



## FRESH-WATER MOLLUSKS FROM THE MORRISON FORMATION (JURASSIC) OF SUBLETTE COUNTY, WYOMING

TENG-CHIEN YEN AND JOHN B. REESIDE, JR.  
Geological Survey, Washington, D. C.

THIS paper deals with a single lot of silicified fresh-water mollusks from beds in Sublette County, Wyoming, that are attributed to the Morrison formation, of late Jurassic age. The locality lies west of Mill Creek below Lower Green River Lake, on the west slope of the Wind River Mountains. The collection was made by Gerald Richmond, with the assistance of W. G. Pierce and J. D. Love, to all of whom grateful acknowledgment is made.

The fauna apparently represents a new facies, for most of the genera and species have not been reported previously from the Morrison. A few of the forms, however, were originally described from Morrison deposits at other localities. There are represented 12 recognizable species of gastropods assigned to 10 genera in 6 families, and 1 pelecypod. Of these, 9 species and 3 genera are described as new. In addition, a few imperfectly preserved specimens, left unidentified for the present, indicate the presence of still other groups in the fauna.

### REVIEW OF THE LITERATURE

The earliest records of fresh-water mollusks from Jurassic deposits, or beds supposed to be of Jurassic age, in North America were made by Meek and Hayden between 1858 and 1865, the first full descriptions and figures appearing in a summary discussion in the latter year. This early work noted the presence of six species, namely *Valvata? scabrida*, *Viviparus gilli*, *Planorbis veterenus*, and *Unio nucalis* from the "southwest base of the Black Hills;" and *Neritella nebrascensis* and *Lioplacodes veterenus* from the "head of Wind River." There was confusion, however, as to the locality of *Viviparus gilli*, and Stanton (1903, p. 196) has pointed out that it actually came from the "head of Wind River." By a slip it was ascribed by Meek and Hayden (1865, p. 107) to the Black Hills, though it occurs with

*Neritella nebrascensis* and *Lioplacodes veterenus*, as noted by Meek and Hayden themselves (1865, p. 115), and the original label assigns it to the "head of Wind River."

These two lots of species, occurring at different localities, seem to belong to different ages. The species from the Black Hills are now also recognized in the Morrison formation of central Colorado and southern Wyoming and seem validly assigned to the Jurassic. The species from the head of Wind River are identical with or closely related to forms from Lower Cretaceous beds that occur in the Wind River Basin near Lander, Wyoming, and that recently came to our hands through the efforts of J. D. Love.

A classic work among the earlier contributions to knowledge of the Jurassic fresh-water mollusks of the Rocky Mountain States was presented by C. A. White in 1886, in which he described six species of *Unio*, three species of *Limnaea*, and one species of *Vorticifex* in addition to his recording of *Planorbis veterenus* and *Valvata scabrida* with queries. White's material was collected from the "Atlantosaurus" beds, now called the Morrison formation, 8 miles north of Canon City, Colorado, where it is directly associated with a varied dinosaurian fauna and is without doubt of Jurassic age.

In 1900 Logan published an account of mollusks from the Freeze-out Hills of Wyoming, which records three new species of *Unio*, one species of *Valvata*, and *Planorbis veterenus* Meek and Hayden. We have not seen the original collection on which Logan's paper was based, and his illustrations are unusable. The species were reported to be in direct association with a Morrison dinosaurian fauna and are therefore undoubtedly of Jurassic age.

C. C. Branson published in 1935 a paper on invertebrate fossils obtained at a locality 3 miles south of Mayoworth, Wyoming. He described a new genus of unionid pelecypods

and one gastropod with two new species in each, and one new species of *Valvata*. He also recorded *Valvata scabrada*, *Lioplacodes veter-nus*, *Viviparus gilli*, and *Planorbis veter-nus*. Judged by the illustrations and a small part of his original material available to us, Branson's identifications of the previously recorded forms, probably with the exception of *Planorbis veter-nus*, need further confirmation, though there is no doubt of the Jurassic age of the material.

E. L. Holt in 1942 recorded a new species of unionid pelecypod from the Morrison near Fruita, Colorado, indicating that it is associated with *Vorticifex stearnsii* White. *Valvata scabrada* is recorded as occurring at a higher horizon.

#### COMPOSITION AND AGE OF THE FAUNA

The forms recognized in the collection described in this paper are as follows:

##### Valvatidae.

*Valvata minuscula* Yen and Reeside.

##### Amnicolidae.

*Amnicola gilloides* Yen and Reeside.

*Mesocochliopa assiminoidea* Yen and Reeside.

*Mesopyrgium pendilabium* Yen and Reeside.

##### Ellobiidae.

*Tortacella* aff. *T. haldemani* (White).

##### Limnaeidae.

*Galba atuvuncula* (White).

##### Planorbidae.

*Gyraulus veter-nus* (Meek and Hayden).

*Graetophysa spiralis* Yen and Reeside.

##### Physidae.

*Physa micra* Yen and Reeside.

*Physa conspira* Yen and Reeside.

*Aplexa militaria* Yen and Reeside.

*Aplexa morrisonana* Yen and Reeside.

##### Unionidae.

*Unio iridoidea* White.

Undetermined charophyte oogonia, a few ostracodes, and a single fish vertebra are also present.

*Amnicola* and the planorbids are the dominant forms in the fauna. The new genera, *Mesocochliopa*, *Mesopyrgium*, and *Graetophysa*, have close relatives in the later faunal assemblages, and show that the lineages go back farther than hitherto recorded. *Tortacella* also has not been reported previously below the Cretaceous.

Almost the entire collection is of small gastropods, none exceeding 10 mm. in height. This limitation in size may be due to greater suitability of small shells for preservation, but it may also imply that the body of water in which the animals lived was shallow. The latter explanation is supported by the fact that 6 species out of 13, or about 46 percent, are air-breathing gastropods; by the abundant occurrence of individuals of the families Amnicolidae and Planorbidae, which families generally live in places covered by dense growth of vegetation, either in marshy areas or sluggish streams; and by the presence of numerous oogonia of *Chara*-like plants. The presence of so many distinct genera may well imply a sizable body of water, for such a rich fauna is not likely to arise in a small pond or stream.

As to age of the fauna, the three previously recorded species in the collection, namely *Galba atuvuncula* (= *Limnaea atuvuncula*), *Gyraulus veter-nus* (= *Planorbis veter-nus*), and *Unio iridoidea*, were described from the Morrison formation north of Canon City, Colorado, and appear to occur consistently in Jurassic deposits. In addition, the present collection of mollusks shows a remarkable difference in elements from those in the collection noted above that was obtained from a Lower Cretaceous horizon near Lander. There is nearly nothing in common, though the geographic separation is small, probably less than 50 miles, the apparent stratigraphic position not very different, and the enclosing rocks are so similar that essentially the same ecologic environment is implied.

#### SYSTEMATIC DESCRIPTIONS

##### Family VALVATIDAE

VALVATA MINUSCULA Yen and Reeside,  
n. sp.

Figures 1a, b

Shell small, having an elevated spire and descending body whorl, the last one-half of which is barely attached to the penult whorl. Whorls roundly convex, slightly shouldered below the suture and rapidly increasing in size. Suture profoundly incised, the deep incision being evidently due to removal of the external layer of the shell. No sculpture visible. Aperture descending, almost circular in outline, having thin and en-

tire peristome. Umbilicus wide and open, about one-third of the shell diameter, well defined by an obtuse angulation on the basal surface of the body whorl.

Shell, altitude 2.5 mm., width 2.1 mm.; aperture diameter 1.0 mm.; number of whorls  $3\frac{1}{2}$ .

Three species of *Valvata* have been described from Jurassic formations of North America: *Valvata gregorii* Robinson from the Morrison at Wand Terrace, 16 miles southwest of Tuba, Arizona; *Valvata leei* Logan from the "Atlantosaurus beds" (Morrison) of the Freeze-out Hills, east-central Wyoming; and *Valvata scabrida* Meek and Hayden from Jurassic beds near the southwest base of Black Hills. The present species, although represented here by a single individual, seems to be decidedly different from any of the three named forms by its smaller size, strongly convex whorls, and wider umbilicus.

U.S.N.M. 103799.

#### Family AMNICOLIDAE

#### AMNICOLA GILLOIDES Yen and Reeside,

n. sp.

Figures 2a, b

Shell ovately oblong in outline, having an elevated spire and descending body whorl. The former is almost as high as the latter. Whorls rapidly increasing in size, apex small and exsert, early whorls less convex than later ones. The body whorl is slightly shouldered and bears an obtuse angulation below the well-impressed suture. Aperture pyriform, slightly oblique; peristome continuous, barely attaching to the penultimate whorl. Umbilicus narrowly perforate. Operculum moderately thick and solid, of calcareous substance, pyriform in outline, having a spiral nucleus, central in the young and subcentral in the adult specimens; spiral stage superposed and surrounded by a band of concentric increment.

	Paratype	Holotype
Altitude of shell	9.0 mm.	7.0 mm.
Width of shell	6.6 mm.	5.5 mm.
Height of aperture	4.6 mm.	3.7 mm.
Width of aperture	4.2 mm.	3.1 mm.
Number of whorls	5.0	$4\frac{1}{2}$

Numerous specimens representing various developmental stages are available, together

with many loose opercula of various sizes. The operculum is identical in kind with that of the living fresh-water rissoid snails referred to species of the Amnicolidae, and there seems to be little doubt that the shell and operculum belong to the same species.

The species resembles in outline "*Ampullaria*" *powelli* Walcott of the Lower Cretaceous, but differs in its smaller size, higher spire, and more strongly convex whorls.

Holotype, U.S.N.M. 103800; paratypes, U.S.N.M. 103801.

#### MESOCOCHLIOPA Yen and Reeside, n. gen.

Shell umbilicate, small, having an elevated spire and moderately dilated body whorl. Whorls convex, gradually increasing in size, and rounded along the periphery. Aperture ovate and gently descending.

Genotype, *Mesococliopa assiminoides* Yen and Reeside.

The genus under consideration recalls *Cochliopa* Stimpson, described from North America. The present available data do not permit us now to establish definitely its relationship with that genus, represented so far by living species only. However, the morphological features seem to indicate relationship.

#### MESOCOCHLIOPA ASSIMINOIDES Yen and

Reeside, n. sp.

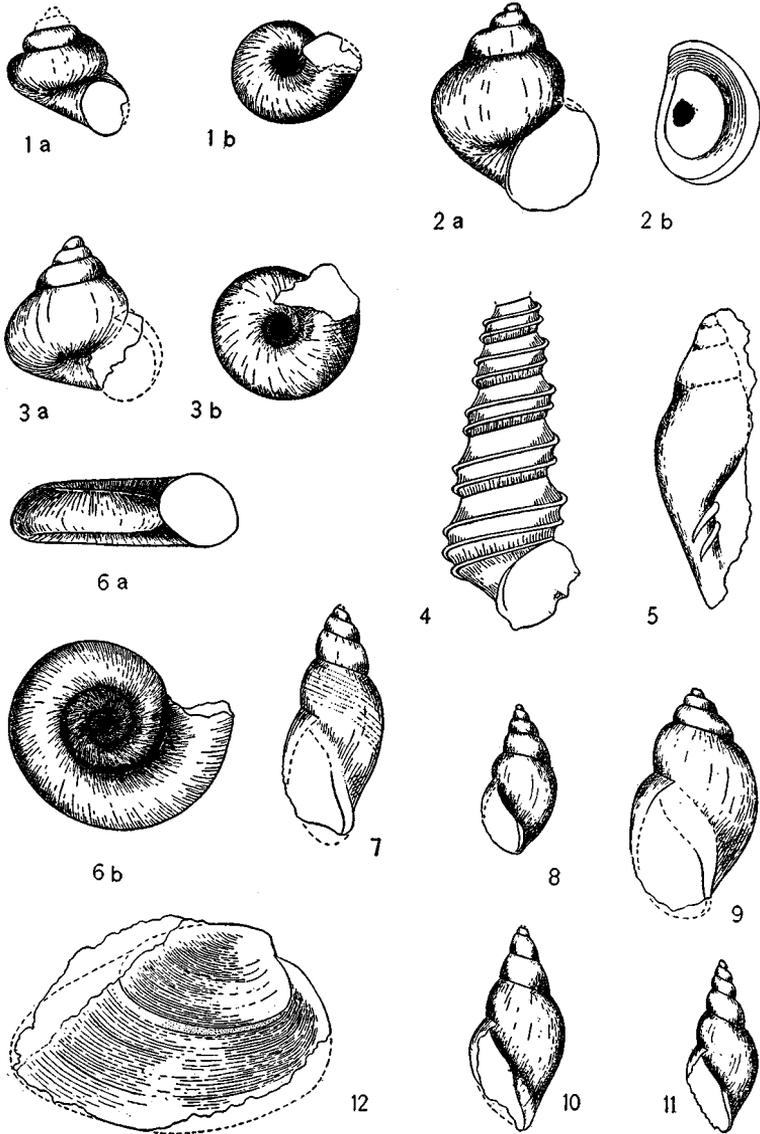
Figures 3a, b

Shell short and broad, small, having a conical spire about as high as the body whorl. Whorls gently convex, increasing gradually in size. No sculpture visible; suture well impressed. Body whorl descending, gently dilated, roundly convex at the periphery as well as on basal surface; aperture ovate. Umbilicus exposed and deep, about one-fourth the diameter of the shell in width. Operculum unknown.

Altitude of shell 2.5 mm.; width 2.0 mm.; diameter of umbilicus 0.5 mm.; number of whorls  $4\frac{1}{2}$ .

The species is characterized by its small size, broadly conical outline, and widely exposed umbilicus. Two examples of younger stages in the collection are of smaller size, with a little over one whorl less.

Holotype, U.S.N.M. 103802; paratypes, U.S.N.M. 103803.



EXPLANATION OF FIGURES 1-12

- FIGS. 1a, b—*Valvata minuscula* Yen and Reeside.  $\times 8$ .  
 2a, b—*Amnicola giloides* Yen and Reeside.  $\times 4$ .  
 3a, b—*Mesocochliopa assiminoidea* Yen and Reeside,  $\times 8$ .  
 4—*Mesopyrgium pendilabium* Yen and Reeside.  $\times 8$ .  
 5—*Tortacella* aff. *T. haldemani* (White).  $\times 8$ .  
 6a, b—*Gyraulus veternus* (Meek and Hayden).  $\times 8$ .  
 7—*Graptophysa spiralis* Yen and Reeside.  $\times 8$ .  
 8—*Physa micra* Yen and Reeside.  $\times 8$ .  
 9—*Physa conspirata* Yen and Reeside.  $\times 4$ .  
 10—*Aplexa militaria* Yen and Reeside.  $\times 4$ .  
 11—*Aplexia morrisonana* Yen and Reeside.  $\times 4$ .  
 12—*Unio iridoides* White.  $\times 4$ .

- (p. 53)  
 (p. 54)  
 (p. 54)  
 (p. 56)  
 (p. 56)  
 (p. 56)  
 (p. 57)  
 (p. 57)  
 (p. 57)  
 (p. 57)  
 (p. 58)  
 (p. 58)

## MESOPYRGIUM Yen and Reeside, n. gen.

Shell imperforate, small, with highly turritid spire. Apical whorls smooth, subsequent whorls bearing spiral carinae. Aperture descending, anteriorly notched. Peristome thin, expanded at outer margin. Columella slightly reflected.

Genotype, *Mesopyrgium pendilabium* Yen and Reeside.

The size and general shape of the shell recall some forms of *Pyrgula* Christofori and Jan, but the new genus differs in its expanded outer lip and the presence of an anterior notch, which are features generally borne by species of cerithioid snails.

## MESOPYRGIUM PENDILABIUM Yen and Reeside, n. sp.

Figure 4

Shell imperforate, small, slender, with highly turritid spire and descending body whorl. Whorls increasing moderately rapidly in size, first two smooth and roundly convex, subsequent whorls bearing two spiral carinae on flatly concave surface with a basal carina appearing below periphery of the body whorl. Suture shallow but traceable. Aperture descending, slightly oblique, and of ovately polyangulated form. Peristome thin, expanded at outer margin, a notch present at anterior end. Columellar margin slightly reflected; parietal wall well defined.

	Paratype	Holotype
Altitude of shell	5.1 mm.	5.6 mm.
Width of shell	2.2 mm.	2.2 mm.
Height of aperture	1.0 mm.	1.0 mm.
Width of aperture	1.0 mm.	1.0 mm.
Number of whorls	7.3	8.0

This species is readily recognized by its small size, high spire, heavy spiral carinae, and expanded margin of outer lip.

Holotype, U.S.N.M. 103804; paratypes, U.S.N.M. 103805.

## Family ELLOBIIDAE

TORTACELLA aff. *T. HALDEMANI* (White)

*Acella haldemani* WHITE, 1878, U. S. Geol. and Geog. Survey Terr. Bull. 4, pt. 3, p. 714.

*Tortacella haldemani* WHITE, 1895, U. S. Geol. Survey Bull. 128, p. 44, pl. 5, figs. 8, 9.

*Tortacella wyomingensis* HENDERSON, 1935, Geol. Soc. America Spec. Papers no. 3, p. 234.

A single imperfect specimen resembles *Tortacella haldemani* (White) of the Upper

Cretaceous Bear River formation. This shell is small and slender, with weakly convex whorls that bear distinct but fine costulate growth lines and a narrow aperture with two oblique plicae on its columellar margin. The preserved part of the shell is 5.2 mm. in altitude, 2.0 mm. in width, and has about 3 whorls.

Change of the name *T. haldemani* to *T. wyomingensis* by Henderson in 1920 (Nautilus 33, p. 108), reaffirmed in 1935, does not seem to be necessary. The original name was only a secondary homonym of *Limnaea haldemani* Deshayes, 1867, and, as long as *Acella* is recognized as a valid genus, no change is needed.

*Tortacella* may possibly be a synonym of *Zptychius* Walcott, of the Lower Cretaceous. However, the problem cannot be settled for the present, as the holotype specimen of Walcott's genotype is not well preserved.

U.S.N.M. 103806.

## Family LIMNAEIDAE

## GALBA ATIVUNCULA (White)

*Limnaea ativuncula* WHITE, 1886, U. S. Geol. Survey Bull. 29, p. 20, pl. 4, fig. 11.

*Galba ativuncula* BAKER, 1911, Chicago Academy Sci. Spec. Pub. no. 3, p. 87, pl. 16, fig. 2.

Two imperfect specimens agree well with the smaller specimen contained in the type lot of this species (U.S.N.M. 20054).

U.S.N.M. 103807.

## Family PLANORBIDAE

## GYRAULUS VETERNUS (Meek and Hayden)

Figures 6a, b

*Planorbis veternus* MEEK and HAYDEN, 1860, Acad. Nat. Sci., Philadelphia, Proc., vol. 12, p. 418; 1865, Smithsonian Contr. Knowledge, vol. 14, no. 172, p. 107, pl. 4, fig. 1.

Over a hundred specimens, representing various developmental stages, are available. These seem to be identical with this species as originally described from the Black Hills area. It is characterized by its small size and rapidly increasing whorls. A mature individual measures 1.0 mm. in altitude, 2.2 mm. in width, and has  $3\frac{1}{2}$  whorls.

U.S.N.M. 103808.

## GRAPTOPHYSA Yen and Reeside, n. gen.

Shell sinistral, imperforate, narrowly oblong in outline, having rapidly increasing whorls, which are separated by an incised

suture. Sculpture consisting of both growth lines and incised spiral lines. Aperture narrowly ovate in form, with simple and thin peristomal margin and well-twisted columella.

Genotype, *Graptophysa spiralis* Yen and Reeside.

The genus consists of forms of *Physa*-like snails that bear both growth lines and spiral sculpture and have incised sutures. It recalls some species of *Camptoceras* Benson, found in the Recent fauna, and *Pseudophysa* Yen, described from Pliocene fresh-water beds of Yunnan, China.

GRAPTOPHYSA SPIRALIS Yen and  
Reeside, n. sp.

Figure 7

Shell sinistral, fusiform, imperforate, small, having the spire about as high as body whorl. Whorls rapidly increasing in size, gently convex on exposed surface, and separated by an incised suture. Sculpture consists of growth striae and spiral lines, which are well shown on better-preserved individuals. Aperture of narrowly ovate form, simple and thin at outer lip margin, attenuated at parietal wall and well twisted toward the columella.

	Holotype	Paratype
Altitude of shell	3.2 mm.	4.1 mm.
Width of shell	1.4 mm.	2.0 mm.
Height of aperture	1.4 mm.	2.0 mm.
Width of aperture	0.5 mm.	1.0 mm.
Number of whorls	4.0	4.5

The younger forms are more ovate in outline, and the whorls increase more rapidly in length than width, most of the examples appear to be smooth on the exposed surface of the whorls, apparently owing to poor state of preservation.

Holotype, U.S.N.M. 103809; paratypes, U.S.N.M. 103810.

Family PHYSIDAE

PHYSA MICRA Yen and Reeside, n. sp.

Figure 8

Shell sinistral, ovately globose in outline, with a short but elevated spire and dilated body whorl; spire about one-third of the entire height of the shell. Whorls rapidly increasing in size, well-rounded on exposed surface, slightly shouldered below the su-

ture. Body whorl ventricose, roundly convex along periphery. Aperture ovate in outline, having thin outer lip and parietal wall, weakly twisted columella with slightly reflected margin. Umbilicus narrowly perforate.

Altitude of shell 3.5 mm.; width of shell 2.0 mm.; height of aperture 2.3 mm.; width of aperture 0.10 mm.; number of whorls 5.3.

The species approaches in size and general outline *Physa walcottii* Yen and Reeside<sup>1</sup> of the Lower Cretaceous. However, it differs by its more strongly convex whorls, which are well shouldered.

Holotype, U.S.N.M. 103811; paratypes, U.S.N.M. 103812.

PHYSA CONSPIRA Yen and Reeside

Figure 9

Shell sinistral, broadly fusiform, small. Spire conical, a little higher than the body whorl. Whorls increasing rapidly, with exposed surface gently convex. Sutures well impressed. Body whorl moderately dilated but somewhat reduced at the base. Aperture narrowly ovate in outline; outer lip and parietal margin thin; columella slightly reflected. Umbilicus very narrowly perforate.

Altitude of shell 5.0 mm.; width of shell 2.8 mm.; height of aperture 2.4 mm.; width of aperture 1.4 mm.; number of whorls 6.0

The species differs from *Physa walcottii* by its broadly fusiform outline, more convex whorls, and higher spire. Most other species of *Physa* from various Cretaceous horizons in North America are much larger.

Holotype, U.S.N.M. 103813; paratypes, U.S.N.M. 103814.

APLEXA MILITARIA Yen and Reeside, n. sp.

Figure 10

Shell sinistral, subfusiform in outline, and small. Spire conically elevated, almost equal in height to the body whorl. Whorls rapidly increasing in size, scarcely convex, and bearing distinct axial lines and fine growth striae on the interspaces. Suture superficially impressed. Body whorl narrowly dilated, reduced at base. Aperture subpyriform in outline, outer lip thin and simple, parietal

<sup>1</sup> The name *Physa prisca* Walcott (1883, p. 808) is preoccupied by *Physa prisca* Noulet (1854, p. 12). *P. prisca* Walcott is here renamed *Physa walcottii*.

wall thinly spreading, not well defined, and columella slightly reflected to form an almost imperforate umbilicus.

Altitude of shell 6.5 mm.; width of shell 3.0 mm.; height of aperture 3.3 mm.; width of aperture 1.3 mm.; number of whorls 5.0.

This species and the following are provisionally assigned to the genus *Aplexa*, because of the scarcely convex whorls and high spire. They are, however, much smaller than most species of that genus.

Holotype, U.S.N.M. 103815; paratypes, U.S.N.M. 103816.

*APLEXA MORRISONANA* Yen and Reeside  
n. sp.

Figure 11

Shell sinistral, subfusiform, small, having gradually tapering spire and narrowly dilated body whorl, the former higher than the latter. Whorls increasing in size with moderate rapidity; gently convex. Suture well impressed. Aperture subpyriform in outline, outer lip and parietal wall thin and simple. Columella twisted in the lower part and slightly reflected at the base. Umbilicus almost imperforate.

	Holotype	Paratype
Altitude of shell	5.8 mm.	7.0 mm.
Width of shell	2.3 mm.	3.0 mm.
Height of aperture	2.5 mm.	—
Width of aperture	1.0 mm.	—
Number of whorls	5½	6½

This species is characterized by its slender outline, highly turrated spire and narrowly dilated body whorl. It has a higher spire and narrower width of body whorl than the preceding species, *Aplexa militaria*. However, it is much smaller than most of the other known species of the genus.

Holotype, U.S.N.M. 103817; paratypes, U.S.N.M. 103818.

Family UNIONIDAE  
UNIO IRIDOIDES White

Figure 12

*Unio iridoides* WHITE, 1886, U. S. Geol. Survey Bull. 29, p. 17, pl. 2, figs. 3, 4.

Two specimens, much smaller than the types, seem to be the young form of this species. They agree in character sufficiently well to justify use of the name.

Plesiotype, U.S.N.M. 103819.

BIBLIOGRAPHY

- BRANSON, C. C., 1935, Fresh-water invertebrates from the Morrison (Jurassic?) of Wyoming: Jour. Paleontology, vol. 9, no. 6, pp. 514-522, 2 pls.
- HENDERSON, JUNIUS, 1935, Fossil nonmarine Mollusca of North America: Geol. Soc. America Spec. Papers no. 3, 1935.
- HOLT, E. L., 1942, A new *Unio* from the Morrison formation of Grand River Valley, Colorado: Jour. Paleontology, vol. 16, pp. 459-460, 1 pl.
- LOGAN, W. H., 1900, The stratigraphy and invertebrate faunas of the Jurassic formation in the Freeze-out Hills of Wyoming: Kansas Univ. Quart., vol. 9, no. 2, pp. 109-134, 7 pls. (Kansas Univ. Bull., vol. 1, no. 3).
- MACNEIL, F. STEARNS, 1939, Fresh-water invertebrates and land plants of Cretaceous age from Eureka, Nevada: Jour. Paleontology, vol. 13, no. 3, pp. 355-360, 1 pl.
- MEEK, F. B., and HAYDEN, F. V., 1864, Paleontology of the upper Missouri invertebrates: Smithsonian Contr., vol. 14, no. 172, pp. 1-175 (with text figs.).
- NOULET, J. B., 1854, Mémoires sur les coquilles fossiles des tertiaires d'eau douce du sud-ouest de la France, p. 12.
- ROBINSON, W. I., 1915, Two new fresh-water gastropods from the Mesozoic of Arizona: Am. Jour. Sci., ser. 4, vol. 40, pp. 649-651.
- STANTON, T. W., 1903, A new fresh-water molluscan fauna from the Cretaceous of Montana: Am. Philos. Soc. Proc., vol. 42, pp. 188-199.
- , 1915, Invertebrate fauna of the Morrison formation: Geol. Soc. America Bull., vol. 26, pp. 343-348.
- WALCOTT, C. D., 1883, Fresh-water shells from the Palaeozoic rocks of Nevada: Science, vol. 2, pp. 808-809.
- , 1884, Paleontology of the Eureka District: U. S. Geol. Survey Mon. 8, pp. 261-263.
- WHITE, C. A., 1878, Descriptions of new species of invertebrate fossils from the Laramie group: U. S. Geol. and Geog. Survey Terr. Bull. 4, no. 3, pp. 707-719.
- , 1883, A review of the nonmarine fossil Mollusca of North America: U. S. Geol. Survey Ann. Rept. 3, pp. 403-550.
- , 1886, On the fresh-water invertebrates of the North American Jurassic: U. S. Geol. Survey Bull. 29.