the Bear River formation. Most specimens found in the sequence exposed in the vicinity of Cokeville are smaller than usual but the significance of the difference in size is unknown.

Vokes (1945) proposed the genus *Ursirivus* for this species because of its possession of a chondrophore, its large size, deep lunule and escutcheon, and its pronounced pyriform shape of both valves and presence of a small but definite pallial sinus (p. 17). I examined all available specimens, including Vokes' specimens and the type lot of the species, and found that the anterior and posterior muscular impressions are slightly depressed but not so deep as to warrant special note; the pallial sinus, which is an obtusely angular curvature formed by the pallial line below the posterior muscular impression is not noticeably different from that of about half a dozen Recent species of *Corbula* I have examined.

Besides, the differences in general shape and size are hardly features of generic importance.

Moreover, Vokes' figure of the left valve of *Corbula sulcata* Lamarck, which is said to be a topotype from coast of Senegal, West Africa, shows considerable difference in hinge features from that given by Brugière (pl. 230, fig. 1c), which was drawn from one of the original types. Bruguière's illustration shows a small but distinct projecting structure on the left valve, and the presence of this feature has been confirmed by later authors. Tryon, for instance, described it as a "projecting cartilage-process." Such a difference, as shown by the figures of Bruguière, is particularly significant when Dr. Vokes so emphasized the importance of the absence of this chondrophore as a basic element in his treatment of subfamilies and genera of Corbulidae.

Figured specimens: USNM 108498.

Corbula engelmanni Meek, 1860

Plate 17, figures 57, 58

Corbula (*Potamomya?*) engelmanni Meek, Acad. Nat. Sci. Phila. Proc., v. 12, p. 312, 1860; *Corbula engelmanni*, White, U. S. Geol. Survey Bull. 128, p. 40, pl. 40, figs. 10, 11, 1895.

This species is commonly found at different levels in the Bear River formation, and also in the lower part of division 2. This species is characterized by its small size, subtriangular outline of shell, strong and elevated concentric riblines. The hinge structure is not known, but, judged by the external features of shell, the species resembles *Corbula zurcheri* Repelin, 1902 (p. 57, pl. 4, figs. 16–21), which is a species of *Corbula* as indicated by external features and the hinge.

Figured specimens: USNM 108493.

Family CORBICULIDAE

Corbicula durkeei (Meek), 1870

Plate 17, figures 54–56

Cyrena (*Corbicula?*) *durkeei* Meek, Am. Philos. Soc. Phila. Proc., v. 11, p. 431, 1870; *Corbicula durkeei*, White, U. S. Geol. Survey Bull. 128, p. 36, pl. 4, figs. 1–4, 1895.

This species is common in the Bear River formation, but rather rare in the sequence exposed in the vicinity of Cokeville.

Specimens collected from locality 6 of division 2 are smaller than those found in the Bear River. They may represent a new variety, but the specimens in the collection are too poorly preserved to provide a characteristic description of the form.

Figured specimen: USNM 108499.

Family UNIONIDAE

Unio vetustus Meek, 1860

Plate 17, figure 63

Unio vetustus Meek, Acad. Nat. Sci. Phila. Proc., v. 12, p. 312, 1860; White, U. S. Geol. Survey Bull. 128, p. 38, pl. 3, figs. 1–4, 1895.

This common Bear River species, usually found in association with *U. belliplicatus*, is easily distinguished from that by having strong concentric riblines confined to the umbonal area, and fine lines of growth over the postumbonal surface; and the species may be used generally as an index for local correlation of the Upper Cretaceous in southwestern Wyoming.

As White noted, the species is particularly common in the Bear River at both localities 11 and 12 of division 1. It seems to be common also at locality 6 of division 2, but the specimens collected from that area are mostly distorted, and its specific identification cannot at present be definitely established.

Figured specimen: USNM 108506.

Unio belliplicatus Meek, 1870

Plate 17, figure 62

Unio belliplicatus Meek, Am. Philos. Soc. Phila. Proc., v. 11, p. 439, 1870; White U. S. Geol. Survey Bull. 128, p. 34, pl. 2, figs. 4–6, 1895.

This species is readily recognized by its prominent radiating plications on about the posterior two-thirds of the external surface. Its occurrence in the Bear River is abundant at various levels. However, it is not so common in the sequence exposed in the vicinity of Cokeville, where only fragmentary pieces of shells bearing the characteristic plications have been collected.

Figured specimen: USNM 108504.

REFERENCES CITED

Bruguière, J. G., 1798, Tableau encyclopédique et méthodique 2, Planches 93–286, Paris.

Meek, F. B., 1860, Descriptions of new fossil remains collected in Nebraska and Utah, Proc. Acad. Nat. Sci. Phila., v. 12, p. 308–315.

——— 1870, A preliminary list of fossils, collected by Dr. Hayden, etc.: Proc. Am. Philos. Soc. Phila., v. 11, p. 425–431.

——— 1871, Preliminary paleontological report consisting of lists of fossils with description of some new types: U. S. Geol. and Geog. Survey Terr., 4th. report, 287–318.

——— 1873, Preliminary paleontological report consisting of lists and descriptions of fossils, with remarks on the ages of rocks, etc.: U. S. Geol. and Geog. Survey Terr., 6th. annual report (for 1872), p. 431–541.

——— 1877, Paleontology: U. S. Explor. 40th Parallel, v. 4, pt. 1, p. 1–197, 17 pls.

Repelin, J., 1902, Description des faunes et des gisement du Cénomanien saumatre ou d'eau douce du Midi de la France: Arch. Mus. d'Hist. nat. Marseilles, tome 7 part 2.

Rubey, W. W. 1950, Alternate return log (of field trip), first day, August 9, 1950; Guide Book of 5th Geol. Field Conference of Wyoming.

Stache, Guido, 1889, Die liburnische Stufe und deren Grenz-Horizonte: K. k. geol. Reichsanstalt Abh. Band 13, pt. 1.

Vokes, Harold E., 1945, Supraspecific groups of the pelecypod family Corbulidae: Am. Mus. Nat. History Bull., v. 86, no. 1, 32 p. 4 pls.

White, C. A., 1876, Invertebrate paleontology, *in* J. W. Powell Report on geology of eastern portion of Uinta Mountains, p. 74–135.

——— 1878, Paleontological Papers, no. 6: U. S. Geol. and Geog. Survey Terr. Bull. 4, p. 707–719.

——— 1880, Contribution to invertebrate paleontology, no. 4: U. S. Geol. and Geog. Survey Terr., 12th. report, pt. 1, p. 49–103.

——— 1895, The Bear River formation and its characteristic fauna: U. S. Geol. Survey Bull. 128, p. 1–86, 10 pls.

Yen, T. C., 1951, Fresh-water mollusks of Cretaceous age from Montana and Wyoming: U. S. Geol. Survey Prof. Paper 233–A, pt. 2, p. 11–18, 1 pl.

——— 1952a Fresh-water molluscan fauna from an Upper Cretaceous porcellanite near Sage Junction, Wyo.: Am. Jour. Sci., v. 250, p. 344–359, 1 pl.

——— 1952b, Age of the Bear River formation, Wyoming: Geol. Soc. America Bull., v. 63, p. 757–764.

———1952c, Ecological interpretations of Upper Cretaceous depositions near Sage Junction, Wyo.: Geol. Soc. America Bull., v. 63, p. 1317.

PART 2: FAUNAS FROM EASTERN UTAH AND WESTERN COLORADO

ABSTRACT

Fifteen collections of nonmarine mollusks are recorded from the Price River (Farrer and Neslen members) Mount Garfield, and Hunter Canyon formations exposed in the Books Cliffs coalfield area in eastern Utah and western Colorado. Three species of *Unio* and one of *Tolotomops* are described as new.

INTRODUCTION

Few late Cretaceous nonmarine molluscan faunas have been studied since Stanton's work, which was based on the collections made in San Juan Basin of Northern New Mexico, was published in 1916. In the late twenties, C. E. Erdmann and D. J. Fisher investigated the coal fields of the Book Cliffs in eastern Utah and western Colorado, and as a result, several large collections of nonmarine fossils were made from some usually inaccessible localities in this extremely rugged country. As a report by Erdmann, Fisher and Reeside on the stratigraphic results of their investigations in this area is nearing completion, it seems appropriate to describe the nonmarine mollusks from their collections.

Most of the specimens have been preliminarily identified by Dr. T. W. Stanton, or by Dr. John B. Reeside, Jr., who collected some of the specimens. Most of the fossils were imbedded in sandstone or in sandy shale, which as usual contain rich faunules but rather poorly preserved specimens; however, in a few localities, more perfectly preserved specimens permit description of some new species.

COLLECTION LOCALITIES AND THEIR MOLLUSCAN ASSEMBLAGES

The present work deals with collections of nonmarine mollusks from the following five units in the Mesaverde group:

1. Price River formation:

USGS Mesozoic loc. 8140, in sec. 14, T. 13 S., R. 10 E., Deadmans Canyon, Wellington quadrangle, Utah; base of Price River formation, collected by F. R. and G. W. Clark, 1912. It contains the following species of mollusks:

Unio cf. *U. priscus* White
Unio cf. *U. amarillensis* Stanton
Unio sp. undet.
Sphaerium cf. *S. planum* Meek and Hayden
Tulotomops sp. undet.
Campeloma cf. *C. amarillensis* Stanton

USGS Mesozoic loc. 12247, about 1 mile above the Castle Gate on Price River; very near top of Castlegate sandstone; collected by E. M. Spieker and J. B. Reeside, Jr., 1923. It contains the following species of mollusks:

Unio sp. undet.
Valvata sp. undet.
Viviparus sp. undet.
Tulotomops sp. undet.
Lioplacodes sp. undet.
Goniobasis? subtortusa Stanton

2. Farrer formation:

USGS Mesozoic loc. 13682, in SE¼ sec. 32, T. 20 S., R. 20 E, Book Cliffs, Utah; about 390 feet above Sego sandstone; collected by D. J. Fisher, 1926. It contains the following species of mollusks:

Unio cf. *U. brimhallensis* Stanton
Unio cf. *U. brachyopisthus* Stanton
Unio amarillensis Stanton
Tulotomops sp. undet.
Campeloma amarillensis Stanton
Amnicola sp. undet.

3. Neslen formation:

USGS Mesozoic loc. 13686, in sec. 18, T. 19 S., R. 23 E., Diamond Canyon, north of Cisco, Utah; about 120 feet above Sego sandstone; collected by R. M. Leggette, 1926. It contains the following species of mollusks:

Unio sp. undet.
Corbula subtrigonalis Meek and Hayden
Tulotomops sp. undet.
Campeloma amarillensis Stanton

USGS Mesozoic loc. 13688, in sec. 10, T. 17 S., R. 24 E., East Canyon, Westwater Creek, Utah; 304 feet above Sego sandstone; collected by R. M. Leggette, 1926. The collection contains the following species of mollusks:

Tulotomops sp. undet.
Campeloma cf. *C. amarillensis* Stanton
Amnicola sp. undet.

USGS Mesozoic loc. 13689, in sec. 24, T. 18 S., R. 23 E., in a canyon off east side of Sulphur Canyon, Book Cliffs, Utah; collected by D. J. Fisher, 1926. It contains the following species of mollusks:

Unio sp. undet.
Tulotomops laevibasalis Yen
Campeloma sp. undet.

USGS Mesozoic loc. 13674, in sec. 2, T. 21 S., R. 18 E., Horse Canyon, Utah; 340 feet above Castlegate sandstone; collected by D. J. Fisher, 1926. It contains the following species of mollusks:

Corbula subtrigonalis Meek and Hayden
Tulotomops laevibasalis Yen
Campeloma amarillensis Stanton
Lioplacodes sp. undet.

USGS Mesozoic loc. 13334, in NW¼ sec. 9, T. 20 S., R. 17 E., Book Cliffs, Utah; 230 feet above top of Castlegate sandstone; collected by D. J. Fisher, 1925. It contains the following species of mollusks:

Unio sp. undet.
Sphaerium cf. *S. planum* Meek and Hayden
Tulotomops cf. *T. laevibasalis* Yen
Physa sp. undet.

4. Mount Garfield formation:

USGS Mesozoic loc. 13970, in NW corner SW¼ sec. 29, T. 7 S., R. 104 W., near Closure, Colorado; 40 feet above highest Carbonera coal bed, and 375 feet above Sego sandstone; collected by C. E. Erdmann, 1927. It contains the following species of mollusks:

Unio pseudendlichi Yen
Unio mesaverdensis Yen
Unio paraholmesianus Yen
Unio sp. undet.
Campeloma sp. undet.

USGS Mesozoic loc. 4195 and 4197, in sec. 23, T. 11 S., R. 98 W., about 4 miles SE of Palisade, Colorado; 150 feet above the upper coal bed; collected by W. T. Lee, 1907. It contains the following species of mollusks:

Sphaerium cf. *S. planum* Meek and Hayden
Corbula subtrigonalis Meek and Hayden
Tulotomops laevibasalis Yen
Campeloma sp. undet.
Mesolanistes reesidei (Stanton)
Amnicola sp. undet.
Physa sp. undet.

USGS Mesozoic loc. 4184—about 4 miles SE of Palisade, Colorado; 300 feet above upper coal bed of Grand Mesa coalfield; collected by T. W. Stanton, 1907. It contains the following species of mollusks:

Unio cf. *U. brimhallensis* Stanton
Unio amarillensis Stanton
Tulotomops sp. undet.
Campeloma cf. *C. amarillensis* Stanton
Lioplacodes sp. undet.
Amnicola sp. undet.

5. Hunter Canyon formation:

USGS Mesozoic loc. 4188, in sec. 1, T. 11 S., R. 98 W., about 3 miles east of Palisade, Grand River, Colorado; collected by W. T. Lee, 1907. It contains the following species of mollusks:

Sphaerium sp. undet.
Valvata sp. undet.
Mesolanistes cf. *M. reesidei* (Stanton)
Campeloma sp. undet.
Goniobasis cf. *G. eulimoides* (Meek)
Goniobasis sp. undet.
Physa sp. undet.

USGS Mesozoic loc. 4191, in sec. 26, T. 10 S., R. 98 W., head of Gulch, 1 mile east of Grand River, 2 miles below mouth of Plateau Creek, Colorado; collected by W. T. Lee, 1907. It contains the following species of mollusks:

Unio cf. *U. priscus* White
Tulotomops sp. undet.
Campeloma cf. *C. amarillensis* Stanton

USGS Mesozoic loc. 4214, in sec. 20, T. 13 S., R. 95 W., Oak Creek, near Delta, Colorado; "about 700 feet above

the base of Laramie:" collected by W. T. Lee, 1907. It contains the following species of mollusks:

Unio sp. undet.
Sphaerium sp. undet.
Tulotomops laevibasalis Yen
Campeloma sp. undet.
Lioplacodes sp. undet.
Goniobasis? subtortusa (Meek and Hayden)
Amnicola sp. undet.

USGS Mesozoic loc. 4486, in sec. 20, T. 13 S., R. 95 W., near Hotchkiss, Colorado; "995 feet above base of coal-bearing beds, and 500 feet below Wasatch or Ruby shales"; collected by W. T. Lee, 1907. It contains the following species of mollusks:

Unio cf. *U. priscus* Meek and Hayden
Unio cf. *U. amarillensis* Stanton
Unio cf. *U. brimhallensis* Stanton
Teredina sp. undet.
Tulotomops sp. undet.
Campeloma sp. undet.
Lioplacodes sp. undet.

SYSTEMATIC DESCRIPTIONS

PELECYPODA

Family UNIONIDAE

Unio cf. U. brimhallensis Stanton

Plate 18, figure 12

Unio brimhallensis Stanton, U. S. Geol. Survey Prof. Paper 98–R, pl. 81, fig. 7; pl. 82, fig. 1, 1916.

Several specimens in the collection bear resemblance in general shape to Stanton's species, which was originally described from the Fruitland formation, but they are much smaller. They probably represent a distinct form, possibly related to the Fruitland species.

Figured specimen: USNM 108511.

Unio cf. U. brachyopisthus White 1876

Plate 19, figure 32

Unio brachyopisthus Stanton, U. S. Geol. Survey Prof. Paper 98–R, p. 314, pl. 81, figs. 2, 3, 1916.

A single poorly preserved specimen resembles the species as illustrated by Stanton from the Fruitland formation, although the latter specimen is ovately rhomboid and it is somewhat larger.

Figured specimen: USNM 108512.

Unio paraholmesianus, n. sp.

Plate 18, figure 9; plate 19, figure 31

Shell subelliptical to subovate, medium thick in substance, and having moderately convex valves. Beaks situated close to the anterior end and bear two broad radiating folds on the surface, which produce two prominent ridges extending anteriorly and posteriorly; V-shaped sculpture is subregularly formed along both ridges over about two-thirds or more of the shell surface. The hinge features are not preserved in the specimens available.

Measurements (in millimeters): length 48.0; height 30.0 (a young but fairly well preserved specimen).

This species is readily recognized by its characteristic sculpture.

Holotype: USNM 108539; paratypes: USNM 108540 (figured), 108541.
Type locality: USGS Mesozoic loc. 13790.

Unio pseudendlichi, n. sp.

Plate 18, figures 13, 14

Shell broadly subovate in outline, large and of thick substance. Valves moderately convex and bear distinct concentric lines of growth, conspicuous but irregular bandings produced by the slightly convex and sharp-edged basal margin at various resting stages. Hinge features not definitely known except for the presence of a prominent pseudocardinal and rather posteriorly placed laterals.

Measurements (in millimeters): length 127.0, height 76.0.

The size of this species approaches that of *Unio endlichi* White, which was described from the Lance formation in Wyoming, but the species from the Mesaverde seems to have a more prominent pseudocardinal and smaller posterior laterals.

Holotype: USNM 108538.
Type locality: USGS Mesozoic loc. 13790.

Unio mesaverdensis, n. sp.

Plate 18, figures 10, 11; plate 19, figures 33, 34

Shell ovately subtriangular in outline, of thick substance and medium size. Valves strongly convex and bearing simple growth lines. Pseudocardinal on left valve larger than that on right, depth of corresponding sockets likewise adjusted; single posterior lateral on the left valve is well developed to fit deep cavity bound by two laterals on the right. Anterior muscular impression much deeper than posterior one. Anterior protractor scar deep but small.

Measurements (in millimeters): Length 68.2, height 49.5, convexity 38.0.
Holotype: USNM 108542.
Type locality: USGS Mesozoic loc. 13790.

Unio amarillensis Stanton

Unio amarillensis Stanton, U. S. Geol. Survey Prof. Paper 98–P, pl. 80, fig. 89, 1916.

This species is characterized by its small size and by having its V-shaped sculpture confined to the umbonal

area and the surface of its posterior slope. Its hinge structure is not known.

Several specimens in the present collection, which were found in the Farrer and Mount Garfield formations, seem to belong to this species, which was originally described from the Fruitland formation of New Mexico.

Unio cf. U. priscus Meek and Hayden

Plate 19, figure 30

Unio priscus Meek and Hayden, Acad. Nat. Sci. Philadelphia Proc., v. 8, p. 117, 1856.

Several specimens of rather thin shell substance and light hinge structure, although they are incompletely shown, seem to be comparable with this common Upper Cretaceous species. The available valves, which are either much distorted or in the form of internal molds, do not permit definite identification to species.

Figured specimen: USNM 108578.

Family SPHAERIIDAE

Sphaerium cf. S. planum Meek and Hayden

Sphaerium planum Meek and Hayden, Acad. Nat. Sci. Philadelphia Proc., v. 12, p. 175, 1860.

The size and general outline of several valves, represented by imbedded molds, show resemblance to this species, which has been recorded from the Lance and the Judith River formations in Wyoming and Montana. The available specimens are not identifiable definitely to species.

Sphaerium sp. undet.

Another form of *Sphaerium*, slightly larger in size and somewhat more triangular in outline than *S. ? planum* occurs in the Price River formation. Only two internal molds of separate valves are available, and they cannot be identified to species.

Family CORBULIDAE

Corbula subtrigonalis Meek and Hayden

Plate 19, figure 29

Corbula subtrigonalis Meek and Hayden, Acad. Nat. Sci. Philadelphia Proc., v. 8, p. 279, 1856.

A large number of specimens in one collection from the Mt. Garfield formation agree with this species which was originally described from Upper Cretaceous deposits in Wyoming and Montana.

Figured specimen: USNM 108536.

Family PHOLADIDAE

Teredina sp. undet.

Plate 19, figures 9, 10

The specimens in the present collection consist of tubes only, so that their identity cannot be established definitely. However, there is little doubt that such tubes indicate the presence of *Teredina*-like species.

Figured specimen: USNM 108581.

GASTROPODA

Family VALVATIDAE

Valvata sp. undet.

A single specimen imbedded in the matrix represents a species of *Valvata* from the Hunter Canyon formation. The specimen consists of a little more than three tubular whorls, and has a slightly elevated spire. The features of aperture and umbilicus are not shown, therefore its specific identification cannot be established.

Family VIVIPARIDAE

Tulotomops laevibasalis, n. sp.

Plate 19, figures 24–26

Tulotoma thompsoni Stanton, U. S. Geol. Survey Prof. Paper 98–R, p. 318, pl. 83, figs. 9–11, 1916 (not White 1876).

Shell of trochoid outline, imperforate, with conical spire and descending body whorl. Height of the spire slightly greater than that of body whorl. Whorls increasing rapidly in size, later ones coiling below periphery. Whorl surface slightly convex, initiated with an almost mucronate apex and a roundly convex apical whorl. Faint angulation on shoulder of the third whorl, developing into a strong and heavy carina on shoulder of later whorls. A second equally heavy carina on body whorl marks edge of basal surface. Occasional tubercles on these spiral carinae of the last two whorls, but they never became very conspicuous. The basal surface is nearly flat or slightly convex and bears no spiral carina. Aperture subovate in outline; outer lip biangulated, the angles being formed by the two strong carinae on the body whorl; parietal wall thickened and well defined, and columellar margin slightly arched.

Measurements (in millimeters): Altitude 36.5, width 23.0; height of aperture, 15.5, width 14.0; 7 whorls.

This species is readily distinguished from *T. thompsoni* (White) by having only two instead of three, and lower spiral carinae with a few tubercles on the surface, and also by the absence of a ridge on the basal surface. These features are persistent in the Mesaverde specimens.

Holotype: USNM 108533; figured paratypes, USNM 108534; paratypes USNM 108535.

Type locality: USGS Mesozoic loc. 13674.

Tulotomops sp. undet.

Several lots of specimens resemble *T. laevibasalis* in general outline, but they differ by their size and obscure sculptures. None of them is well enough pre-

served for definite identification to species and some of them may belong to *T. laevibasalis*.

Campeloma amarillensis Stanton

Plate 19, figures 22, 23

Campeloma amarillensis Stanton, U. S. Geol. Survey Prof. Paper 98–R, p. 318, pl. 83, figs. 5–6, 1916.

This species is probably common in the Mesaverde group, although it was originally described from the Fruitland formation in New Mexico. Some specimens, even though imperfectly preserved, show broader body whorl and higher spire. Such differences are within the range of variation of the viviparous species of gastropods. Specimens of immature stages appear generally to have a subtriangular outline.

Figured specimen: USNM 108515.

Campeloma sp. undet.

Plate 19, figures 11, 12

Some of the specimens consist of internal molds that are somewhat distorted. Some resemble *Campeloma amarillensis* in outline and size. These specimens can be recognized only as members of the genus.

Figured specimens: USNM 108544.

Lioplacodes sp. undet.

Plate 19, figures 13–17, 20, 21

Several lots of specimens resemble in outline and size some species of *Lioplacodes*, which have been recorded from Early Cretaceous to Early Tertiary deposits in the western interior. However, these specimens consist of internal molds and imperfect shells, and so cannot be identified to species.

A single specimen collected from the Hunter Canyon formation (USGS Mesozic loc. 4486) resembles *Lioplacodes veternus* Meek in outline, but is larger. Other specimens in the collection may represent other species of the genus.

Figured specimens: USNM 108584.

Family AMPULLARIIDAE

Mesolanistes reesidei (Stanton)

Plate 19, figures 27, 28

Physa reesidei Stanton, U. S. Geol. Survey Prof. Paper 98–R. p. 319, pl. 83, figs. 12–13, 1916.

A single specimen seems to belong to this species, which was originally described from the Fruitland formation.

Since I described *Mesolanistes* in 1945, more specimens of this sinistral group of gastropods have come to my attention. The specimens are all distorted, and perfect outline of the shell has so far not been recorded, although a number of important shell features have been described.

Figured specimen: USNM 108562.

Family AMNICOLIDAE

Amnicola sp. undet.

Plate 17, figures 45–47; plate 19, figures 1–4, 7

Several lots of specimens, most containing a single specimen, may belong in this genus, and a few of them are illustrated on plate 19.

A single specimen collected from the Mount Garfield formation (USGS Mesozoic loc. 4184) has a planorbitoid initial whorl similar to that of *Probythinella* Thiele and *Brannerillus* Hannibal. It is illustrated by figures 1 and 2 of plate 19. This specimen represents the earliest record of an amnicolid bearing a planorboid summit. It is a poorly preserved specimen, and more perfect examples may reveal it to be a distinct genus.

Figured specimen: USNM 108516.

Family PLEUROCERITIDAE

Goniobasis? subtortuosa (Meek and Hayden)

Plate 19, figures 5, 6

Melania subtortuosa Meek and Hayden, Acad. Nat. Sci. Philadelphia Proc., v. 9, p. 136; *Goniobasis? subtortuosa* Stanton, U. S. Geol. Survey Prof. Paper 98–R, p. 319, 1857, pl. 83, figs. 7, 8, 1916.

This species is characterized by its conoid screw-shaped outline, with a strong carina along the periphery. Three specimens of immature stages collected from the Hunter Canyon formation seem to belong in it. The species was originally described from the Judith River formation in Montana, but it is also recorded from the Fruitland formation in New Mexico.

The generic assignment here is considered uncertain and the species is probably not a *Goniobasis*, but the material available does not permit more exact identification.

Figured specimen: USNM 108576.

Goniobasis cf. G. eulimoides (Meek)

Plate 19, figure 8

A single specimen collected from the Hunter Canyon formation resembles *G. eulimoides* (Meek) in general outline and size. The species was originally described as a species of *Hydrobia* and from the Clear Fork of Powder River in Montana. Some of the specimens in the type lot of *G. eulimoides* show distinctly a curvature of the outer lip margin, which feature alone indicates that this species does not belong to *Hydrobia*, but more likely is a species of *Goniobasis*.

Figured specimen: USNM 108564.

Goniobasis sp. undet.

A single imperfect specimen seems to represent another species of *Goniobasis* in the Hunter Canyon formation. It is smaller than most species of the genus, and its whorl surface appears to be smooth rather than sculptured.

Family PHYSIDAE

Physa sp. undet.

Plate 19, figures 18, 19

Three specimens, one each from the Neslen, the Mount Garfield, and the Hunter Canyon formations, represent species of Physa in the present collection. The general outline and size of the shell indicate that they may be three different species, but none of them is well enough preserved to show specific features. The specimen illustrated was collected from the Mount Garfield formation.

Figured specimen: USNM 108559.

REFERENCES CITED

Meek, F. B., and Hayden, F. V., 1856, Description of new species of Acephala and Gastropoda from the Teritary formations of Nebraska Territory: Acad. Nat. Sci. Phila. Proc., v. 8, p. 111–126.

——— 1857, Description of new species and genera of fossils: Acad. Nat. Sci. Phila. Proc., v. 9, p. 117–148.

——— 1860, Description of new organic remains from the Tertiary, Cretaceous, and Jurassic rocks of Nebraska: Acad. Nat. Sci. Phila. Proc., v. 12, p. 175–185.

Stanton, T. W., 1916, Nonmarine Cretaceous invertebrates of the San Juan Basin: U. S. Geol. Survey Prof. Paper 98–R, 309–319, 5 pls.

Stanton, T. W., and Hatcher, J. B., 1905, Geology and paleontology of the Judith River beds: U. S. Geol. Survey Bull. 257.

White, C. A., 1876, Invertebrate paleontology, *in* J. W. Powell Report on geology of eastern portion of Uinta Mountains, p. 74–135.

Yen, T. C., 1945, Notes on Cretaceous fresh-water gastropods of southwestern Utah: Acad. Nat. Sci. Phila. Notulae Naturae, no. 160, p. 1–2, 1 pl.

INDEX

[Italic numbers indicate descriptions]

A

Page

Acknowledgements ... 45, 59
altisptrale, Parateinostoma ... 46, 47, 48, *53*, pl. 17
amarillensis, Campeloma ... 59, 60, *63*, pl. 19
Unio ... 59, 60, *61*
Amnicola sp ... 60, 61, *63*, pls. 17, 19
Anisopsis minutis ... 46, 48, 49, *57*
attentuata, Lioplacodes stachei ... 46, 47, 48, *52*, pl. 17
Auricula neumayri ... 46, 49, *56*

B

Bear River formation, molluscan fauna ... 45–46, 47, 48, 49, 50
bearensis, Mesocochliopa ... 46, 47, 49, *52*, pl. 17
bellipicatus, Unio ... 46, 47, *58*, pl. 17
Brachydontes ... 47
peali ... 46, *57*
brachyopisthus, Unio ... 60, *61*, pl. 19
Brannerillus ... 63
brimhallensis, Unio ... 60, *61*, pl. 18

C

Campeloma amarillensis ... 59, 60, *63*, pl. 19
cokevillensis ... 46, 48, 49, *51*, pl. 17
macrospira ... 46, 47, 49, *51*, 52
rubeyi ... 46, 49, *51*, pl. 17
sp ... 48, 54, 60, 61, *63*, pl. 19
Charydrobia sp ... 52
chrysalis, Pachychiloides ... 46, *55*, pl. 17
chrysalloidea, Pachychiloides ... 46, 49, *55*, pl. 17
Clark, F. R., and G. W., collections by ... 59
clarki, Melampoides ... 46, 47, 48, *56*, pl. 17
cleburni, Pachychiloides ... 46, 55, pl. 17
Cokeville area, molluscan fauna ... 49
rocks ... 49–50
cokevillensis, Campeloma ... 46, 48, 49, *51*, pl. 17
Helicina ... 46, 48, 49, *50*, pl. 18
Mesocochliopa ... 46, 48, 49, 53, pl. 17
Pachychiloides ... 46, 49, *55*, pl. 18
Physa ... 46, 48, 49, *56*, pl. 17
Pyrgulifera humerosa ... 46, 48, 49, *54*, pl. 18
Viviparus ... 46, 48, 49, *51*, pl. 18
contractum, Parateinostoma ... 46, 48, 49, *53*
convexa, Pseudarinia ... 51
convexum, Parateinostoma ... 46, 48, 49, *53*
cretacea, Helicina ... 46, 47, 49, *50*, pl. 17
Mesocochliopa ... 53
Corbicula ... 47
durkeei ... 46, *58*, pl. 17
Corbula ... 47
engelmanni ... 56, 47, *58*, pl. 17
pyriformis ... 46, *57*, pl. 17
subtrigonalis ... 60, *62*, pl. 19
sulcata ... 58
zurcheri ... 58
sp ... 57, 58
couesi, Viviparus ... 46, 47, 49, *51*, pl. 17
cylindrica, Parhydrobia ... 46, 48, 49, *53*

D

durkeei, Corbicula ... 46, *58*, pl.17

E

Ecology ... 46–48
elongata, Pyrgulifera stantoni ... 46, 48, 49, *54*, pls. 17, 18
endlichi, Lioplacodes ... 46, *52*
Unio ... 61
engelmanni, Corbula ... 46, 47, *58*, pl. 17
Erdmann, C. E., collections by ... 60
eulimoides, Goniobasis ... 60, *65*, pl. 19
evanstonensis, Helicina ... 50

F

Ferrer formation, molluscan fauna ... 60
Fisher, D. J., collections by ... 60

G

Geltena sp ... pl. 17
Geography ... 46–48
globosa, Physa ... 46, 48, 49, *56*, pl. 17
Goniobasis eulimoides ... 60, *63*, pl. 19
leedsensis ... 46, 48, 49, *54*
subtortusa ... 59, 61, *63*, pl. 19
sp ... 60, *64*
Gyraulus sp ... 46, 47, 52, 54, *57*

H

haldemanni, Zaptychius ... 46, 48, *55*, pl. 17
hayden, Ostrea ... 46, *57*
Helicina cokevillensis ... 46, 48, 49, *50*, pl. 18
cretacea ... 46, 47, 49, *50*, pl. 17
evanstonensis ... 50
humerosa, Pyrgulifera ... 46, 49, *54*, pl. 17
humerosa cokevillensis, Pyrgulifera ... 46, 48, 49, *54*, pl. 18
Hunter Canyon formation, molluscan fauna ... 60–61
Hydrobia ... 52, 63

I

inflatus, Lioplacodes stachei ... 46, 48, 49, 52, pl. 17
isoclina, Tornatellina ... 46, 49, *53*

L

laevibasalis, Tulotomops ... 60, 61, *62*, 63, pl. 19
latentis, Parateinostoma ... 46, 48, 49, *53*
Lee, W. T., collections by ... 60, 61
Leeds Creek area, molluscan fauna ... 49
leedsensis, Goniobasis ... 46, 48, 49, *54*
Leggette, R. M., collections by ... 60
Lioplacodes ... 52, 57
endlichi ... 46, *52*
stachei ... 46, 47, 48, 49, *52*, pl. 17
attentuata ... 46, 47, 48, *52*, pl. 17
inflatus ... 46, 48, 49, *52*, pl. 17
veternus ... 63
sp ... 48, 54, 59, 61, *63*, pl. 19
Lymnaea nitidula ... 46, 49, *57*
sp ... 57

M

macilenta, Pachychiloides ... 46, 47, 48, *55*, pl. 17
macilenta minuta, Pachychiloides ... 46, 48, 49
macrospira, Campeloma ... 46, 47, 49, *51*, 52
meeki, Rhytophorus ... 46, 48, 49, *56*
Melampoides clarki ... 46, 47, 48, *56*, pl. 17
sp ... 56
Melanoides sp ... 54
Mesaverde group, molluscana fauna ... 59–61

Page

mesaverdensis, Unio ... 60, *61*, pls. 18, 19
Mesocochliopa ... 53
bearensis ... 46, 47, 49, *52*, pl. 17
cokevillensis ... 46, 48, 49, *53*, pl. 17
cretacea ... 53
sp ... 54
Mesoglypterpes sagensis ... pl. 17
sp ... 47, pl. 17
Mesolanistes ... 63
reesidei ... 60, *63*, pl. 19
Mesoneritina naticiformis ... 46, 47, 48, *50*, pl. 17
stantoni ... 46, 47, 48, *50*, pl. 17
sp ... 48, 54
minuta, Pachychiloides macilenta ... 46, 48, 49
minutis, Anisopsis ... 46, 48, 49, *57*
Mount Garfield formation, molluscan fauna ... 60

N

naticiformis, Mesoneritina ... 46, 47, 48, *50*, pl. 17
Nelsen formation, molluscan fauna ... 60
Neritina ... 50
neumayri, "Auricula" ... 46, 49, *56*
nitidula, Lymnaea ... 46, 49, *57*

O

occulta, Parateinostoma ... 46, *55*
Ostrea haydeni ... 46, *57*

P

Pachychiloides chrysalis ... 46, *55*, pl. 17
chrysalloidea ... 46, 49, *55*, pl. 17
cleburni ... 46, *55*, pl. 17
cokevillensis ... 46, 49, *55*, pl. 18
macilenta ... 46, 47, 48, *55*, pl. 17
minuta ... 46, 48, 49
turricula ... 46, 49, *55*
spp ... 49
Paraholmesianus Unio ... 60, *61*, pls. 18, 19
Parateinostoma ... 48
altispirale ... 46, 47, 48, *55*, pl. 17
contractum ... 46, 48, 49, *53*
convexum ... 46, 48, 49, *53*
latentis ... 46, 48, 49, *53*
occulta ... 46, *53*
Parhydrobia cylindrica ... 46, 48, 49, *55*
peali, Brachydontes ... 46, *57*
Physa ... 56
cokevillensis ... 46, 48, 49, *56*, pl. 17
globosa ... 46, 48, 49, *56*, pl. 17
usitata ... 46, 47, 48, *56*
sp. A ... 48
sp. B ... 48
sp ... 48, 54, 60, *64*, pl. 19
planum, Sphaerium ... 59, *62*
praecursoris. Valvata ... 46, 47, 48, *52*, 57
Price River formation, molluscan fauna ... 59
priscus, Rhytophorus ... 46, 47, 49, *56*
Unio ... 59, 61, *62*, pl. 19
Probythinella ... 63
Pseudarinia convexa ... 51
uniplica ... 46, 47, *50*, pl. 17
pseudendlichi, Unio ... 60, *61*, pl. 18
Pyrgulifera ... 47
humerosa ... 46, 49, *54*, pl. 17
cokevillensis ... 46, 48, 49, *54*, pl. 18
stantoni ... 46, 49, *54*, pl. 17
elongata ... 46, 48, 49, *54*, pl. 17, 18
sp ... 48
pyriformis, Corbula ... 46, *57*, pl. 17

R

Reeside, J. B., Jr., collections by ... 59
reesidei, Mesolanistes ... 60, *63*, pl. 19

Page

Rhytophorus meeki ... 46, 48, 49, *56*
priscus ... 46, 47, 49, *56*
sp ... 56
Rubey, W. W., cited ... 45–46
rubeyi, Campeloma ... 46, 49, *51*, pl. 17

S

sagensis, Mesoglypterpes ... pl. 17
Sphaerium planum ... 59, *62*
sp ... 60, 61, *62*
Spieker, E. M., collections by ... 59
stachei, Lioplacodes ... 46, 47, 48, 49, *52*, pl. 17
stachei attenuata, Lioplacodes ... 46, 47, 48, *52*, pl. 17
stachei inflatus, Lioplacodes ... 46, 48, 49, *52*, pl. 17
Stanton, T. W., collections by ... 60
stantoni, Mesoneritina ... 46, 47, 48, *50*, pl. 17
Pyrgulifera ... 46, 49, *54*, pl. 17
stantoni elongata, Pyrgulifera ... 46, 48, 49, *54*, pls. 17, 18
Stratigraphic distribution of molluscan faunas, western Wyoming ... 46
subtortusa, Goniobasis ... 59, 61, *63*, pl. 19
subtrigonalis, Corbula ... 60, *62*, pl. 19
sulcata, Corbula ... 58

T

Teredina sp ... 61, *62*, pl. 19
Tornatellina ... 53
isoclina ... 46, 49, *53*
Trochispira ... *53*
wyomingensis ... 46, 47, 49, *53*, pl. 17
Tulotomops laevibasalis ... 60, 61, *62*, 63, pl. 19
sp ... 59, 60, 61, *62*
turricula, Pachychiloides ... 46, 49, *55*

U

Unio amarillensis ... 59, 60, *61*
bellipicatus ... 46, 47, *58*, pl. 17
brachyopisthus ... 60, *61*, pl. 19
brimhallensis ... 60, *61*, pl. 18,
endlichi ... 61
mesaverdensis ... 60, *61*, pls. 18, 19
paraholmesianus ... 60, *61*, pls. 18, 19
priscus ... 59, 61, *62*, pl. 19
pseudendlichi ... 60, *61*, pl. 18
vetustus ... 46, 48, *58*, pl. 17
sp ... 59, 60, 61
uniplica, Pseudarinia ... 46, 47, *50*, pl. 17
Unit C, molluscan fauna ... 45–46
Unit E, molluscan fauna ... 46
Ursirivus sp ... 57
usitata, Physa ... 46, 47, 48, *56*

V

Valvata ... 57
praecursoris ... 46, 47, 48, *52*, 57
sp ... 54, 59, *62*
vetermus, Lioplacodes ... 63
vetustus, Unio ... 46, 48, *58*, pl. 17
Viriparus cokevillensis ... 46, 48, 49, *51*, pl. 18
couesi ... 46, 47, 49, *51*, pl. 17
sp ... 48, 54, *59*

W

White, C. A., cited ... 45
wyomingensis, Trochispira ... 46, 47, 49, *53*, pl. 17

Y

Yen, T. C., cited ... 46

Z

Zaptychius haldemanni ... 46, 48, *55*, pl. 17
zurcheri, Corbula ... 57

PLATES 17–19

PLATE 17

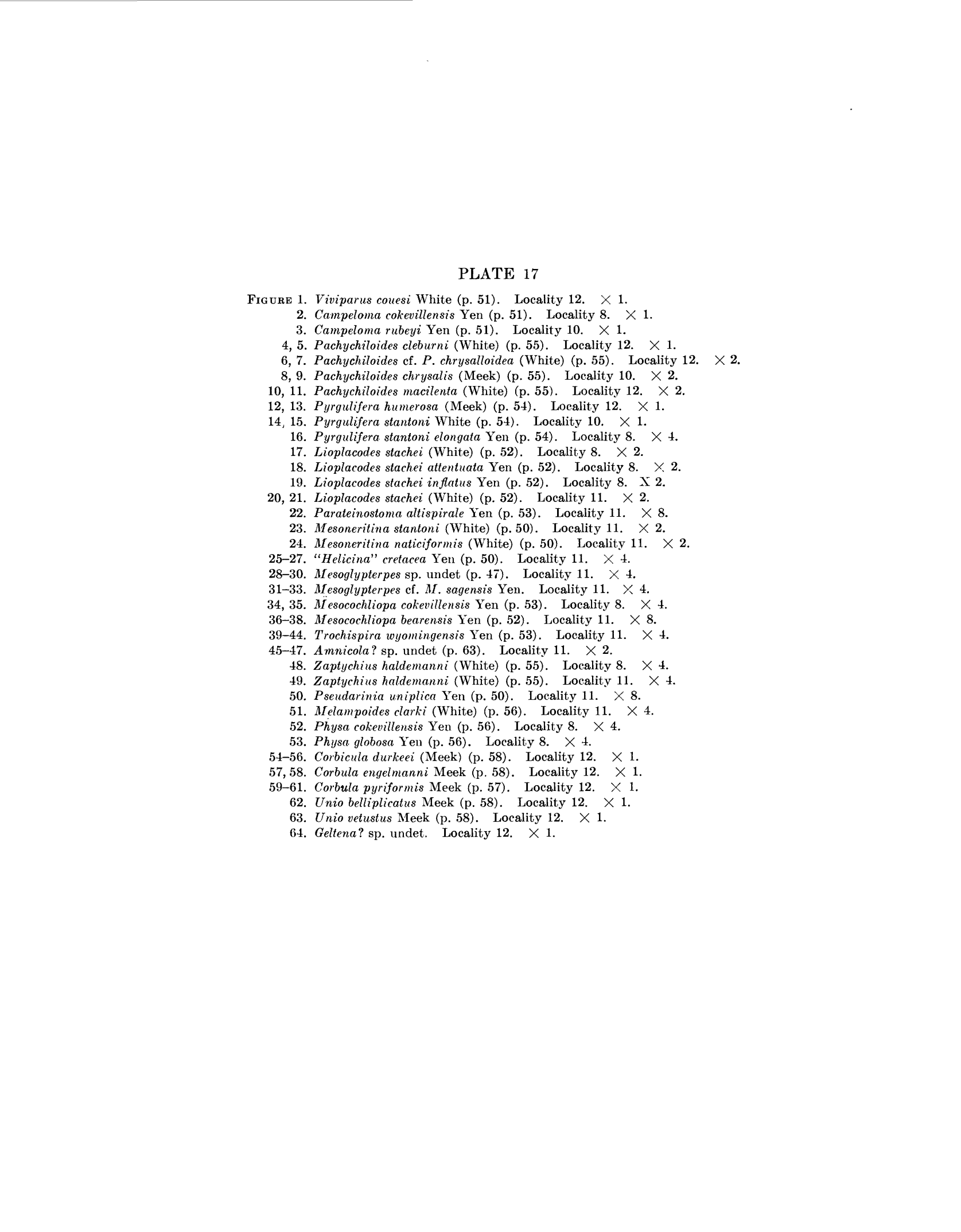
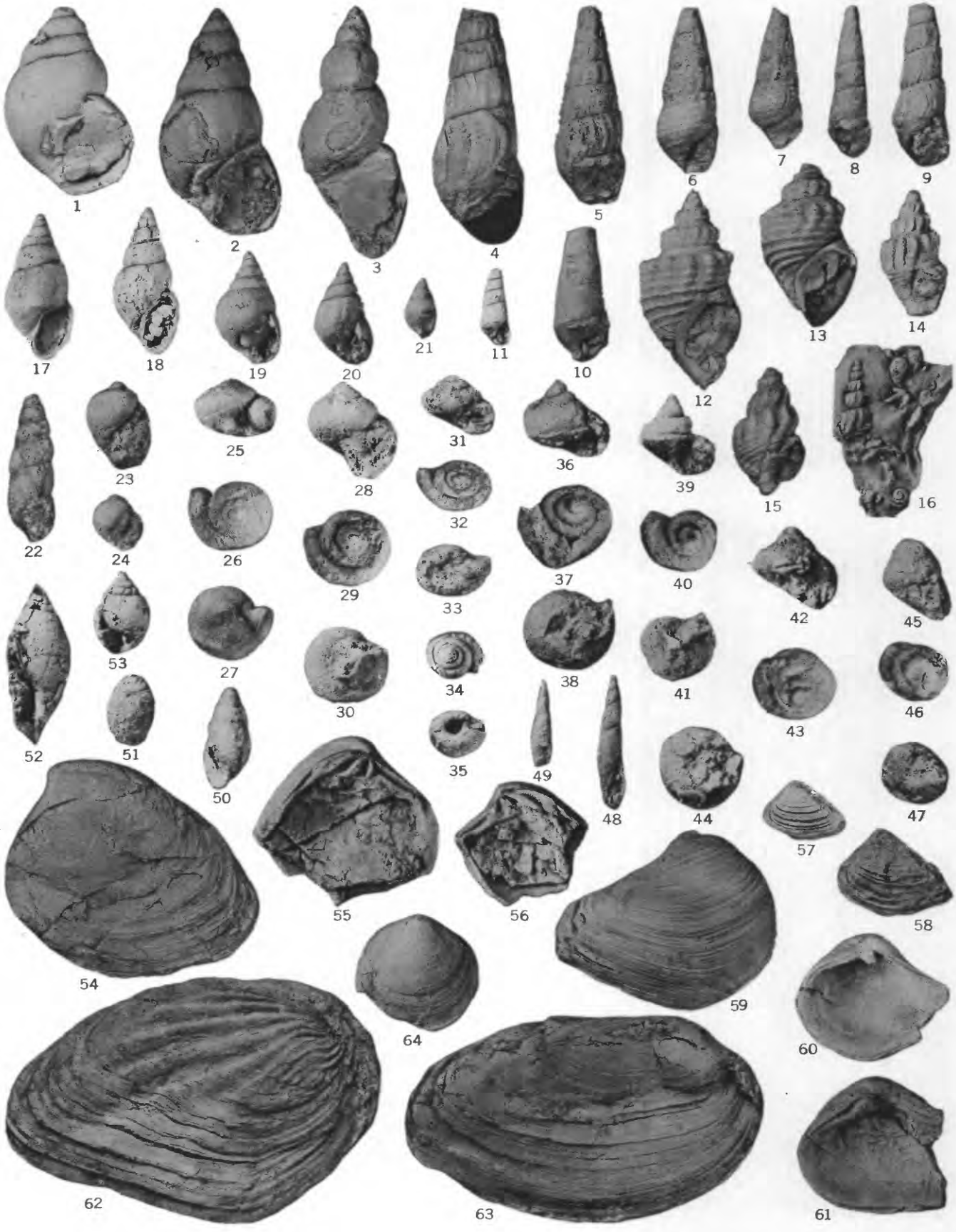
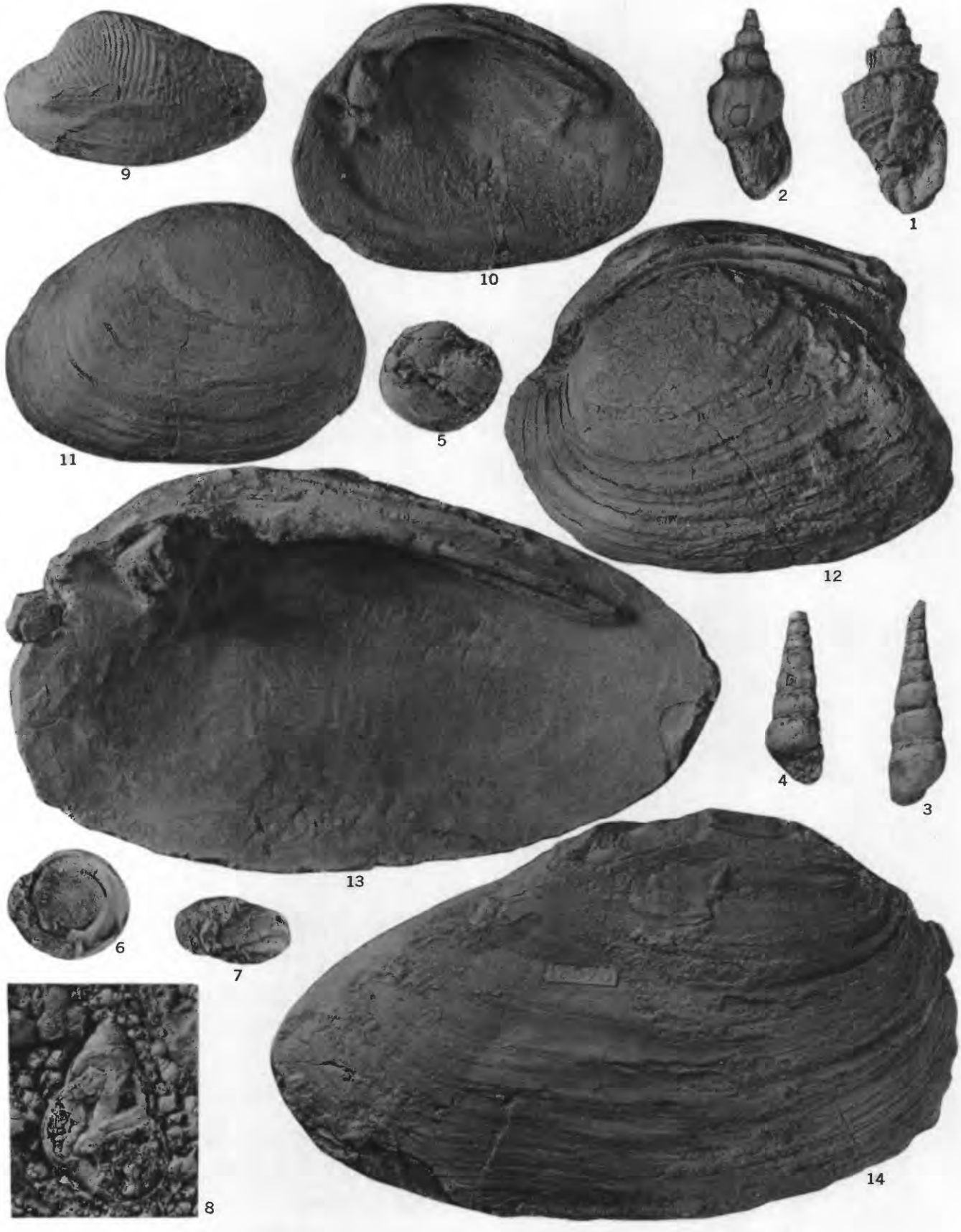


FIGURE 1. *Viviparus couesi* White (p. 51). Locality 12. × 1.
2. *Campeloma cokevillensis* Yen (p. 51). Locality 8. × 1.
3. *Campeloma rubeyi* Yen (p. 51). Locality 10. × 1.
4, 5. *Pachychiloides cleburni* (White) (p. 55). Locality 12. × 1.
6, 7. *Pachychiloides* cf. *P. chrysalloidea* (White) (p. 55). Locality 12. × 2.
8, 9. *Pachychiloides chrysalis* (Meek) (p. 55). Locality 10. × 2.
10, 11. *Pachychiloides macilenta* (White) (p. 55). Locality 12. × 2.
12, 13. *Pyrgulifera humerosa* (Meek) (p. 54). Locality 12. × 1.
14, 15. *Pyrgulifera stantoni* White (p. 54). Locality 10. × 1.
16. *Pyrgulifera stantoni elongata* Yen (p. 54). Locality 8. × 4.
17. *Lioplacodes stachei* (White) (p. 52). Locality 8. × 2.
18. *Lioplacodes stachei attentuata* Yen (p. 52). Locality 8. × 2.
19. *Lioplacodes stachei inflatus* Yen (p. 52). Locality 8. × 2.
20, 21. *Lioplacodes stachei* (White) (p. 52). Locality 11. × 2.
22. *Parateinostoma altispirale* Yen (p. 53). Locality 11. × 8.
23. *Mesoneritina stantoni* (White) (p. 50). Locality 11. × 2.
24. *Mesoneritina naticiformis* (White) (p. 50). Locality 11. × 2.
25–27. *"Helicina" cretacea* Yen (p. 50). Locality 11. × 4.
28–30. *Mesoglypterpes* sp. undet (p. 47). Locality 11. × 4.
31–33. *Mesoglypterpes* cf. *M. sagensis* Yen. Locality 11. × 4.
34, 35. *Mesocochliopa cokevillensis* Yen (p. 53). Locality 8. × 4.
36–38. *Mesocochliopa bearensis* Yen (p. 52). Locality 11. × 8.
39–44. *Trochispira wyomingensis* Yen (p. 53). Locality 11. × 4.
45–47. *Amnicola?* sp. undet (p. 63). Locality 11. × 2.
48. *Zaptychius haldemanni* (White) (p. 55). Locality 8. × 4.
49. *Zaptychius haldemanni* (White) (p. 55). Locality 11. × 4.
50. *Pseudarinia uniplica* Yen (p. 50). Locality 11. × 8.
51. *Melampoides clarki* (White) (p. 56). Locality 11. × 4.
52. *Physa cokevillensis* Yen (p. 56). Locality 8. × 4.
53. *Physa globosa* Yen (p. 56). Locality 8. × 4.
54–56. *Corbicula durkeei* (Meek) (p. 58). Locality 12. × 1.
57, 58. *Corbula engelmanni* Meek (p. 58). Locality 12. × 1.
59–61. *Corbula pyriformis* Meek (p. 57). Locality 12. × 1.
62. *Unio belliplicatus* Meek (p. 58). Locality 12. × 1.
63. *Unio vetustus* Meek (p. 58). Locality 12. × 1.
64. *Geltena?* sp. undet. Locality 12. × 1.



UPPER CRETACEOUS NONMARINE MOLLUSKS FROM WYOMING



UPPER CRETACEOUS NONMARINE MOLLUSKS FROM UTAH AND COLORADO

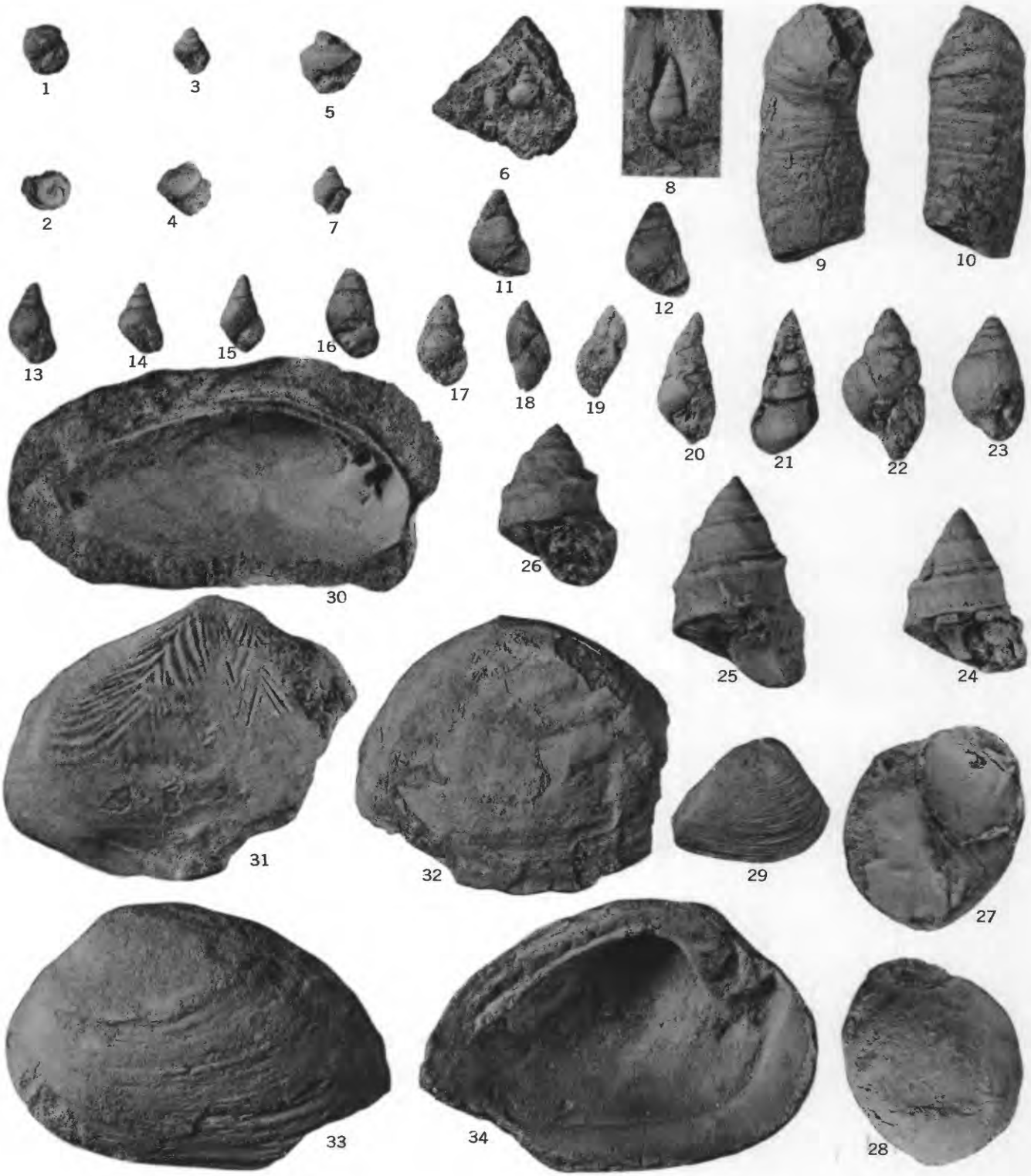
PLATE 18

FIGURE 1. *Pyrgulifera humerosa cokevillensis* Yen (p. 54). Locality 10. × 2.
2. *Pyrgulifera stantoni elongata* Yen (p. 54). Locality 6. × 2.
3, 4. *Pachychiloides cokevillensis* Yen (p. 55). Locality 8. × 1.
5–7. *"Helicina" cokevillensis* Yen (p. 50). Locality 8. × 1.
8. *Viviparus cokevillensis* Yen (p. 51). Locality 8. × 1.
9. *Unio paraholmesianus* Yen (p. 61). USGS Mesozoic locality 13970. × 1.
10, 11. *Unio mesaverdensis* Yen (p. 61). USGS Mesozoic locality 13969. × 1.
12. *Unio* cf. *U. brimhallensis* Stanton (p. 61). USGS Mesozoic locality 13682. × 1.
13, 14. *Unio pseudendlichi* Yen (p. 61). USGS Mesozoic locality 13970. × 1.

PLATE 19

FIGURES 1, 2. *Amnicola* sp. undet (p. 63). USGS Mesozoic locality 4184. × 2.
3. *Amnicola* sp. undet (p. 63). USGS Mesozoic locality 4214. × 2.
4. *Amnicola* sp. undet (p. 63). USGS Mesozoic locality 4195. × 2.
5, 6. *Goniobasis? subtortuosa* Meek and Hayden (p. 63). USGS Mesozoic locality 4214. × 2.
7. *Amnicola* sp. undet (p. 63). USGS Mesozoic locality 13682. × 2.
8. *Goniobasis* cf. *G. eulomoides* (Meek) (p. 63). USGS Mesozoic locality 4188. × 2.
9, 10. *Teredina* sp. undet (p. 62). USGS Mesozoic locality 4486. × 1.
11, 12. *Campeloma* sp. undet (p. 63). USGS Mesozoic locality 13969. × 1.
13–15. *Lioplacodes* sp. undet (p. 63). USGS Mesozoic locality 4214. × 1.
16, 17. *Lioplacodes* sp. undet (p. 63). USGS Mesozoic locality 4184. × 1.
18, 19. *Physa* sp. undet (p. 64). USGS Mesozoic locality 4195. × 1.
20, 21. *Lioplacodes* sp. undet (p. 63). USGS Mesozoic locality 4486. × 1.
22. *Campeloma amarillensis* Stanton (p. 63). USGS Mesozoic locality 4184. × 1.
23. *Campeloma amarillensis* Stanton (p. 63). USGS Mesozoic locality 13682. × 1.
24–26. *Tulotomops laevibasalis* Yen (p. 62). USGS Mesozoic locality 13764. × 1.
27, 28. *Mesolanites reesidei* (Stanton) (p. 63). USGS Mesozoic locality 4195. × 1.
29. *Corbula subtrigonalis* Meek and Hayden (p. 62). USGS Mesozoic locality 13764. × 1.
30. *Unio* cf. *U. priscus* Meek and Hayden (p. 62). USGS Mesozoic locality 4486. × 1.
31. *Unio paraholmesianus* Yen (p. 61). USGS Mesozoic locality 13970. × 1.
32. *Unio brachyopisthus* Stanton (p. 61). USGS Mesozoic locality 13682. × 1.
33, 34. *Unio mesaverdensis* Yen (p. 61). USGS Mesozoic locality 13969. × 1.

U. S. GOVERNMENT PRINTING OFFICE: 1954



UPPER CRETACEOUS NONMARINE MOLLUSKS FROM UTAH AND COLORADO