THE MUSSELS (UNIONACEA:BIVALVIA) OF OKLAHOMA—PART 2: THE UNIONINAE, PLEUROBEMINI AND ANODONTINI

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Keys and distributional data for the genera and species of the tribes Pleurobemini and Anodontini that occur or possibly occur in Oklahoma are presented. Photographs of the species are included.

INTRODUCTION

This contribution continues the work started in Part 1 (1, and the literature cited therein) on the naiads of Oklahoma. The present part provides distributional data, illustrations, and diagnostic keys to the species of two of the three tribes; i. e., the Pleurobemini and Anodontini of the Unioninae. The remaining tribe Lampsilini will be the subject of a subsequent contribution. Readers should note, that I (1) inadvertently reversed character labels I and J in Fig. 1 in Part 1.

KEY TO THE TRIBES OF THE UNIONINAE AND GENERA AND SPECIES OF PLEUROBEMINI AND ANODONTINI

1 a. Water tubes of marsupial gills divided into 3 parts, 2 laterals and 1 central; glochidia hooked and incubated in central tubes only ..... Tribe Anodontini 3
  b. Water tubes of marsupial gills not divided; glochidia hookless (except in *Proptera* where the larvae are ascialate or axehead shaped) 2
2 a. Valves often sexually dimorphic; only portions of outer pair of gills, which are grooved, serve as marsupia ..... Tribe Lampsilini
  b. Valves do not demonstrate sexual dimorphism; entire outer pair of gills, which are smooth, serve as marsupia ..... Tribe Pleurobemini ... 14
3 a. Lateral and pseudocardinal teeth much reduced or lacking entirely; shell usually thin and fragile (often thickened in *Anodonta corpulenta*) 4
  b. Lateral and pseudocardinal teeth well developed; valves thick or thin, not fragile 11
4 a. Valves lacking pseudocardinal teeth (*Strophitus* occasionally an exception) 5
  b. Valves with rudimentary pseudocardinals 10
5 a. Dorsal margin of umbos very low, scarcely extending above general curvature of the shell 6
  b. Dorsal margin of umbos distinctly above general curvature of the shell 7
6 a. Valves nearly round in outline, strongly compressed and very fragile ..... *Anodonta suborbiculata* ..... Fig. 1
  b. Valves elongated, not strongly compressed ..... *Anodonta imbecillus* ..... Fig. 2
7 a. Ratio of value length to valve height equal to 1.6 or less; valves thick; nacre pinkish ..... *Anodonta corpulenta* ..... Fig. 3
  b. Ratio of valve length to valve height greater than 1.6; valves usually thin; nacre not pinkish 8
8 a. Umbonal sculpture parallel to lines of shell growth 9
  b. Umbonal sculpture curved, not parallel to lines of shell growth ..... *Anodontoides ferussacianus* ... Fig. 6
9 a. Vestigial pseudocardinal teeth usually lacking; nacre usually whitish or bluish-white; umbonal ridges distinctly double looped and rather nodulose

(usually evident only in young specimens) ..... *Anodonta grandis* ..... Fig. 4
b. Vestigial pseudocardinal teeth usually present; nacre usually salmon-colored; umbonal ridges single looped and never nodulose (usually evident in young specimens only) ... *Strophitus undulatus* ..... Fig. 5
10 a. Posterior slopes of valves usually with corrugations ..... *Alasmidonta marginata* ..... Fig. 7
b. Posterior slopes of valves lacking corrugations ..... occasional specimens of *Strophitus undulatus*
11 a. Valves with heavy corrugations on posterior slopes 12
b. Valves lacking heavy posterior corrugations 13
12 a. Pseudocardinal teeth heavy and triangular, not blade-like; tubercles restricted to beaks ..... *Arkansia wheeleri* ..... Fig. 8
b. Pseudocardinal teeth thin and bladelike; tuberculation extends from beaks to rest of valve ..... *Arcidens confragosus* ..... Fig. 9
13 a. Hinge teeth heavy and roughly corrugated; valves nearly round in outline with a large posterior wing; valves without low corrugations ..... *Lasmigona complanata* ..... Fig. 10
b. Hinge teeth smooth and not so heavy; valves elongated, lacking wings; valves with weakly developed posterior corrugations ..... *Lasmigona costata* ..... Fig. 11
14 a. Surface of valves tuberculate or pustulose 15
b. Surface of valves lacking tubercles or pustules 16
15 a. Nacre purple; valves semi-round in outline ..... *Cyclonaias tuberculata* ..... Fig. 12
b. Nacre white to pinkish; valves elongated or oval in outline ..... *Plethobasus cyphyus* ..... Fig. 13
16 a. Pseudocardinal teeth poorly developed (sometimes lacking) ..... *Uniomerus tetralasmus* .... Fig. 14
b. Pseudocardinal teeth well developed 17
17 a. Beaks arched and high, tilted forward; valves high, triangular or oval and very thick; nacre usually white ..... *Pleurobema cordatum* ..... Figs. 15,16
b. Beaks low, not tilted forward; valves elongated, relatively thin; nacre usually purple or pink 18
18 a. Posterior ridge of valves nearly straight and situated in a more or less median position ..... *Elliptio complanata* ..... Fig. 17
b. Posterior ridge of valves curving upward and situated close to the dorsal margin ..... *Elliptio dilatata* ..... Fig. 18

ANNOTATED LIST TRIBE ANODONTINI

The Oklahoma representatives of this tribe include 7 genera and 11 species, mostly in the eastern two-thirds of the state.

GENUS *Anodonta*

With few exceptions, these mussels possess thin valves and poorly developed hinge teeth. Four species occur in Oklahoma or close enough to the state to allow prognostication of occurrence.

Anodonta suborbiculata Say 1821 Figure 1

Oklahoma distribution: this species has not been reported from Oklahoma. However, since Johnson (2) reported it from the Neosho River in Woodson and Allen counties, Kansas, the mussel probably occurs in backwaters and embayments of that stream in Ottawa and Cherokee counties, Oklahoma. There are no synonyms.

Anodonta imbecillus Say 1829 Figure 2

Oklahoma distribution: Chikaskia River drainage (3,4), Mountain Fork River drainage (5), Kiamichi River (4,6), Red River and creek tributaries (4,6), Lake Texoma (7,8), Illinois River (4), Neosho River and creek tributaries (4,9), Little River (6), Blue River (rare) (6), Washita River (6), Big River and Bird Creek in Osage and Tulsa counties, Salt and Hominy creeks in Osage and Tulsa counties (2).

Throughout much of Oklahoma, *A. imbecillus* is not a particularly variable mussel. However, specimens from the Red, Little, Mountain Fork and Kiamichi drainages show more variations than elsewhere,

possibly reflecting genetic incursions from more easterly populations.

Johnson (2) listed the following synonyms for the species: *A. ohiensis* Rafinesque 1820 and *Utterbackia imbecillus fusca* Baker 1928.

Anodonta corpulenta Cooper 1834 Figure 3

Oklahoma distribution: Lake Texoma (8), Chikaskia River (3), Red River (4).

The much thicker valves with pinkish nacre serve to easily distinguish this species from *A. grandis* and its nominal races. Simpson (10) discussed the biology and variation of this species and presented the synonymies: *A. corpulenta* Sowerby 1870, *A. corpulenta* Lea 1870.

Anodonta grandis Say 1829 Figue 4

Oklahoma distribution: Chikaskia River (3,4), Verdigris River and creek tributaries (4), Kiamichi River (4,6), Poteau River and creek tributaries (4,11), Neosho River and creek tributaries (4,5,9,12), Glover River (6), Little River (6), Mountain Fork River (5,6), Blue River (6), Washita River and tributaries (6), Red River (6), Lake Murray (6), Lake Texoma (6,7,8), Big and Middle Caney rivers, Bird Creek in Osage and Tulsa counties, Salt and Hominy creeks in Osage and Tulsa counties (20).

Anodonta grandis enjoys a wide distribution and occurs in a variety of habitats. There is considerable variation in external color, mostly through shades of gray and greenish, and the degrees to which the valves are inflated. This variation stimulated the description of several species in the past. Johnson (2) listed the following synonyms: *A. plana* Lea 1834, *A. stewartiana* Lea 1834, *A. gigantea* Lea 1838, *A. footiana* Lea 1840, *A. virens* Lea 1852, *A. leonensis* Lea 1857, *A. danielsii* Lea 1858, *A. texasensis* Lea 1859, *A. bealii* Lea 1863, and *A. dakota* Frierson 1910.

GENUS *STROPHITUS*

There are two species presently assigned to this genus (13), only one of which occurs in Oklahoma, *S. undulatus*. The smooth, coarse umbonal ridges, poorly developed pesudocardinal teeth, salmon-color nacre, and relatively thin valves are the principal diagnostic features.

Strophitus undulatus (Say 1817) Figure 5

Oklahoma distribution: Illinois River (6), Kiamichi River (4), Neosho River and creek tributaries (4,12), Poteau River (4,11), Clear Boggy River (4).

The principal habitat is in backwater situations with mud bottoms. The periostracum varies from grayish to grayish-green. Occasional specimens have white nacre.

Synonymies include the following (4): *Anodon rugosus* Swainson 1822, *Alasmidonta edentula* Say 1829, *Anodonta parvonia* Lea 1836, *Strophitus undulatus tennesseensis* Frierson 1927, *S. u. ovatus* Frierson 1927, *S. rugosus winnebagoensis* Baker 1928, and *S. r. lacustris* Baker 1928.

GENUS *ANODONTOIDES*

Two species are assigned to this genus, one of which is widespread in the Mississippi River drainage from Pennsylvania and Tennessee west to Minnesota and Colorado (14), some records being close to the Oklahoma border (4).

Anodontoides ferussacianus (Lea 1834) Figure 6

Oklahoma distribution: unknown.

The lack of hinge teeth, presence of white nacre and low umbos with fine ridges, and the burnished color and low contours of the valves are good field identification characteristics for recognizing this species. Johnson (2) listed the following synonomies: *Anodonta ferussacianus* (Lea 1834), *A. subcylindracea* Lea 1838, *A. modesta* Lea 1857, and *Anodontoides bergei* Baker 1928.

GENUS *ALASMIDONTA*

This distinctive genus contains 11 species (13), only one of which occurs in Oklahoma. The beautiful green or variegated valves are strongly truncated and corrugated. Most of the species prefer relatively swift, clear, well-oxygenated water, mostly in rocky bottoms.

Alasmidonta marginata Say 1819 Figure 7

Oklahoma distribution: Illinois River (4), Neosho River (9,12).

This handsome mussel is doubtless widespread in the Neosho and Illinois rivers, the few records reflecting inadequate surveys. The synonyms include: *Margaritana marginata truncata* Wright 1898 and *A. marginatus variabilis* Baker 1928.

GENUS *ARKANSIA*

This peculiar, monotypic genus is entirely restricted to the Kiamichi River of Oklahoma and the Old River of Arkansas (13). The subovate valves are usually thick and moderately inflated, somewhat truncated posteriorly. The umbos are prominent. The reddish-brown to black periostracum has a silky texture. The typical habitat is in soft mud along the margins of streams (15).

Arkansia wheeleri Ortmann and Walker 1917 Figure 8

Oklahoma distribution: Kiamichi River in Pushmataha (2,4) and Choctaw (2) counties.

The species is listed as Rare and Endangered nationally (2). There are no synonyms.

GENUS *ARCIDENS*

Another monotypic genus, most closely related to *Arkansia* (2), that is poorly known in Oklahoma. The large shell (100 mm or longer) is rather rhomboidal in outline with a nearly straight hingeline and evenly curved ventral margin. The pseudocardinal tooth of the left valve is elongated and arched.

Arcidens confragosus (Say 1829) Figure 9

Oklahoma distribution: unknown.

This mud-loving species is included here because of its known distribution includes many sections of the Gulf Coastal region and streams of the Ozarkian region (2). The synonyms include *Alasmidonta confragosus* Say 1829 and *Arcidens confragosus jacintoensis* Strecker 1931 (2).

GENUS *LASMIGONA*

There are five sepcies in *Lasmigona* as now understood (13), two of which occur in Oklahoma.

Lasmigona complanata (Barnes 1823) Figure 10

Oklahoma distribution: Chikaskia River and creek tributaries (3,4), Washita River and tributaries (4,6), Blue River (4,6), Boggy River (4), Clear Boggy River (4), Neosho River and tributaries (4,5,9,12), Illinois River (4), Poteau River (4,11), Arkansas River and tributaries (4), Lake Texoma (8), "Oklahoma City" (16), Big and Middle Caney rivers, Bird Creek in Osage and Tulsa counties, Salt and Hominy creeks in Osage and Tulsa counties (20).

This heavy, white-nacred mussel was a favorite button species, and it is still actively sought for export to Japan (John Williams, Eastern Kentucky University, personal comm.). The synonyms include the following: *Unio complanata* Barnes 1823), *Symphynota complanata* (Barnes 1823), and *Unio katherinae* Lea 1838.

Lasmigona costata (Rafinesque 1820) Figure 11

Oklahoma distribution: Neosho River (4), Little and Glover rivers (6), Mountain Fork River (5,6), eastern tributaries of the Arkansas River (6).

The synonymies for this species are *L. costata pepinensis* Baker 1928 and *L. costata nuda* Baker 1928.

GENUS *CYCLONAIAS*

A monotypic genus with *Quadrula*-like, thick, rounded valves. The massive hinge teeth and dark purple nacre are diagnostic characters.

Cyclonaias tuberculata (Rafinesque 1820) Figure 12

Oklahoma distribution: unknown.

This species is included here because of its wide distribution in the Mississippi River drainage (13) and because of its possible occurrence in the Neosho and Illinois river systems. Synonyms include *Unio graniferus* Lea 1838 and *Quadrula granifera pusilla* Simpson 1900.

GENUS *PLETHOBASUS*

Two species have been described in this genus, one of which occurs n the Oklahoma region (13). The genus is principally found in streams above the Ozarkian Crest

(2), but one species has been reported from the Verdigris (tributary of the Arkansas River) (17) and Spring (tributary of the Neosho River) (17) rivers in Kansas.

Plethobasus cyphyus (Rafinesque 1820) Figure 13

Oklahoma distribution: unknown.

This species should be sought in the Arkansas and Neosho river drainages. Synonyms: *Unio varicosus* Lea 1829, *Unio graniferus* Lea 1838, *Quadrula granifera pusilla* Simpson 1900, *Unio compertus* Frierson 1911, *Quadrula tuberculata utterbachiana* Frierson 1927 (13).

GENUS *UNIOMERUS*

This montotypic genus enjoys a wide distribution in Oklahoma. The relatively thin shell with poorly developed (sometimes lacking) pseudocardinal teeth is usually smooth and brownish in coloration.

Uniomerus tetralasmus (Say 1831) Figure 14

Oklahoma distribution: Arkansas River and tributaries (4), Neosho River and tributaries (4), Verdigris River (4), Chikaskia River and tributaries (3,4), Washita River and tributaries and Blue River (6), Mountain Fork River and Lake Carl Blackwell (Payne County) (5), Bird Creek and Hominy Creek, Osage County (20).

The complete and long list of synonyms for this species is presented by Johnson (19).

GENUS *PLEUROBEMA*

Because of the exceptional confusion and differences of opinion within this genus, the number of confirmed species is problematic. Stansbery (18) recognizes as valid species several forms (see below) that I consider to be eco-phenotypes of a single highly variable species.

Pleurobema cordatum (Rafinesque 1820) Figures 15, 16

Oklahoma distribution: Chikaskia River (as *P. coccineum)* (3), Little River (4), Kiamichi River (4), Verdigris River (4), Neosho River (4), Neosho River as *P. coccineum* (12), Poteau River (4,11), Mountain Fork River (5), Spring River (12).

As mentioned above, Stansbery (18) recognizes four species within a complex. One is the typical *P. cordatum* with an equilateral triangular outline. The synonymies of this form include *Unio obliqua* Lamarck 1819, *U. plenum* Lea 1840, *Obovaria cordata* Rafinesque 1820, and *Pleurobema premorsa* Rafinesque 1831 and *Unio catillus* Conrad 1836 (13).

Pleurobema pyramidatum (Lea 1834), taking the form of a scaline triangle in outline, and often having pinkish nacre, is considered an ecophenotype of medium-sized rivers and large creeks with swift currents. The synonymies include the following (2): *Unio mytiloides* Rafinesque 1820, *Pleurobema obliguata* (Rafinesque 1820), *P. rubrum* Rafinesque 1820, *Unio cardiacea* (Guerin 1829), *Unio pyramidatus* Lea 1834, and *Pleurobema coccineum mississippiensis* (part) Baker 1928.

Pleurobema coccineum (Conrad 1836), with a subcircular outline and reddish nacre, is considered an ecophenotype of large to medium rivers with moderate currents. The synonymies include (2): *Unio sintoxa* Rafinesque 1820, *U. coccineus* Conrad 1836, *U. catillus* Conrad 1836, *U. coccineum* Lea 1838, *U. solidus* Lea 1838, *U. cuneus* Conrad 1838, *U. gouldianus* Ward 1839, *U. fulgidus* Lea 1845, *Quadrula coccinea paupercula* Simpson 1900, and *Pleurobema coccineum mississippiensis* (part) Baker 1928.

GENUS *ELLIPTIO*

The genus *Elliptio* contains at least 19 species, many of them highly variable. Most of the species have elongated shells with rather poorly developed beaks and well-developed hinge teeth. The periostracum varies from dark brown to nearly black. Only the outer gills serve as marsupia. Two species have been reported from Oklahoma.

Elliptio complanata (Lightfoot 1786) Figure 17

Oklahoma distribution: Washita, Blue, Boggy, Clear Boggy, Neosho, Illinois, Chikaskia, Arkansas and Poteau rivers (4).

Isaac Lea of Philadelphia seems to have specialized in describing *E. complanata* (see Burch, 13, and Johnson, 2, for a complete synonymy, much too long to repeat here). From 1829 through 1874 Lea de-

scribed at least 76 "new" species, all now considered synonyms of *E. complanata.* Arranging the list alphabetically makes it obvious that Lea purposefully attempted to add at least one new name for each letter of the alphabet, from *Unio abbevillensis* Lea through *Unio zigzag* Lea 1829.

Elliptio dilatatus Rafinesque 1820 Figure 18

Oklahoma distribution: Kiamichi and Neosho rivers (4) and the Poteau River (3,11).

The list of synonyms for this species includes (2): *Unio gibbosus* Barnes 1823, *U. subgibbosus* Lea 1837, *U. gibbosus delicatus* Simpson 1900, and *Elliptio dilatatus sterkii* Grier 1918.

CONCLUDING REMARKS

The final contribution to this series will present keys, distributional data, and photographs of the Oklahoma representatives of the large unionid tribe Lampsilini. In the first part, I inadvertently omitted an important paper by Metcalf (20) that contained Arkansas River localities for some of the species discussed therein.

ACKNOWLEDGMENTS

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FIGURE 1. *Anodonta suborbiculata.* a = external view, scale line = 36 mm; b = internal view, scale line = 36 mm.

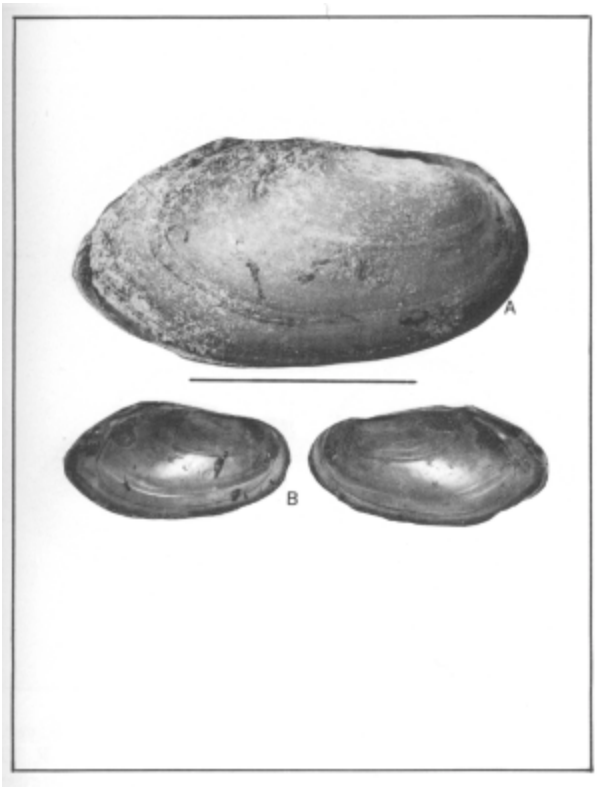

FIGURE 2. *Anodonta imbecillus.* a = external view, scale line = 22 mm; b = internal view.

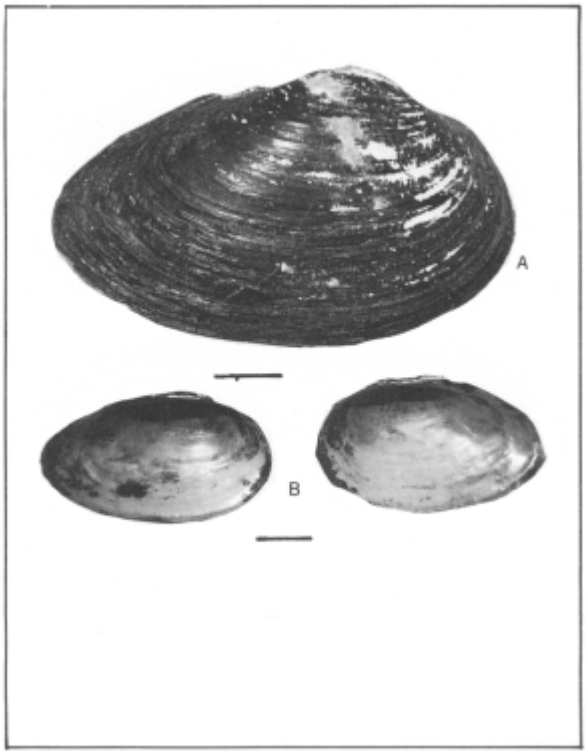

FIGURE 4. *Anodonta grandis.* a = external view, scale line = 15 mm; b = internal view, scale line = 23 mm.

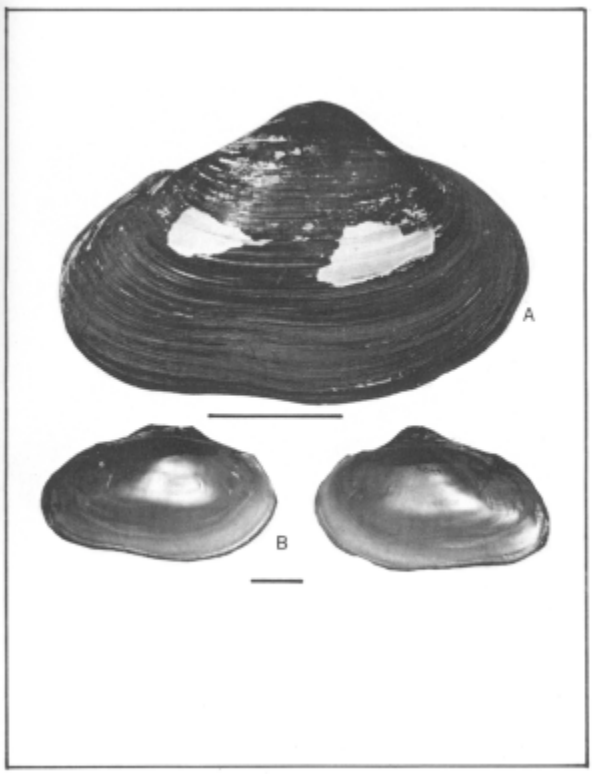

FIGURE 3. *Anodonta corpulenta.* a = external view, scale line = 42 mm; b = internal view, scale line = 31 mm.

FIGURE 5. *Strophitus undulatus.* a = external view, scale line = 30 mm; b = internal view, scale line = 24 mm.

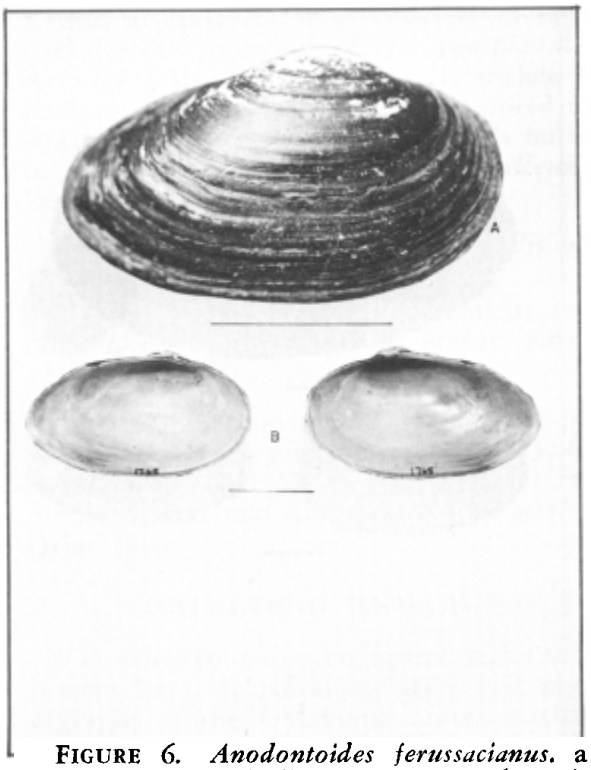

FIGURE 6. *Anodontoides ferussacianus.* a = external view, scale line = 32.5 mm; b = internal view, scale line = 25 mm.

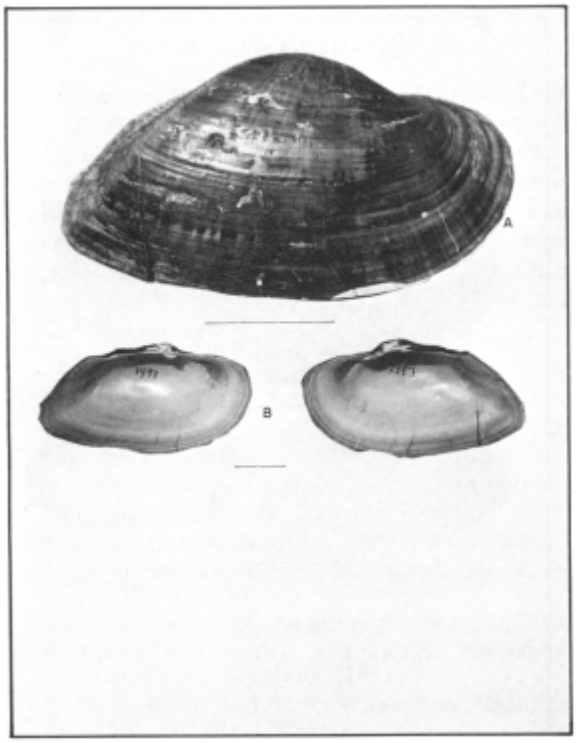

FIGURE 7. *Alasmidonta marginata.* a = external view, scale line = 26 mm; b = internal view, scale line = 26 mm.

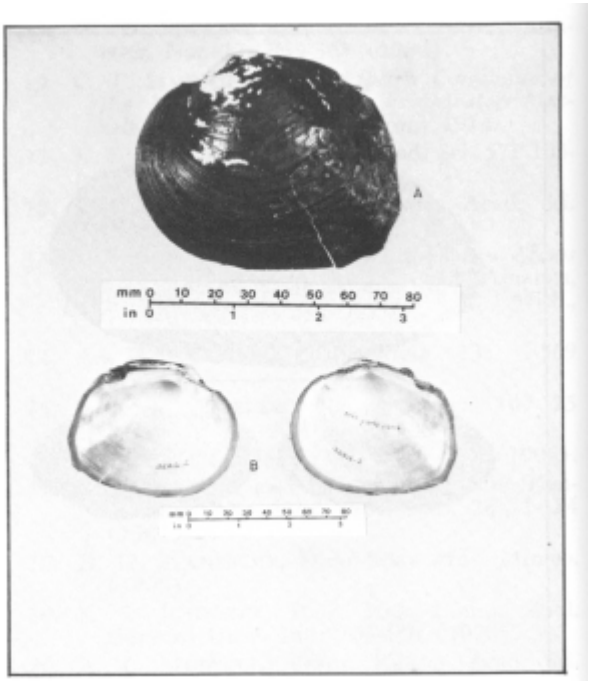

FIGURE 8. *Arkansia wheeleri.* Kiamichi River, U. S. Route 271, 1.9 km SE Clayton, T 1 N, R 19 E, S 7, Pushmataha County, Oklahoma; 22 August 1971; collector D. H. Stansbery. Photographs by A. E. Spreitzer. A = external view; b = internal

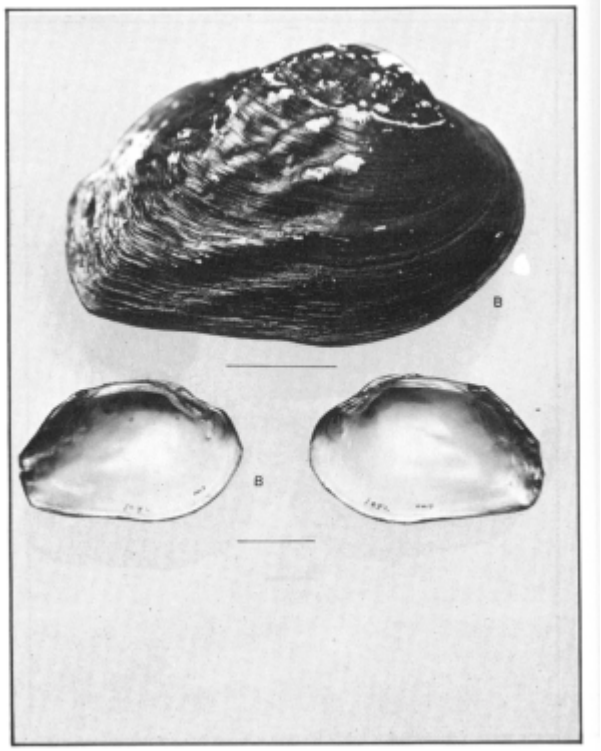

FIGURE 9. *Arcidens confragosus.* a = external view, scale line = 28 mm; b = internal view, scale line = 35 mm.

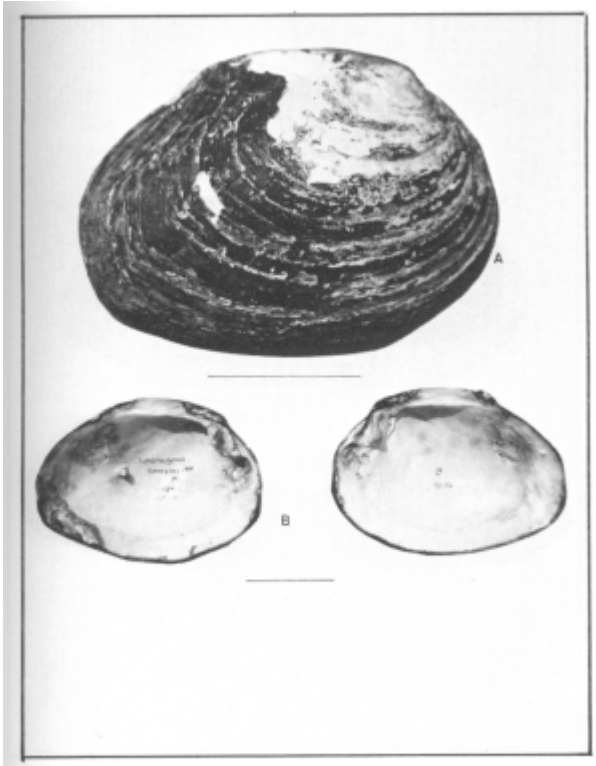

FIGURE 10. *Lasmigona complanata.* a = external view, scale line = 52 mm; b = internal view, scale line = 53 mm.

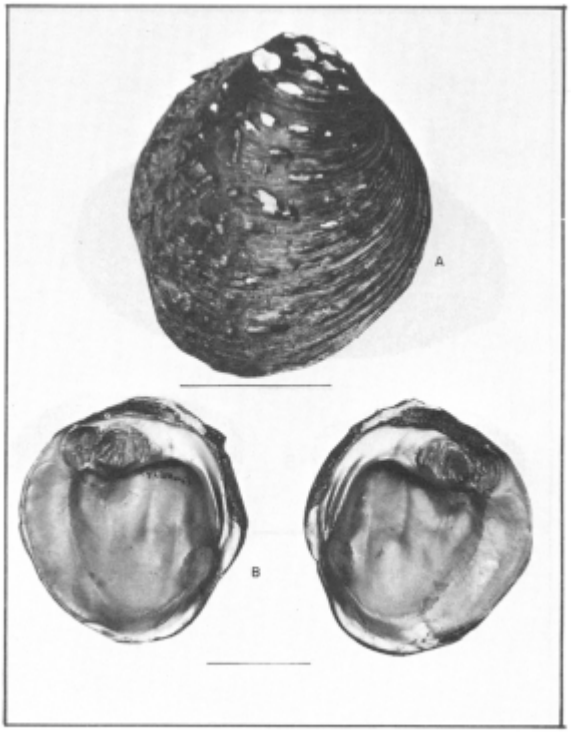

FIGURE 12. *Cyclonaias tuberculata.* a = external view, scale line = 40 mm; b = internal view, scale line = 35 mm.

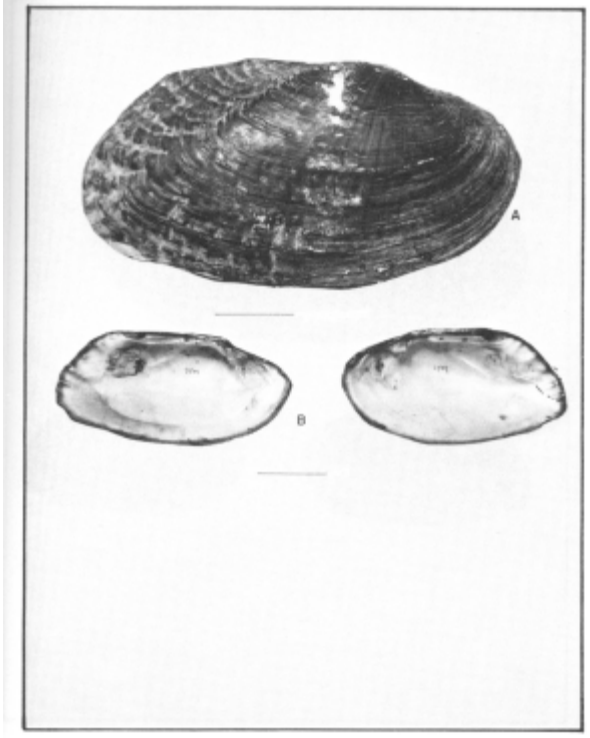

FIGURE 11. *Lasmigona costata.* a = external view, scale line = 28 mm; b = internal view, scale line = 41 mm.

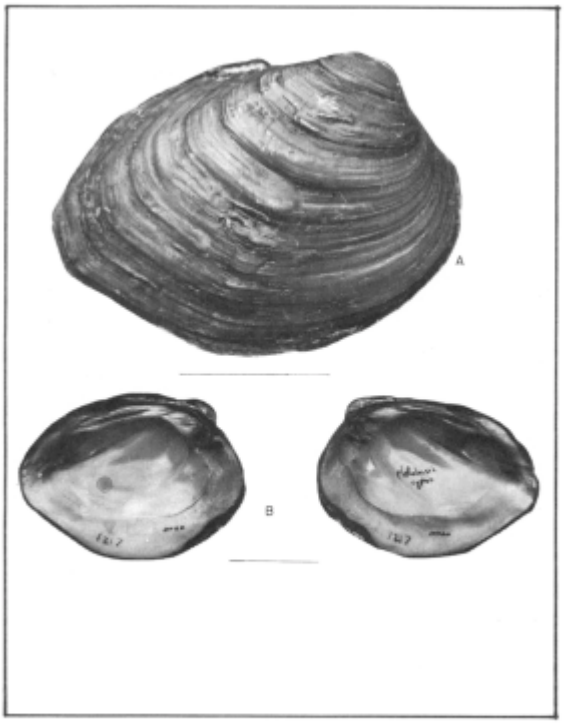

FIGURE 13. *Plethobasus cyphyus.* a = external view, scale line = 35 mm; b = internal view, scale line = 36 mm.

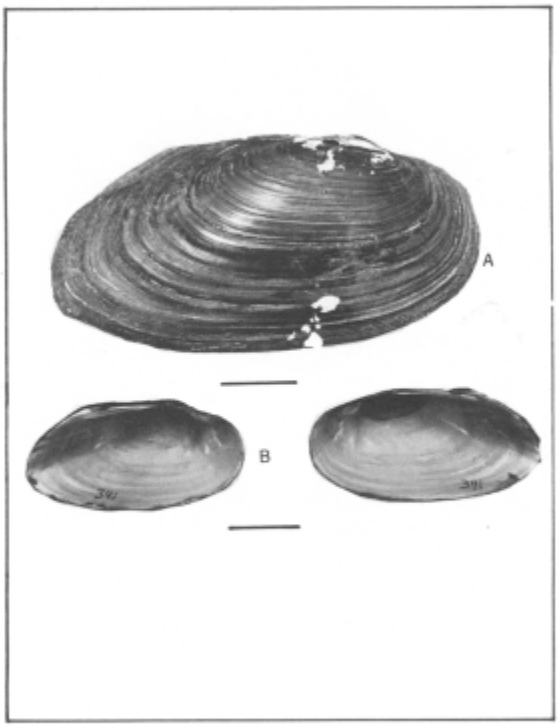

FIGURE 14. *Uniomerus tetralasmus.* a = external view, scale line = 17 mm; b = internal view, scale line = 28 mm.

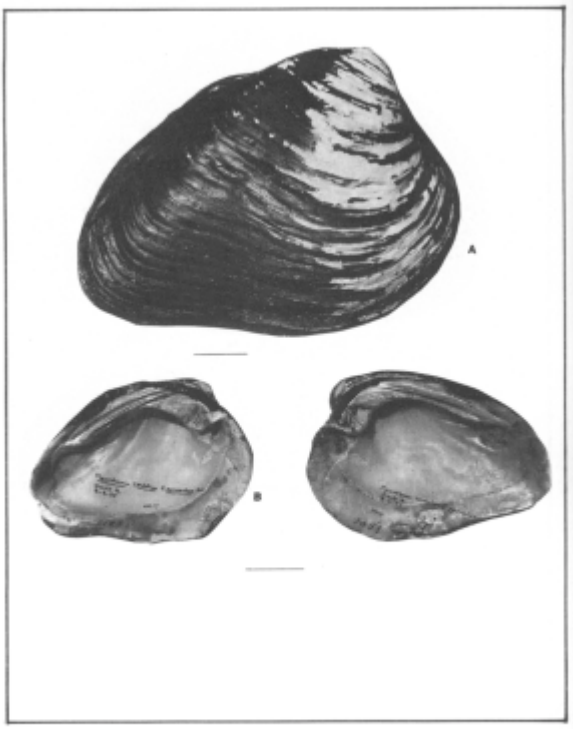

FIGURE 16. *Pleurobema cordatum* f. *pyramidatum.* a = external view, scale line = 29 mm; b = internal view, scale line = 32 mm.

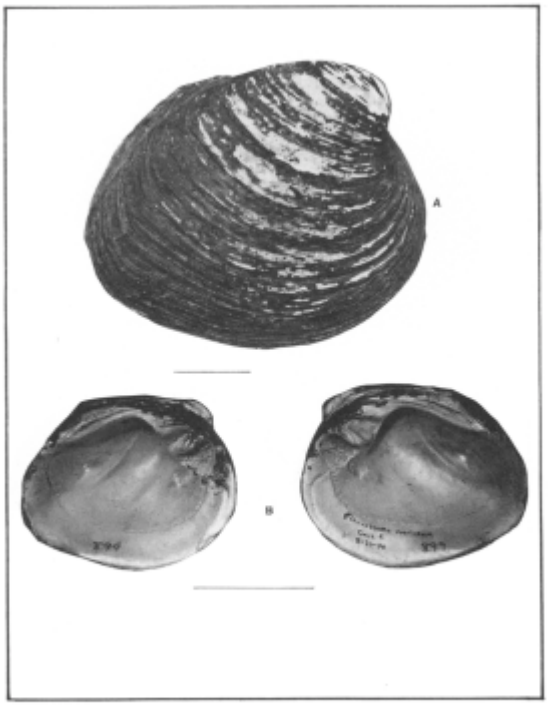

FIGURE 15. *Pleurobema cordatum* f. *coccineum.* a = external view, scale line = 32 mm; b = internal view, scale line = 65 mm.

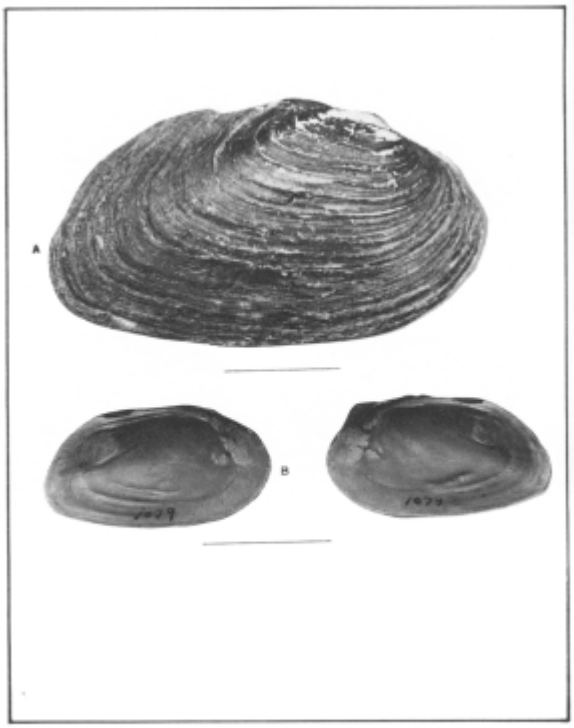

FIGURE 17. *Elliptio complanata.* a = external view, scale line = 21 mm; b = internal view, scale line = 42 mm.

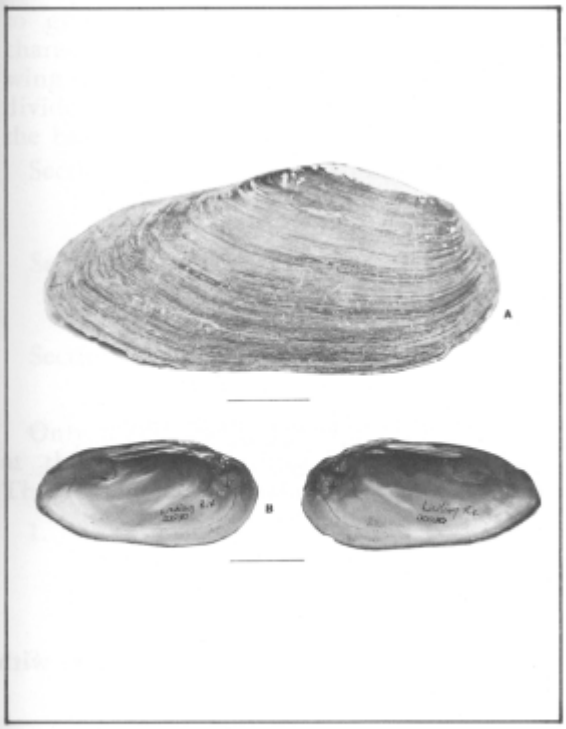

FIGURE 18. *Elliptio dilatatus.* a = external view, scale line = 41 mm; b = internal view, scale line = 27 mm.