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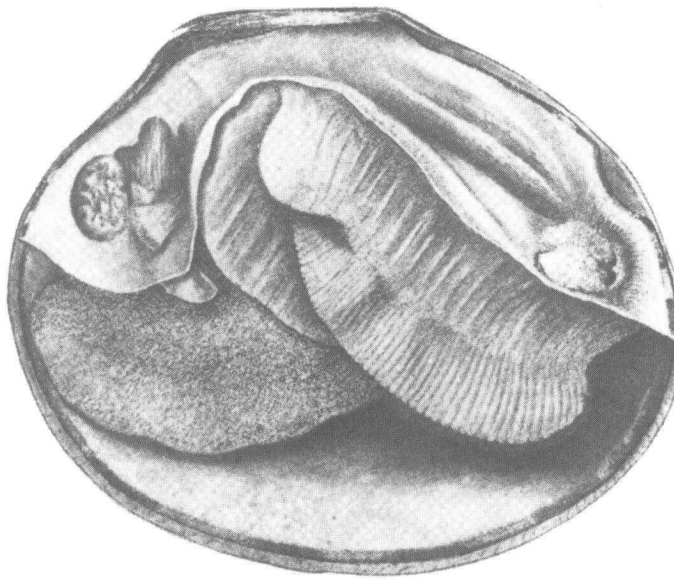

DROMUS DROMAS (LEA).

UNIVERSITY OF MICHIGAN

MUSEUM OF ZOOLOGY

Miscellaneous Publications No. 6

A Synopsis of the Classification of the Fresh-Water Mollusca of North America, North of Mexico,

AND

A Catalogue of the More Recently Described Species, With Notes

BY

BRYANT WALKER

PART II—CATALOGUE

ANN ARBOR, MICHIGAN
PUBLISHED BY THE UNIVERSITY
DECEMBER 30, 1918

A CATALOGUE OF THE MORE RECENTLY DESCRIBED FRESH-WATER MOLLUSCA OF NORTH AMERICA, WITH NOTES

Subclass EUTHYNEURA.
Order PULMONATA.
Suborder BASOMMATOPHORA.
Superfamily LIMNOPHILA.
Family LYMNÆIDÆ.

Genus LYMNÆA Lamarck, 1788.

Baker's elaborate monograph of the *Lymnæidæ* of North America (No. 6) brings the subject down to 1911.

Simpsonia having been used by Rochebrune in 1904 for a group of Naiades, Baker (7, p. 120) has substituted *Pseudogalba* for his Lymnæid group. The synonymy will be as follows:

Simpsonia Baker, Chi. Acad. Sci., Sp. Pub., 3, 1911, p. 236. *Non* Rochebrune, 1904.

Pseudogalba Baker, Naut., XXVI, 1913, p. 120.

For a proposed revision of Baker's arrangement and key, see Colton (22, p. 116 and 23, p. 119) and reply by Baker (8, p. 20).

For the author's arrangement, see ante p. 6.

LYMNÆA APICINA Lea.

Although Lea's name *solida* for this species has page precedence as stated by Hannibal (53, p. 146), and has been preferred by Haldeman, Tryon and Binney, according to Küster (Con. Cab., Lymnæus, p. 48) *solida* Phil. has priority and Lea's species must be known by the later name.

LYMNÆA AURICULARIA (L.).

This species seems to have become thoroughly acclimated and is extending its range in this country very rapidly. In addition to the localities cited by Baker (6, p. 182), it has been listed from Toledo, O., by Goodrch (47, p. 11); Lake Erie, Kingsville, Ont., by Allen (1, p. 60); Philadelphia, Pa., by Long (72, p. 27); Colorado Springs, Colo., by Henderson (55, p. 84); Charles River, Cambridge, Mass., by Clapp (19, p. 116) and Johnson (59, p. 83) and has more recently been found in the Detroit River at Belle Isle by Dr. H. B. Baker and at Gibralter, Wayne Co., and La Plaisance Bay, Monroe Co., by Goodrich and at Harbor Beach, Huron Co., Mich., by Walter Koelz.

LYMNÆA COOPERI Hannibal.
Lymnæa Cooperi Hannibal, Proc. Mal. Soc. Lond., X, 1912, p. 143, pl. VI, figs. 13a-c.
Type locality: Spring at Wright's, Santa Cruz Mountains, Cal.

LYMNÆA MONTANENSIS Baker.
Lymnæa montanensis Baker, Naut., XXVI, 1913, p. 115.
Type locality: Hayes' Creek, Ward, Montana.

Family PLANORBIDÆ.
Subfamily PLANORBINÆ H. and A. Adams, 1858.
Genus PLANORBIS Müller, 1774.

Dr. Dall genus (32, p. 80) has proposed the following arrangement of this genus:

Subgenus *Planorbis s. s.*
Type *Planorbis corneus* Müller.
Section *Planorbina* Haldeman.
Type *P. olivaceus* Spix.
Subgenus *Helisoma* Swainson.
Type *P. bicarinatus* (Say) Sowerby.
Section *Pierosoma* Dall.
Type *P. trivolvis* Say.
Section *Planorbella* Haldeman.
Type *P. campanulatus* Say.
Subgenus *Tropidiscus* Stein.
Type *P. umbilicatus* Müller.
Subgenus *Hippeutis* Agassiz.
Type *P. fontanus* Lightfoot.
Section *Menetus* H. and A. Adams.
Type *P. opercularis* Gould.
Subgenus *Gyraulus* Agassiz.
Type *P. albus* Müller.
Section *Torquis* Dall.
Type *P. parvus* Say.
Section *Armiger* Hartmann.
Type *P. crista* L.

For a criticism of Dall's arrangement, see Kennard (64, p. 47) and reply by Dall (33, p. 141).

Brown and Pilsbry have proposed (15, p. 212) a new section, *Tropicorbis,* type *P. liebmanni* Dkr., but without any definition.

PLANORBIS ALABAMENSIS Pilsbry.
Planorbis alabamensis Pilsbry, Naut., VIII, 1895, p. 114.
Type locality: Woodville, Ala.

Dall (32, p. 92) considers this a local race of *dilatatus* Gld., but it seems sufficiently distinct.

PLANORBIS ALABAMENSIS AVUS Pilsbry.
Planorbis alabamensis avus Pilsbry, Naut., XIX, 1905, p. 34.
Type locality: Caloosahatchee Pliocene, Fla. Also from the marl at Lake Panasoffkee, Fla.

PLANORBIS ANTROSUS Conrad.

Vanatta has shown (138, p. 138) that as the earliest available name this must take precedence over the familiar *P. bicarinatus* Say, *non* Lamarck,1804.

Conrad's type has disappeared and until topotypes can be obtained, the uncertainty as to whether Conrad's species is typical *bicarinatus* Say or equivalent to var. *angistomus* Hald. prevents the proper re-arrangement of the forms.

According to Vanatta (l. c.) *P. bicarinatus major* and *bicarinatus minor* of Beck (Index Moll., 1837, p. 118) are synonyms of the typical form.

Planorbis biangulatus Say., Con. Icon., Planorbis, 1877, Sp. 25, pl. IV, fig. 25, said to be from Brazil is apparently this species.

PLANORBIS ANTROSUS ANGISTOMUS Haldeman.
Planorbis bicarinatus angistomus Haldeman, Mon., 1844, p. 7; Walker, Naut., 1909, XXIII, p. 4, pl. II, figs. 4-5.
Type locality not given.

PLANORBIS ANTROSUS AROOSTOOKENSIS Pilsbry.
Planorbis bicarinatus aroostookensis Pilsbry, Naut., VIII, 1895, p.115; Walker, Naut., 1909, XXIII, p. 7, pl. 1, figs. 1 & 3.
Type locality: Salmon Brook, Woodland, Aroostook Co., Me.

PLANORBIS ANTROSUS CORRUGATUS Currier.
Planorbis bicarinatus corrugatus Currier MSS, DeCamp, Kent Sci. Inst. Misc. Pub., 1868, p. 8; Walker, Naut., XXIII, 1909, p. 5, pl. I, fig. 10.
Type locality: Perch Lake, Kent Co., Mich.

PLANORBIS ANTROSUS PERCARINATUS Walker.
Planorbis bicarinatus major Walker, Naut., VI, 1893, p. 136.
Planorbis bicarinatus percarinatus Walker, Naut., XXIII, 1909, p. 6, pl. I, fig. 12.
Type locality: Crystal Lake, Benzie Co., Mich.

PLANORBIS ANTROSUS PORTAGENSIS Baker.
Planorbis bicarinatus portagensis Baker, Naut., XXII, 1908, p. 45; Walker, Naut., 1909, XXIII, p. 8, pl. I, fig. 9.
Type locality: Portage Lake, Aroostook Co., Me.

PLANORBIS ANTROSUS ROYALENSIS Walker.
Planorbis bicarinatus royalensis Walker, Naut., XXIII, 1909, p. 9, pl. I, fig. 11.
Type locality: Siskowit Lake, Isle Royale, Mich.

PLANORBIS ANTROSUS STRIATUS Baker.
Planorbis bicarinatus striatus Baker, Naut., XV, 1902, p. 120; Tr. Acad. Sci. St. Louis, 1906, XVI, p. 9, pl. I, fig. 11.
Type locality: Coldspring Park, Milwaukee, Wis. Also recent. See Walker, 151a, p. 7.

PLANORBIS ANTROSUS UNICARINATUS Haldeman.
Planorbis bicarinatus unicarinatus Haldeman, Mon., 1844, p. 7; Walker, Naut., XXIII, 1909, p. 3, pl. I, figs. 6-8.
Type locality: Schuylkill River, Pa.

PLANORBIS ARCTICUS Möller.
Planorbis arcticus Möller, Index Moll. Grönl., 1842, p. 5; Mörch, Am. J. of Con., 1868, IV, p. 32, pl. 4, fig. 9.
Type locality: Kudsuk, Greenland. Also Fort Chimo, Ungava, Labrador.

PLANORBIS ARIZONENSIS Pilsbry and Ferriss.
Planorbis filocinctus Pilsbry and Ferriss, Pr. A. N. S. P., 1906, p. 165, pl. IX, figs. 1-3, not of Sandberger.
Planorbis arizonensis Pilsbry and Ferriss, Pr. A. N. S. P., 1915, p. 390.
Type locality: San Pedro River, Benson, Ariz.

PLANORBIS BILLINGSI Lea.
Planorbis billingsi Lea, Pr. A. N. S. P., 1864, p. 111; Jour. A. N. S. P., 1866, VI, p. 15, pl. 23, fig. 72; Obs., 1866, XI, p. 115, pl. 23, fig. 72.
Type locality: Ottawa River, Canada. See *parvus*.

PLANORBIS CALLIOGLYPTUS Vanatta.
Planorbis callioglyptus Vanatta, Naut., IX, 1895, p. 54.
Type locality: Freeport, Wash.
Is *opercularis planulatus* Cooper according to Dall (32, p. 92).

PLANORBIS CAMPANULATUS MINOR Dunker.
Planorbis companulatus minor Dunker, Con. Cab., 1850, Limnæiden, p. 52, pl. 9, fig. 10.
Type locality not given.

PLANORBIS CAMPANULATUS RUDENTIS Dall.
Planorbis campanulatus rudentis Dall, Rep. Harriman Exp., 1905, XIII, p. 90.
Type locality: Knee Lake, Keewatin, Canada.

The citations of *P. multivolvis* from Newfoundland by Farrar (37, p. 36), and from Michigan by Walker, prior to 1907, refer to this form and not to Case's species.

PLANORBIS CAMPANULATUS SMITHII Baker.
Planorbis campanulatus smithii Baker, Naut., XXV, 1912, p. 118.
Type locality: Douglas Lake, Cheboygan Co., Mich.

PLANORBIS CARIBÆUS d'Orbigny.

This name has priority for the species commonly known as *tumidus* Pfr.

PLANORBIS CARUS Pilsbry and Ferriss.
Planorbis carus Pilsbry and Ferriss, Pr. A. N. S. P., 1906, p. 164, pl. IX, figs. 4-5.
Type locality: Canyon of the Pecos River, above High Bridge, Val Verde Co., Texas.

PLANORBIS CENTERVILLENSIS Tryon.
Planorbis centervillensis Tryon, Mon., 1870, p. 210, pl. 7, figs. 7-9.
Type locality: Centerville, Cal.

Is a form of *opercularis* according to Dall (32, p. 92).

PLANORBIS CIRCUMSTRIATUS Tryon.
Planorbis circumstriatus Tryon, Am. J. of Con., II, 1866. p. 113, pl. 10, figs. 6-8.
Type locality: Weatogue, Conn.

As identified by Sterki, this species is certainly distinct from *P. parvus* Say. It ranges from Connecticut to Colorado.

PLANORBIS COARCTATUS Sowerby.
Planorbis coarctatus Sowerby, Con. Icon., Planorbis, 1876, Sp. 21, pl. 3, fig. 21a-b.
Type locality:?
This is apparently an immature *campanulatus*.

PLANORBIS COMMUTATUS "Dunker" Sowerby.
Planorbis commutatus Sowerby, Con. Icon., Planorbis, 1876, Sp. 63, pl. 8, fig. 63.
Type locality: North America.

PLANORBIS CORPULENTUS Say.

Is a valid species. See Walker, 144, p. 133. The citation of this species from Florida or South Carolina by Melvill (74, p. 167) is no doubt erroneous. Sowerby's figures of this species in the Conchologia Iconica are *binneyi* Tryon.

PLANORBIS CRISTA L.
Planorbis nautileus, Walker, Naut., 1897, X, p. 117; Hanham, Naut., 1897, X, 130; Taylor, Naut., 1897, X, p. 139.
Planorbis costatus DeTarr and Beecher, Leaflet, Albany, 1878; Baker, Naut., 1906, XIX, p. 120.
Range: Maine, west to Alberta and Illinois.

PLANORBIS CULTRATUS Orbigny.
Planorbis cultratus Orbigny, Hist. Cuba Moll., 1853, (Fr. ed.) I, p. 196, pl. 14, figs. 5-8; Pilsbry, Naut., 1889, III, p. 63, pl. I, figs. 1-3.
Type locality: Cuba?

Listed from Miami, Fla., by Rhoads (113, p. 48) and by Pilsbry from Hidalgo, Tex. (88, p. 63) and by Pilsbry and Ferriss from Devils River, Val Verde Co., Tex. (106, p. 165).

PLANORBIS DECLIVIS Sowerby.
Planorbis declivis Sowerby, Con. Icon., Planorbis, 1876, Sp. 28, pl. 4, fig. 29.
Type locality: ?

Von Martens (73, p. 397) thinks that this is probably a form of *trivolvis*. The name is preoccupied by Tate (1870), for a species from Nicaragua.

PLANORBIS DEFLECTUS Say.
Planorbis deflexus Sowerby, Con. Icon., Planorbis, 1876, Sp. 88. pl. XI, fig. 88.

Dall (32, p. 94) considers this doubtfully distinct from *hirsutus* and apparently identical with the European form known as *draparnaudi* or *draparnaldi* Shepp.

PLANORBIS DILATATUS Gould.

Includes *buchanensis* Lea according to Tryon (132, p. 209); *virens* and *elevatus* according to Vanatta (136, p. 55); and *lens, alabamensis* and *buchanensis* according to Dall (32, p. 92).

PLANORBIS DILATATUS PENNSYLVANICUS Pilsbry.
Planorbis dilatatus pennsylvanicus Pilsbry, Naut., XXX, 1916, p. 96.
Type locality: Glenolden, Delaware Co., Pa.

PLANORBIS DURYI Wetherby.
Planorbis duryi Wetherby, Jour. Cin. Soc. Nat. Hist., 1879, p. 7, fig. 4.
Type locality: Everglades, Fla. Types No. 9712 Coll. Walker.

PLANORBIS DURYI INTERCALARIS Pilsbry.
Planorbis duryi intercalaris Pilsbry, Amer. Nat., 1887, XXI, p. 287.
Planorbis intercalaris Rhoads, Naut., 1899, XIII, p. 47.
Type locality: Florida.

PLANORBIS EUCOSMIUS Bartsch.
Planorbis eucosmius Bartsch, Pr. U. S. Nat. Mus., 1908, XXXIII, p. 699, pl. 57, figs. 1-3.
Type locality: Greenfield Pond, Wilmington, N. C.

PLANORBIS EUCOSMIUS VAUGHANI Bartsch.
Planorbis eucosmius vaughani Bartsch, Pr. U. S. Nat. Mus., XXXIII, 1908, p. 699, pl. 57, figs. 4-6.
Type locality; Burkes Place, La.

PLANORBIS EXACUOUS Say.

Commonly known as *exacutus* Say, but Dall (32, p. 91) restores the name as originally used by Say. Henderson and Daniels (56, p. 56), after careful consideration, have done likewise. It includes *buchanensis* Lea according to Vanatta (*fide* Simpson) (136, p. 54).

PLANORBIS EXACUOUS MEGAS Dall.
Planorbis exacuous megas Dall, Rep. Harriman Exp., XIII, 1905, p. 91.
Type locality: Birtle, Manitoba.

PLANORBIS GLABRATUS Say.

Haldeman's and Binney's figures do not represent this species, which is entirely distinct from *trivolvis*. It is not uncommon in Florida and in the United States does not range outside of that state, (Pilsbry, 91, p. 321). Dall (32, p. 86) includes *lentus*, which was described from New Orleans, but this does not accord with Fischer and Crosse's (38, p. 65) identification of Say's type. The true *glabratus* belongs to section *Planorbina* and not to *Pierosoma*.

PLANORBIS GRACILENTUS Gould.

Tryon (132, p. 1921) Fischer and Crosse (38, p. 72) consider this distinct from *liebmanni,* to which it is referred by Binney.

PLANORBIS HAVANENSIS Pfeiffer.

Listed from New Orleans, La., as a *Segmentina* by Pilsbry (85, p. 20) and Hinkley (58, p. 36).

PLANORBIS HIRSUTUS Gould.

Is considered distinct from *albus* Müll. by Vanatta (136, p. 55). Dall (32, p. 94) refers it to the so-called *albus* Müll., but in view of the uncertainty as to the proper name to be used for that species, retains Gould's name. Kennard (64, p. 49) considers the American and European species as distinct.

PLANORBIS HIRSUTUS BOREALIS Westerlund.

Planorbis borealis Westerlund, Mal. Bl., XXII, 1875, p. 77.

Type locality: Port Clarence, Alaska; Northern Sweden.

Stated by Dall (32, p. 94) to be "merely a somewhat delicately sculptured mutation."

PLANORBIS HORNI Tryon.

Planorbis horni Tryon, Am. J. of Con., I, 1865, p. 231, pl. 22, fig. 16.

Type locality: Fort Simpson, British America.

Listed as a var. of *trivolvis* by Pilsbry (95, p. 65). Dall (32, p. 89) states that there is a doubt as to whether the types came from Fort Simpson on the Mackenzie River, or Fort Simpson, British Columbia, but that the figure looks more like the Pacific variety (*subcrenatus*), which he refers to *trivolvis.*

PLANORBIS INTERTEXTUS Sowerby.

Planorbis intertextus Sowerby, Con. Icon., Planorbis, 1876, Sp. 123, pl. 14, figs. 123a-b.

Type locality: Florida.

Through the courtesy of Mr. E. A. Smith of the British Museum I have been able to examine one of the cotypes of this species. Both the description and the figure given by Sowerby are quite erroneous and very misleading. It has no resemblance whatever to *antrosus,* but is undoubtedly a young shell of one of the many southern mutations of *trivolvis.*

PLANORBIS JENKSII Carpenter.

Planorbis jenksii Carpenter, Central Falls (R. I.) Visitor, Mar. 2, 1871; Con. Ex., II, 1887, p. 2.

Type locality: Pawtucket, R. I.

PLANORBIS LENTUS Say.

Fischer and Crosse (38, p. 65) restrict this species to the New Orleans form described by Say and do not consider that the figures given by Gould, Haldeman, Dunker and others represent the species. Dall (32, p. 86) refers it to *glabratus*.

PLANORBIS LIEBMANNI Dunker.

Is referred to *orbiculus* by Fischer and Crosse (38, p. 71), but is stated by Pilsbry (91, p. 322) to be distinct. It is the type of section *Tropicorbis* Brown and Pilsbry.

PLANORBIS MAGNIFICUS Pilsbry.

Planorbis magnificus Pilsbry, Naut., 1903, XVII, p. 75; Bartsch, Pr. U. S. Nat. Mus., XXXIII, 1908, p. 697, pl. 57, figs. 7-9.

Type locality: Cape Fear River, Wilmington, N. C.

PLANORBIS MULTIVOLVIS Case.

Is a valid species and has been rediscovered at Howe Lake, Marquette Co., Mich. See Walker, 149, p. 61. Earlier citations of this species from Michigan, except the original one, and Newfoundland, refer to *P. campanulatus rudentis*.

PLANORBIS NATHORSTI Westerlund.

Planorbis nathorsti Westerlund, Vega Exp., IV, 1887, p. 168.

Type locality: Aulatsivik, West Greenland.

PLANORBIS OCCIDENTALIS Cooper.

Planorbis occidentalis Cooper, Pr. Cal. Acad. Sci., IV, 1870, p. 99.

Type locality: Not given. Range: Washington Terr. to San José, Cal.

See *trivolvis*. Is the mature form of *tumens* according to Cooper (26, p. 89).

PLANORBIS OPERCULARIS Gould.

Planorbis lenticularis Sowerby, Con. Icon., Planorbis, 1876, Sp. 110, pl. 13, fig. 110.

Includes *planulatus* Cooper, *centervillensis* Tryon and *multilineatus* Van. (*oregonensis* Van.) as varieties according to Dall (32, p. 92), with *callioglyptus* Van. as a synonym of *planulatus*.

PLANORBIS OPERCULARIS MULTILINEATUS Vanatta.

Planorbis opercularis oregonensis Vanatta, Naut., IX, 1895, p. 54; *non* Tryon, 1865.

Planorbis opercularis multilineatus Vanatta, Naut., XIII, 1899, p. 48.

Type locality: Salem and Portland, Oregon.

PLANORBIS ORBICULUS Morelet.
Planorbis orbiculus Morelet, Test. Noviss., 1849, I, p. 17.

Includes *haldemani* Dunker (1850) *non haldemani* C. B. Adams (1849). Fischer and Crosse also include *liebmanni*, but Pilsbry (l. c.) considers it to be distinct.

PLANORBIS OREGONENSIS Tryon.
Planorbis oregonensis Tryon, Am. J. of Con., I, 1865, p. 231, pl. 22, fig. 17.
Type locality: Pueblo Valley, Oregon. See *trivolvis*.

PLANORBIS PARVUS Say.

Includes *billingsii* Lea according to Vanatta (136, p. 54) and Dall (32, p. 95) and *circumstriatus* Tryon according to Vanatta (l. c.).

PLANORBIS PARVUS WALKERI Vanatta.
Planorbis parvus walkeri Vanatta, Naut., XVI, 1902, p. 58.
Type locality: Hartland, Vt. Also Michigan.

PLANORBIS PERFORATUS "Gould?" Sowerby.
Planorbis perforatus Sowerby, Con. Icon., Planorbis, 1876, Sp. 105, pl. 13, fig. 105.
Type locality: United States.

Gould never described a *Planorbis* under this name. Clessin (20, p. 227) suggests that the species is perhaps from East Asia.

PLANORBIS PLANULATUS Cooper.

Is doubtfully referred to *P. opercularis* Gld. as a variety by Cooper (25, p. 100).

PLANORBIS PLEXATA Ingersoll.
Planorbis plexata Ingersoll, U. S. Geol. & Geog. Surv. Terr., 1874, p. 402, text-fig.
Type locality: St. Mary's Lake, Antelope Co., Col.

Is a var. of *trivolvis* according to Stearns (121, p. 105) and Cooper (26, p. 85).

PLANORBIS RUBELLUS Sterki.
Planorbis harni Pilsbry, Naut., IV, 1891, p. 137, *sine desc.*
Planorbis exacutus rubellus Sterki, L. and F. W. Moll., New Phila., 1894, p. 7.
Planorbis rubellus Pilsbry, Naut., XIII, 1899, p. 51.
Type locality: Stone Creek Valley, Odbert's Station, O.

PLANORBIS SAMPSONI Ancey.

Planorbis sampsoni Ancey in Sampson, Bull. Sedalia N. H. Soc., No. 1, 1885, p. 10, text-fig.

Type locality: Flat Creek, Sedalia, Mo.

PLANORBIS SCALARIS (Jay).

Paludina scalaris Jay, Cat., 3rd ed., 1839, p. 112, pl. 1, figs. 8-9.

Physa scalaris Haldeman, Mon., 1842, p. 34, pl. IV, fig. 9; W. G. Binney. L. and F. W. Shells, pt. II, 1865, p. 96, fig. 164.

Ameria scalaris Tryon, Mon., 1870, p. 168; Dall, Ann. N. Y. Lyc. N. H., IX, 1870, p. 356; Naut., III, 1889, p. 8.

Planorbis scalaris Pilsbry, Con. Ex., II, 1888, p. 113.

Physa (*Thomsonia*) *carinifera* Ancey, Le Nat., 1886, p. 358.

Type locality: Everglades of Florida.

Pilsbry (86, p. 287) states that this species is a *Planorbis*.

PLANORBIS SINUOSUS Bonnet.

Planorbis sinuosus Bonnet, Rev. & Mag. Zool., 1864, p. 280, pl. XXII, fig. 3.

Type locality: New Mexico.

Is referred to *glabratus* Say by Tryon (129, p. 183). Fischer and Crosse (38, p. 67) question this approximation, but as their opinion is based on Binney's figure (11, fig. 179), which does not represent Say's species, it is not of much value. However as *glabratus* is not known to occur outside of Florida, Tryon's suggestion is wrong anyway. Dr. Pilsbry informs me that it is *P. tumidus* Pfr.

PLANORBIS SUBCRENATUS DISJECTUS Cooper.

Planorbis subcrenatus disjectus Cooper, Pr. Cal. Acad. Sci., (2) III, 1890, p. 84, pl. 1, fig. 30.

Type locality: Tuolumne Meadows, Cal.

PLANORBIS TENUIS Phil.

Listed from the drift of the Santa Cruz River, Tucson, Ariz., by Pilsbry and Ferriss (109, p. 400).

PLANORBIS TRASKII Lea.

Planorbis traskii Lea, Jour. A. N. S. P., VI, 1866, p. 157, pl. XXIII, fig. 70; Obs., XI, 1866, p. 113, pl. XXIII, fig. 70.

Type locality: Kern Lake, Cal.

Dall (32, p. 88) considers this specifically distinct from *P. ammon*.

PLANORBIS TRIVOLVIS Say.

Includes *subcrenatus* Cpr., with *oregonensis* Tryon, *occidentalis* Cooper, and *tumens* Cooper, *non* Cpr., as synonyms and probably *hornii* Tryon according to Dall (32, p. 89). Pilsbry also (95, p. 65) lists *hornii* as a variety.

PLANORBIS TRIVOLVIS BINNEYI Tryon.

Planorbis corpulentus Gould, U. S. Expl. Exp., 1852, p. 114, fig. 130; Haldeman, Mon., 1844, p. 19, pl. III, figs. 7-9; W. G. Binney, L. & F. W. Shells, pt. II, 1865, p. 114, figs. 191-2; Sowerby, Con. Icon., 1877, Sp. 4, pl. I, fig. 4; pl. X, fig. 4b.

Planorbis binneyi Tryon, Am. J. of Con., III, 1867, p. 197.

Type locality: West Coast.

PLANORBIS UMBILICATELLUS Cockerell.

Planorbis umbilicatus Taylor, J. of Con., IV, 1885, p. 351, text-fig. *Non* Müller (1774).

Planorbis umbilicatellus Cockerell, Con. Ex., 1885, II, p. 68.

Type locality: Brandon and Birtle, Manitoba. Ranges from New York to South Dakota. See also Vanatta (137, p. 117).

PLANORBIS VERMICULARIS Gould.

Is referred to *parvus* by Vanatta (136, p. 55), but is considered distinct by Dall (32, p. 95).

Genus SEGMENTINA Fleming, 1817.
Subgenus PLANORBULA Haldeman, 1842.

SEGMENTINA ARMIGERA (Say).

Dr. Pilsbry informs me that he has seen the type of *Planorbis lautus* H. Ads. and that it is a young specimen of this species.

SEGMENTINA ARMIGERA CAMPESTRIS Dawson.

Segmentina armigera campestris Dawson, Rep. Brit. N. A. Boundary Com., 1875, p. 349.

Type locality: Red River Valley, Canada.

SEGMENTINA CHRISTYI Dall.

Segmentina christyi Dall, Rep. Harriman Exp., XIII, 1905, p. 99, pl. 11, figs. 10-11.

Type locality: High Bluff, Manitoba; Fort Smith, Mackenzie River. Reported from South Dakota by Walker (151, p. 11).

SEGMENTINA CRASSILABRIS Walker.

Segmentina crassilabris Walker, Naut., XX, 1907, p. 122, pl. 7, figs. 4-6.

Type locality: Hamtramck, Wayne Co., Mich.

SEGMENTINA DECLIVIS (Tate).
Planorbis declivis Tate, Am. J. of Con., V, 1869, p. 159.
Type locality: San Augustin. Acoyapa, Nicaragua.

Cited by Dall (32, p. 98) from Umpqua River, Oregon.

Hannibal (53, p. 158) states that it has not been found by any of the local collectors in that region and questions the authenticity of the locality of Dall's specimens.

SEGMENTINA OBSTRUCTA (Morelet).
Planorbis obstructus Morelet, Test. Noviss., I, 1849, p. 17.
Planorbis berendti Tryon, Am. J. of Con., II, 1866, p. 10, pl. 2, figs. 14-16.
Type locality: Carmen Island, Yucatan.

"Occurs abundantly in Texas as far north as Austin." (Pilsbry, 91, p. 322. See also Pilsbry and Ferris, 106, p. 166.) In the absence of a figure of this species in any American publication, I have quoted that of *berendti* Tryon from Mexico, which is considered a synonym by Fischer and Crosse (38, p. 78) and von Martens (73, p. 398).

SEGMENTINA WHEATLEYI (Lea).
Planorbis wheatleyi Lea, Jour. A. N. S. P., VI, 1866, p. 158, pl. 23, fig. 71; Obs., XI, 1866, p. 113, pl. 23, fig. 71.
Segmentina wheatleyi Walker, Naut., XX, 1907, p. 123, pl. VII, figs. 7-9.

Dall (32, p. 97) has proposed a new section, *Haldemanina,* for this species, based on the "complex, dentiform and ridgelike" lamellæ, but these differ from those of the other species (*armigera* and *crassilabris*) only in degree. See Pilsbry and Ferriss (106, p. 166) and Walker (l. c.).

Subfamily POMPHOLIGINÆ Dall, 1866.
Genus POMPHOLYX Lea, 1856.

POMPHOLYX LEANA H. and A. Adams.
Pompholyx leana H. and A. Adams, Pr. Zool. Soc. London, 1863, p. 434.
Type locality: West Columbia.

POMPHOLYX SOLIDA Dall.
Pompholyx var. *solida* Dall, Ann. N. Y. Lyc. Nat. Hist., IX, 1870, p. 335, pl. II, fig. 7a.
Type locality: West Columbia.

Dall states that his species is clearly not *effusa* Lea, but that in the absence of typical specimens of *P. leana* H. and A. Adams described from West Columbia, it still remains doubtful whether it belongs to the latter species.

Genus CARINIFEX W. G. Binney, 1863.
Megastropha Lea, 1866.

CARINIFEX NEWBERRYI MINOR Cooper.
Carinifex newberryi var. ? *minor* Cooper, Pr. Cal. Acad. Sci., IV, 1870, p. 98.
Type locality not stated.

CARINIFEX PONSONBYI E. A. Smith.
Carinifex ponsonbyi E. A. Smith, P. Z. S. Lond., 1875, p. 536, text-fig.
Planorbis ponsonbyi Sowerby, Con. Icon., Planorbis, 1876, Sp. 80, pl. X, figs. 80a-b.
Type locality: California.

Call (16, p. 140) states that the figure in the P. Z. S. is interchanged with that of *Diala leithii* described at the same time.

Family PHYSIDÆ.
Genus PHYSA Draparnaud.

Dall (32, p. 100) has proposed the following arrangement:

Section PHYSA *s. s.*
Type *P. fontinalis* L.
Section COSTATELLA Dall.
Type *P. costata* Newcomb.

For an excellent revision of the Eastern American species, see Crandall, No. 27.

Von Martens (73, p. 368) has proposed the subgenus *Alampetis* for the North American and Mexican species with a dull, not glossy surface and (often) thickened lip. He gives no type, but mentions *P. ancillaria* as an example.

PHYSA ALBOFILATA Ancey.
Physa albofilata Ancey, in Sampson, Rep. Geol. Surv. Ark., II, 1891, p. 194.
Type locality: West Leatherwood Creek, Eureka Springs, Carroll Co., Ark.
See *gyrina*.

PHYSA ALTONENSIS Lea.
Physa altonensis Lea, Pr. A. N. S. P., 1864, p. 114; Jour. A. N. S. P., VI, 1866, p. 164, pl. 24, fig. 82; Obs., XI, 1866, p. 120, pl. 24, fig. 82.
Type locality: Alton, Ills.

Is *elliptica* according to Tryon (132, p. 163) and an abnormal gy*rina* according to Crandall (27, p. 71).

PHYSA AMPULLACEA Gould.

Includes *P. lordi* Bd., *propinqua* Try. and *coniformis* Try. as varieties according to Cooper (25, p. 98).

According to Henderson and Daniels (56, p. 52) it is possible that Lea's *P. nuttallii* may be this species. If so it would have priority.

PHYSA AMPULLACEA COLUMBIANA Hemphill.
Physa ampullacea columbiana Hemphill, Naut., IV, 1890, p. 27.
Type locality: Columbia River, Astoria, Oregon.

PHYSA AMYGDALUS Sowerby.
Physa amygdalus Soweriby, Con. Icon., Physa, 1873, Sp. 65, pl. 8, fig. 65.
Type locality: Texas.

PHYSA ANATINA Lea.
Physa anatina Lea, Pr. A. N. S. P., 1864, p. 115; Jour. A. N. S. P., VI, 1866, p. 171, pl. 24, fig. 94; Obs., XI, 1866, p. 127, pl. 24, fig. 94.
Type locality: Northern tributary of the Arkansas River, Kans.

PHYSA ANCILLARIA Say.

According to von Martens (73, p. 374) *Physa subarata* to Mke. belongs to this species and not to *P. heterostropha* Say as supposed by Binney and is represented by fig. 1, pl. III of Haldeman's Monograph.

PHYSA ANCILLARIA CRASSA Walker.
Physa ancillaria crassa Walker, Naut., XIV, 1901, p. 98.
Type locality: Higgins Lake, Roscommon Co., Mich.
Types No. 1471 Coll. Walker.

PHYSA ANCILLARIA MAGNALACUSTRIS Walker.
Physa ancillaria magnalacustris Walker, Naut., XIV, 1901, p. 97.
Type locality: Frankfort, Benzie Co., Mich.
Types No. 9214 Coll. Walker.

PHYSA APLECTOIDES Sterki.
Physa aplectoides Sterki, Pr. O. St. Acad. Sci., IV, 1907, p. 381.
Type locality: Portage and Tuscawaras Co's., O. Also Isle Royale and Schoolcraft County, Michigan.

PHYSA AUREA Lea.

Is a synonym of *elliptica* and not of *heterostropha* according to Tryon (132, p. 163) and Crandall (27, p. 55).

PHYSA BILLINGSII Heron.

Physa billingsii Heron, Tr. Ott. F. Nat. Club, I, 1880, p. 62, pl. 2, fig. 5.
Type locality: Billings' Bridge, Ottawa, Ont.

Is a var. of *integra* according to Crandall (27, p. 15).

PHYSA BINNEYANA Ancey.

Physa diaphana Tryon, Am. J. of Con., I, 1865, p. 224, pl. 23, fig. 11, *non* Krauss (1848).
Physa binneyana Ancey, Le Nat., 1886, p. 358.
Type locality: Oakland, Cal.

PHYSA BLANDI Lea.

Physa blandi Lea, Pr. A. N. S. P., 1864, p. 116; Jour. A. N. S. P., VI, 1866, p. 168, pl. 24, fig. 88; Obs., XI, 1866, p. 124, pl. 24, fig. 88.
Type locality: California.

Includes *distinguenda* Try. and "?" is the same as *grosvernori* Lea and *nuttallii* Lea according to Cooper (25, p. 97). Both of the latter names have priority.

PHYSA BREVISPIRA Lea.

Physa brevispira Lea, Pr. A. N. S. P., 1864, p. 116; Jour. A. N. S. P., VI, 1866, p. 173, pl. 24, fig. 98; Obs., XI, 1866, p. 129, pl. 24, fig. 98.
Type locality: Ottawa River, Ont.

PHYSA CARLTONII Lea.

Physa carltonii Lea, Pr. A. N. S. P., 1869, p. 125; Jour. A. N. S. P., VIII, 1874, p. 63, pl. 21, fig. 19; Obs., XIII, 1874, p. 67, pl. 21, fig. 19.
Type locality: Mount Diablo, Cal.

PHYSA CONIFORMIS Tryon.

Physa coniformis Tryon, Am. J. of Con., II, 1866, p. 6, pl. II, fig. 5.
Type locality: Humboldt River, Oregon.

PHYSA COOPERI Tryon.

Physa cooperi Tryon, Am. J. of Con., I, 1865, p. 224, pl. 23, fig. 9.
Type locality: Crane Lake Valley, Cal.

Is a variety of *P. triticea* Lea according to Cooper (25, p. 97).

PHYSA CRANDALLI Baker.
Physa rhomboidea Crandall, Naut., XV, 1901, p. 44, pl. II, figs. 6-7, *non* Meek and Hayden (1856).
Physa crandalli Baker, Tr. Acad. St. Louis, XVI, 1906, p. 8.
Type locality: Cedar and Muddy Creeks, Sedalia, Mo. Also Dardenelles and Sulphur Springs, Ark., and Las Vegas, N. M.
Types No. 40775 Coll. Walker.
According to Springer (120, p. 513) is a synonym of *P. humerosa*.

PHYSA CROCATA Lea.
Physa crocata Lea, Pr. A. N. S. P., 1864, p. 114; Jour. A. N. S. P., VI, 1866, p. 169, pl. 24, fig. 90; Obs., XI, 1866, p. 125, pl. 24, fig. 90.
Type locality: Lafayette, Walker Co., Ga.
Is closely allied to *microstoma* Hald. according to Crandall (27, p. 70).

PHYSA CUPREONITENS Cockerell.
Physa cupreonitens Cockerell, J. of Con., VI, 1889, p. 63.
Type locality: Hot Spring, Wellsville, Colo.
Though described as a distinct species, in the text it is called a subspecies of *heterostropha*.

PHYSA CUBENSIS Pfeiffer.
Physa cubensis Pfeiffer, Wiegm. Archiv., I, 1839, p. 354.
Physa heterostropha peninsulæ Pilsbry, Naut., XIII, 1899, p. 48; Ibid., XIII, 1899, p. 70.
Type locality: Cuba. Also Miami and elsewhere in Florida. See Rhoads (113, p. 48).

PHYSA DEFORMIS Currier.
Physa deformis Currier, Am. J. of Con., III, 1867, p. 112, pl. 6, fig. 1.
Type locality: Grand Rapids, Mich.
Is *elliptica* Lea according to Crandall (27, p. 54).

PHYSA DISTINGUENDA Tryon.
Physa distinguenda Tryon, Am. J. of Con., I, 1865, p. 225, pl. 23, fig. 6.
Type locality: Marysville and Stockton, Cal.

PHYSA DORBIGNYANA Lea.
Physa striata Lea, Pr. A. N. S. P. 1864, p. 115, *non* d'Orbigny (1853), *nec* Menke (1830).
Physa dorbignyana Lea, Jour. A. N. S. P., VI, 1866, p. 166, pl. 24, fig. 85; Obs., XI, 1866, p. 123, pl. 24, fig. 85.
Type locality: Monterey, Cal.
Is a synonym of *P. virgata* Gld. according to Pilsbry and Ferriss (108, p. 198).

PHYSA ELLIPTICA Lea.

Is a valid species according to Crandall (27, p. 54) and includes *troostiana* Lea and *minor* Crandall as varieties and *aurea, febigeri* and *nicklinii* Lea and *deformis* Currier as synonyms. Baker's figures (4, pl. 34, fig. 5), copied by Blatchley and Daniels (14, pl. I, fig. 118) do not represent the true *elliptica*.

PHYSA ELLIPTICA MINOR Crandall.

Physa elliptica minor Crandall, Naut., XV, 1901, p. 55.
Type locality: Grand Rapids, Mich.
Types No. 14469 Coll. Walker.

PHYSA FEBIGERI Lea.

Physa febigeri Lea, Pr. A. N. S. P., 1864, p. 114; Jour. A. N. S. P., VI, 1866, p. 174, pl. 24, fig. 99; Obs., XI, 1866, p. 130, pl. 24, fig. 99.
Type locality: Logan Co., O.

Is *elliptica* according to Tryon (132, p. 163) and Crandall (27, p. 55).

PHYSA FORSHEYI Lea.

Physa forsheyi Lea, Pr. A. N. S. P., 1864, p. 114; Jour. A. N. S. P., VI, 1866, p. 172, pl. 24, fig. 95; Obs., XI, 1866, p. 128, pl. 24, fig. 95.
Type locality: Rutersville, Texas.

Includes *whitei* Lea according to Crandall (27, p. 67).

PHYSA FRAGILIS Mighels.

Is a pathologic form of *ancillaria* according to Morse (75, p. 43).

PHYSA GROSVERNORI Lea.

Physa grosvernori Lea, Pr. A. N. S. P., 1864, p. 114; Jour. A. N. S. P., VI, 1866, p. 175, pl. 24, fig. 100; Obs., XI, 1866, p. 131, pl. 24, fig. 100.

According to Cooper (25, p. 97) includes *P. traskii* Lea, *occidentalis* Try., *dorbignyana* Lea and *sparsestriata* Try. as varieties.
Type locality: Santa Rita Valley.

Is a var. of *forsheyi* according to Crandall (27, p. 69).

PHYSA GYRINA Say.

Includes *cylindrica* Newc., *altonensis, hawnii* and *smithsoniana* Lea as synonyms and *albofilata* Ancey, *hildrethiana* Lea and *oleacea* Tryon as varieties according to Crandall (27, p. 45).

PHYSA HALEI Lea.
Physa halei Lea, Pr. A. N. S. P., 1864, p. 114; Jour. A. N. S. P., VI, 1866, p. 165, pl. 24, fig. 83; Obs., XI, 1866, p. 121, pl. 24, fig. 83.
Type locality: Alexandria, La.

PHYSA HAWNII Lea.
Physa hawnii Lea, Pr. A. N. S. P., 1864, p. 115; Jour. A. N. S. P., VI, 1866, p. 165, pl. 24, fig. 84; Obs., XI, 1866, p. 121, pl. 24, fig. 84.
Type locality: Verdigris River, Kans.
Is *gyrina* according to Tryon (132, p. 162) and Crandall (27, p. 54).

PHYSA HETEROSTROPHA Say.
Includes *lata* and *primeana* Tryon according to Crandall (27, p. 29).

PHYSA HETEROSTROPHA ALBA Crandall.
Physa heterostropha alba Crandall, Naut., XV, 1901, p. 29.
Type locality: Cedar Lake, Capachet, N. Y.
Types No. 40747 Coll. Walker.

PHYSA HUMEROSA Gould.
Includes *rhomboidea* Crandall (*crandalli* Baker), according to Springer (120, p. 513).

PHYSA INTEGRA Haldeman.
Includes *billingsii* as a var. according to Crandall (27, p. 56).

PHYSA LATA Tryon.
Physa lata Tryon, Am. J. of Con., I, 1865, p. 227, pl. 23, fig. 7.
Type locality: Juniata River, Hallidaysburg, Pa.
See *heterostropha*.

PHYSA LORDI Baird.
Physa parkeri Currier, Kent Sci. Inst., Misc. Pub., 1868, p. 7 (no desc.); DeCamp, Kent Sci. Inst., Misc. Pub., No. 5, 1881, p. 15, pl. 1, fig. 3.
Type locality (*parkeri*): Houghton Lake, Mich.
Types (*parkeri*) No. 11997 Coll. Walker.
Henderson and Daniels (56, p. 75) suggest that the Michigan and Canadian forms differ markedly from the typical western form.

PHYSA MALLEATA Tryon.
Physa malleata Tryon, Am. J. of Con., I, 1865, p. 225, pl. 23, fig. 14.
Type locality: Hell Gate River, Oregon.

PHYSA MARGARITA Lesson.
Physa margarita Lesson, Rev. Zool., 1840, p. 356.
Type locality: Newfoundland.

PHYSA MEXICANA CONOIDEA Fischer and Crosse.
Physa mexicana conoidea Fischer and Crosse, Moll. Mex., II, 1886, p. 101, pl. 39, figs. 8-8a.
Type locality: Mehedin, Mexico.
Also McLennan Co., Texas, see Strecker, 126, p. 64.

PHYSA NIAGARENSIS Lea.
Physa niagarensis Lea, Pr. A. N. S. P., 1864, p. 114; Jour. A. N. S. P., VI, 1866, p. 168, pl. 24, fig. 97; Obs., XI, 1866, p. 124, pl. 24, fig. 97.
Type locality: Niagara River, N. Y.
Is referred to *integra* by Tryon, (132, p. 167), but Crandall (27, p. 55) considers it distinct.

PHYSA NICKLINII Lea.
Physa nicklinii Lea, Pr. A. N. S. P., 1864, p. 114; Jour. A. N. S. P., VI, 1866, p. 175, pl. 24, fig. 101; Obs., XI, 1866, p. 131, pl. 24, fig. 101.
Type locality: Callaghan's, Alleghany Co., Va.
Is *elliptica* according to Tryon (132, p. 163) and Crandall (27, p. 55).

PHYSA NUTTALLII Lea.
Physa nuttallii Lea, Pr. A. N. S. P., 1864, p. 116; Jour. A. N. S. P., VI, 1866, p. 171, pl. 24, fig. 93; Obs., XI, 1866, p. 127, pl. 24, fig. 93.
Type locality: Lewis River, Oregon.
See *ampullacea*.

PHYSA OCCIDENTALIS Tryon.
Physa occidentalis Tryon, Am. J. of Con., I, 1865, p. 226, pl. 2, fig. 8.
Type locality: San Francisco and numerous other localities in California and Oregon.

PHYSA OLEACEA Tryon.
Physa oleacea Tryon, Am. J. of Con., II, 1866, p. 6, pl. II, fig. 6.
Type locality: Bridgeport, Ala., and Lake Superior.
Is *elliptica* according to Tryon (132, p. 163). Crandall states (27, p. 45) that Tryon himself admitted this obvious error and considers it to be a var. of *gyrina*. Baker (5, p. 492) considers it to be simply an immature stage of typical *gyrina*.

PHYSA OSCULANS Haldeman.

Includes *mexicana* Phil. according to Fischer and Crosse (38, p. 100), Pilsbry (91, p. 323) and von Martens (73, p. 370). *"Physa osculans* is readily distinguishable from the eastern forms, *P. heterostropha, integra* and *gyrina;* but several described Californian Physas present no differences from the Mexican species and must be considered synonyms." (Pilsbry, l. c.)

PHYSA PARVA Lea.

Physa parva Lea, Pr. A. N. S. P., 1864, p. 115; Jour. A. N. S. P., VI, 1866, p. 177, pl. 24, fig. 104; Obs., XI, 1866, p. 133, pl. 24, fig. 104.

Type locality: Verdigris River and Roca Creek, Kans.

Is doubtfully referred to *P. malleata* Try. as a variety by Cooper (25, p. 97).

Probably a young *grosvernori,* Tryon (128, p. 169); is *gyrina,* Tryon (132, p. 162); probably a young *anatina,* Crandall (27, p. 71).

PHYSA POLITISSIMA Tryon.

Physa politissima Tryon, Am. J. of Con., I, 1865, p. 226, pl. 23, fig. 13.

Type locality: Sacramento, Cal.

Is a variety of *P. binneyana* Ancey (*P. diaphana* Try.) according to Cooper (25, p. 97).

Is probably a synonym of *triticea,* and both are "dwarfed and arrested aspect(s)" of *gyrina* according to Stearns (122, p. 51).

PHYSA POMILIA Conrad.

Physa pomilia Conrad, Am. J. of Sci., XXV, 1834, p. 343; Am. J. of Con., II, 1866, p. 278, pl. 15, figs. 1-3.

Type locality: Randon's Creek, Claiborne, Ala.

Includes *showalteri* Lea according to Tryon (132, p. 162) and Crandall (27, p. 90).

PHYSA PRIMEANA Tryon.

Physa primeana Tryon, Am. J. of Con., I, 1865, p. 227, pl. 23, fig. 12.

Type locality: Long Island, N. Y.

Is *heterostropha* according to Crandall (27, p. 29).

PHYSA PROPINQUA Tryon.

Physa propinqua Tryon, Am. J. of Con., I, 1865, p. 223, pl. 23, fig. 5.

Type locality: Jordan Creek, Idaho.

PHYSA RIVALIS Sowerby.

Physa rivalis Sowerby, Con. Icon., Physa, 1873, Sp. 31, pl. 4, fig. 31.

Type locality: Columbia River.

This is not the *P. rivalis* of Maton and Rackett (1807) nor of Sowerby (1821-6). Clessin (20, p. 331) considers it a synonym of *hildrethiana* Lea.

PHYSA SAFFORDII Lea.

Physa saffordii Lea, Pr. A. N. S. P., 1864, p. 115; Jour. A. N. S. P., VI, 1866, p. 166, pl. 24, fig. 87; Obs., XI, 1866, p. 123, pl. 24, fig. 87.

Type locality: Lebanon, Wilson Co., Tenn.; Verdigris River, Kans., and Nashville, Tenn.

Is *gyrina* according to Tryon (132, p. 162).

PHYSA SHOWALTERI Lea.

Physa showalteri Lea, Pr. A. N. S. P., 1864, p. 115; Jour. A. N. S. P., VI, 1866, p. 170, pl. 24, fig. 92; Obs., XI, 1866, p. 126, pl. 24, fig. 92.

Type locality: Uniontown, Ala.

PHYSA SMITHSONIANA Lea.

Physa smithsoniana Lea, Pr. A. N. S. P., 1864, p. 115; Jour. A. N. S. P., VI, 1866, p. 169, pl. 24, fig. 97; Obs., XI, 1866, p. 125, pl. 24. fig. 91.

Type locality: Loup Fork of the Platte River.

Is *gyrina* according to Crandall (27, p. 54).

PHYSA SPARSESTRIATA Tryon.

Physa sparsestriata Tryon, Am. J. of Con., I, 1865, p. 224, pl. 23, fig. 10.

Type locality: San Joaquin Valley, Cal.

PHYSA SUBROTUNDA Sowerby.

Physa subrotunda Sowerby, Con. Icon., Physa, 1873, Sp. 87, pl. 10, fig. 87.

Type locality: North America.

PHYSA TENUISSIMA Lea.

Physa tenuissima Lea, Pr. A. N. S. P., 1864, p. 114; Jour. A. N. S. P., VI, 1866, p. 167, pl. 24, fig. 86; Obs., XI, 1866, p. 123, pl. 24, fig. 86.

Type locality: Alexandria, La.

Is referred to *Aplexa* by Tryon (132, p. 17). See Crandall (27, p. 71). His shell now in my collection is a dead, bleached specimen of *Aplexa hypnorum*.

PHYSA TRASKII Lea.

Physa traskii Lea, Pr. A. N. S. P., 1864, p. 115; Jour. A. N. S. P., VI, 1866, p. 163, pl. 24, fig. 80; Obs., XI, 1866, p. 119, pl. 24, fig. 80.

Type locality: Rio Los Angelos, Cal.

Is a synonym of *P. virgata* Gld. according to Pilsbry and Ferriss (108, p. 198).

PHYSA TRITICEA Lea.

Physa triticea Lea, Jour. A. N. S. P., VI, 1866, p. 177, pl. 24, fig. 103; Obs., XI, 1866, p. 132, pl. 24, fig. 103.

Type locality: Shasta Co., Cal.

Is a form of *gyrina* and probably includes *politissima* Tryon, according to Stearns (122, p. 51).

PHYSA TROOSTIANA Lea.

Is *elliptica* according to Tryon (132, p. 163) and Crandall (27, p. 55).

PHYSA VENUSTA Lea.

Physa venusta Lea, Pr. A. N. S. P., 1864, p. 116; Jour. A. N. S. P., VI, 1866, p. 168, pl. 24, fig. 89; Obs., XI, 1866, p. 124, pl. 24, fig. 89.

Type locality: Fort Vancouver, Oregon.

Very closely allied to, if not identical with, *P. virginea* Gld. according to Tryon (128, p. 170), who also remarks in 1870 (Mon., p. 138) that it groups with *gyrina* Say.

PHYSA VINOSA Gould.

Crandall (27, p. 42) considers this to be a var. of *ancillaria,* but it seems to be sufficiently distinct.

PHYSA VIRGATA Gould.

Listed from Muscatine, Ia., by Nelson (76, p. 182). In all probability an erroneous identification. Is a variety of *P. humerosa* Gld. according to Cooper (25, p. 98).

Widely, if sparsely, distributed in Arizona and New Mexico according to Pilsbry and Ferriss (107, p. 144).

PHYSA VIRGATA ALBA Cockerell.

Physa virgata mut. *alba* Cockerell, Jour. Mal., IX, 1902, p. 138.

Type locality: Salt River, Tempe, Ariz.

The varietal name is preoccupied by Crandall, *P. heterostropa alba,* 1901.

PHYSA WALKERI Crandall.

Physa walkeri Crandall, Naut., XV, 1901, p. 57, pl. 11, fig. 5.

Type locality: Petoskey, Mich.

Types No. 3483 Coll. Walker.

PHYSA WARRENIANA Lea.

Physa warreniana Lea, Pr. A. N. S. P., 1864, p. 115; Jour. A. N. S. P., VI, 1866, p. 163, pl. 24, fig. 81; Obs., XI, 1866, p. 120, pl. 24, fig. 81.

Type locality: Long Fork of the Platte River; Milwaukee, Wis.; Grand Rapids, Mich.

Is a var. of *sayii* according to Crandall (27, p. 44).

PHYSA WHITEI Lea.
Physa whitei Lea, Pr. A. N. S. P., 1864, p. 114; Jour. A. N. S. P., VI, 1866, p. 172, pl. 24, fig. 96; Obs., XI, 1866, p. 128, pl. 24, fig. 96.
Type locality: Walker Co., Ga.; Verdigris River, Kans.
Is *forsheyi* according to Crandall (27, p. 69).

PHYSA WOLFIANA Lea.
Physa wolfiana Lea, Pr. A. N. S. P., 1869, p. 125; Jour. A. N. S. P., VIII, 1874, p. 63, pl. 21, fig. 20; Obs., XIII, 1874, p. 67, pl. 21, fig. 20.
Type locality: Hot Springs, Colo.

Genus APLEXA Fleming, 1822.

APLEXA HORDACEA (Lea).
Physa hordacea Lea, Pr. A. N. S. P., 1864, p. 116; Jour. A. N. S. P., VI, 1866, p. 176, pl. 24, fig. 102; Obs., XI, 1866, p. 132, pl. 24, fig. 102.
Type locality: Vancouver Island, Oregon.

Referred to *Aplexa* by Tryon (132, p. 170), and doubtfully by Dall (32, p. 113), but its generic position still remains to be definitely settled by an examination of the animal. Dall (1. c.) states that the types came from Vancouver, Wash. and not from Vancouver Island, B. C.

Is a variety of *P. venusta* Lea according to Cooper (25, p. 97).

APLEXA HYPNORUM L.

Clessin (20, p. 287) distinguishes the American form (*P. elongata* Say) on the ground that the European form has a more slender shell and never a short spire as is the case with both the American varieties recognized by him, but the concensus of opinion is against him.

APLEXA HYPNORUM ARCTICA (Clessin).
Physa elongata arctica Clessin, Con. Cab., Limnæiden, 1886, p. 287, pl. 41, fig. 5.
Type locality: Hudson Bay.

APLEXA HYPNORUM GLABRA (DeKay).
Physa glabra DeKay, N. Y. Moll., 1843, p. 80, pl. 5, fig. 83.
Physa elongatina Lewis, Pr. B. S. N. H., V, 1855, pp. 122, 298.
Range: Conn., N. Y., and Michigan.

This form seems to be entitled to recognition as a well marked race.

APLEXA HYPNORUM TRYONI (Currier).
Bulinus tryoni Currier, Am. J. of Con., III, 1867, p. 112, pl. 6, fig. 2.
Type locality: Grand Rapids, Mich.

Family ANCYLIDÆ.

For a revision of the patelliform genera of this family, see Walker, No. 160.

Subfamily LANCINÆ Hannibal,1914.

Genus LANX Clessin, 1880.

LANX ALTUS (Tryon).

Ancylus altus Tryon, Am. J. of Con., I, 1865, p. 230, pl. 22, fig. 15.

Type locality: Klamath River, Cal.

Is probably only a var. of *newberryi* according to Pilsbry (95, p. 65).

LANX CRASSUS (Haldeman).

Ancylus crassus Haldeman, Mon., 1844, p. 14, pl. 1, fig. 8.

LANX KOOTANIENSIS (Baird).

Ancylus kootaniensis Baird, Pr. Zool. Soc., Lond., 1863, p. 69; W. G. Binney, L. and F. W. Shells, II, 1865, p. 144, fig. 242; Tryon, Mon., 1870, p. 227, pl. 11, figs. 11-12.

Ancylus (*Lævapex*) *kootaniensis* Dall, Alaska, XIII, 1905, p. 110, fig. 82.

Is doubtfully referred to *L. crassus* Hald. as a variety by Cooper (25, p. 100).

LANX NEWBERRYI (Lea).

Ancylus newberryi Lea, Jour. A. N. S. P., VI, 1866, p. 185, pl. 24, fig. 116; Obs., Xl, 1866, p. 141, pl. 24, fig. 116.

LANX NUTTALLII (Haldeman).

Vellettia nuttallii Haldeman, Mon., 1841, pt. 3, p. 3 of cover.

Acroloxus nuttallii Binney, L. and F. W. Shells, II, 1865, p. 147.

LANX PATELLOIDES (Lea).

Ancylus patelloides Lea, Jour. A. N. S. P., VI, 1866, p. 185, pl. 24, fig. 117; Obs., XI, 1866, p. 141, pl. 24, fig. 117.

Is not a marine species as stated by Tryon (132, p. 239). See Pilsbry (93, p. 60).

Includes *altus* Try. and *subrotundus* Try. and doubtfully *newberryi* Lea as varieties according to Cooper (25, p. 100).

LANX PRÆCLARUS (Stimpson). (MSS.?)
Ancylus præclarus "Stimpson" Lea, Obs., XI, 1866, p. 141.

This apparently undescribed species is referred to and distinguished from *newberryi* by Lea.

LANX SUBROTUNDUS (Tryon).
Ancylus subrotundus Tryon, Am. J. of Con., I, 1863, p. 230, pl. 22, fig. 14.
Type locality: Umpqua River, Oregon.

Subgenus WALKEROLA Hannibal, 1912.

LANX (WALKEROLA) KLAMATHENSIS Hannibal.
Lanx (Walkerola) klamathensis Hannibal, Pr. Mal. Soc. Lond., X, 1912, p. 149, pl. VIII, fig. 25.
Type locality: Upper Klamath Lake, Ore.

Genus FISHEROLA Hannibal, 1912.

FISHEROLA LANCIDES Hannibal.
Fisherola lancides Hannibal, Pr. Mal. Soc. Lond., X, 1912, p. 152, pl. VIII, fig. 35.
Type locality: Snake River, Washington.

Genus ACROLOXUS Beck.

Does not occur in our fauna. Of the two species referred to it by Binney, one, *A. nuttallii,* is a *Lanx* and the other, *A. filosus,* is a *Rhodacmea.*

Subfamily FERRISSIINÆ Walker, 1917.
Genus FERRISSIA Walker, 1903.

FERRISSIA BOREALIS (Morse).
Ancylus borealis Walker, Naut., XVIII, 1904, p. 80, pl. 6, figs. 14-16.

FERRISSIA CAURINA ("W. Cooper," W. G. Binney).
Ancylus caurinus, J. G. Cooper, Pr. Cal. Acad. Sci., IV, 1870, p. 100.

Tryon (132, p. 229) refers this species to *fragills,* but it is an error.

Is doubtfully referred to *Ferrissia fragilis* Try. as a variety by Cooper (25, p. 100), but later (26, p. 83) he considers it distinct. Dall (32, p. 110) also doubtfully refers it to *fragilis.*

FERRISSIA CAURINA SUBALPINA (J. G. Cooper).
Ancylus caurinus subalpinus J. G. Cooper, Pr. Cal. Acad. Sci., (2), III, 1890, p. 82, pl. 1, figs. 27-28.
Type locality: Yosemite Valley and Bloody Canyon, Cal. Also Oregon.

FERRISSIA FRAGILIS (Tryon).

As suggested by J. G. Cooper (26, p. 83), and Hannibal (53, p. 148), this is probably the non-septate form of *Gundlachia californica*.

FERRISSIA HALDEMANI (Bourguinat).

Ancylus haldemani Walker, Naut., XVIII, 1904, p. 78, pl. 6, figs. 9-13.

FERRISSIA HENDERSONI (Walker).

Ancylus hendersoni Walker, Naut., XXI, 1908, p. 138, pl. 9, figs. 8-10.
Type locality: Lake Waccamaw, N. C.

FERRISSIA NOVANGLIÆ (Walker).

Ancylus novangliæ Walker, Naut., XXI, 1898, p. 138, pl. 9, figs. 5-7.
Type locality: Cambridge, Mass.

FERRISSIA OVALIS (Morse).

Ancylus ovalis Walker, Naut., XVIII, 1904, p. 79.

FERRISSIA PARALLELA (Haldeman).

Ancylus parallelus Walker, Naut., XVIII, 1914, p. 77, pl. 5, figs. 1-9.

FERRISSIA PUMILA (Sterki).

Ancylus pumilus Sterki, 8th Ann. Rep. O. St. Acad. Sci., 1900, p. 36; separate, p. 7; Walker, Naut., XVIII, 1904, p. 82, pl. 6, figs. 20-22.
Type locality: Tuscawaras River, Tuscawaras Co., O.

It is possible that this will prove to be the non-septate form of *Gundlachia meekiana*.

FERRISSIA RIVULARIS (Say).

Ancylus rivularis Walker, Naut., XVIII, 1904, p. 25, pl. 1, figs. 1-10, 13-14.

FERRISSIA SHIMEKII (Pilsbry).

Ancylus obliquus Shimek, Bull. Lab. Nat. Hist., St. Univ. Ia., I, 1890, p. 214, pl. III, figs. 5a-c, *non* Broderip and Sowerby (1832), nor C. B. Ads. (1850), nor Krauss (1853).

Ancylus shimekii Pilsbry, Naut., IV, 1890, p. 48; Walker, Naut., XVIII, 1904, p. 81, pl. 6, figs. 17-19.

Type locality: Deadman's Run, Lincoln, Neb.

Pilsbry (1. c. and 54, p. 63) has suggested that this may be the non-septate form of a *Gundlachia,* perhaps *meekiana*. This was controverted by Walker (1. c.), but nevertheless may be correct.

FERRISSIA TARDA (Say).
Ancylus tardus Walker, Naut., XVIII, 1904, p. 27, pl. I, figs. 11-12, 16-23; pl. II, figs. 1-23.

FERRISSIA WALKERI (Pilsbry and Ferriss).
Ancylus walkeri Pilsbry and Ferriss, Pr. A. N. S. P., 1906, p. 564, fig. 5.
Type locality: Rogers, Benton Co., Ark.

Subgenus LÆVAPEX Walker, 1903.

FERRISSIA DIAPHANA (Haldeman).
Ancylus diaphanus Walker, Naut., XVII, 1903, p. 17, pl. II, figs. 13-18.

FERRISSIA EXCENTRICA (Morelet).
Ancylus excentricus Morelet, Test. Noviss., II, 1851, p. 17; Pilsbry, Naut., III, 1889, p. 64, pl. I, fig. 4; Walker, Naut., XVII, 1903, p. 27, pl. I, figs. 19-21.
Type locality: Lago de Ita, Peten, Guatemala. Also Comal Creek, New Braunfels and Barton Creek, Travis Co., Texas.

FERRISSIA FUSCA (C. B. Adams).
Ancylus fuscus Walker, Naut., XVII, 1903, p. 15, pl. 1, figs. 1-9.

FERRISSIA FUSCA EUGRAPTA (Pilsbry).
Ancylus eugraptus Pilsbry, Naut., IX, 1896, p. 139.
Ancylus fuscus eugraptus Walker, Naut., XVII, 1903, p. 17, pl. I, figs. 13-18.
Type locality: Illinois River, Havana, Ills.

FERRISSIA HEMISPHÆRICA (Walker).
Ancylus hemisphæricus Walker, Naut., XXI, 1908, p. 140, pl. 9, figs. 14-16.
Type locality: Georgia. Also Decatur, Ala.

FERRISSIA KIRKLANDI (Walker).
Ancylus kirklandi Walker, Naut., XVII, 1903, p. 29, pl. II, figs. 1-12.
Type locality: Grand Rapids, Mich.

FERRISSIA OBSCURA (Haldeman).

See Walker (Naut., XVII, 1903, p. 25, pl. I, figs. 16-18) for the Floridan form doubtfully referred to this. Rediscovered in the south fork of the Powell River at Big Stone Gap, Wise Co., Va., by Goodrich (48, p. 92), and quite different from the supposed Florida examples.

FERRISSIA PENINSULÆ (Pilsbry and Johnson).
Ancylus peninsulæ Pilsbry and Johnson, Naut., IX, p. 138; Walker, Naut., XVII, 1903, p. 28, pl. 11, figs. 19-21.
Type locality: St. Johns River, Fla.

SPECIES INCERTÆ SEDIS.

ANCYLUS CALCARIUS DeKay.

ANCYLUS OREGONENSIS Clessin.
Ancylus oregonensis Clessin, Con. Cab., Ancylinen, 1882, p. 66, pl. 8, fig. 1.
Type locality: Salem, Oregon.
Also listed from theSacramento River, Reading, Shasta Co., by Pilsbry (93, p. 60).

Genus GUNDLACHIA Pfeiffer, 1849.

The validity of this genus has been a subject of considerable discussion. See Dall (31, p. 97) and Walker (148, p. 14, and 160, p. 3). Dall has also published a very interesting series of observations on the relations of *Ancylus* and *Gundlachia* (34, p. 175).

Subgenus GUNDLACHIA s. s.

GUNDLACHIA ANCYLIFORMIS Pfeiffer.
Gundlachia ancyliformis Pfeiffer, Zeitsch. für Mal., 1849, p. 98; Ibid, 1853, p. 180, pl. I, figs. 1-16.
Type locality: Lagune Injinio, San Vincente, Cuba.
Listed by Simpson (117, p. 96), from Palma Sola, Fla.

GUNDLACHIA HJALMARSONI Pfeiffer.
Gundlachia hjalmarsoni Pfeiffer, Mal. Blätt., V, 1858, p. 197.
Type locality: Santa Rosa, Honduras.
Has been recorded and figured by Clapp (18, p. 77), from the drift of the Rio Grande, at Brownsville, Texas.

Subgenus KINCAIDELLA Hannibal, 1912.

This group includes: *G. meekiana* Stimp., *californica* Row., and *stimpsoniana* S. Smith.

GUNDLACHIA STIMPSONIANA S. Smith.
Gundlachia stimpsoniana S. Smith, Ann. N. Y. Lyc. Nat. Hist., IX, 1870, p. 399, fig. 6; Walker, Naut., XXI, 1907, p. 15, pl. IV.
Type locality: Greenport, Long Island, N. Y. Also on Shelter Island, N. Y.

Subfamily RHODACMEINÆ Walker, 1917.
Genus RHODACMEA Walker, 1917.
Subgenus RHODACMEA s. s.

RHODACMEA FILOSA (Conrad).

Ancylus filosus Conrad, New F. W. Shells, 1834, p. 57; Haldeman, Mon., 1844, p. 10, pl. I, fig. 9; Binnev, L. and F. W. Shells, II, 1865, p. 147, fig. 248; Walker, Naut., XVIII, p. 75, pl. 6, figs. 7-8.

Acroloxus filosus Tryon, Mon., 1870, p. 232.

Type locality: Black Warrior River, south of Blount Springs.

RHODACMEA CAHAWBENSIS Walker.

Ancylus filosus Walker, Naut., XVIII, 1904, p. 76, pl. VI, figs. 1-6.

Rhodacmea cahawbensis Walker, Naut., XXXI, 1917, p. 7, pl. I, figs. 4-6.

Type locality: Cahawba River, Gurnee, Shelby Co., Ala.

RHODACMEA ELATIOR (Anthony).

Ancylus elatior Anthony, Ann. N. Y. Lyc. Nat. Hist., VI, 1855, p. 158, pl. V, fig. 20; Binney, L. and F. W. Shells, II, 1865, p. 140, fig. 234; Walker, Naut., XVIII, 1904, p. 78, pl. V, figs. 10-12.

Type locality: Green River, Ky.

RHODACMEA HINKLEYI Walker.

Ancylus rhodaceus "Walker," Hinkley, Naut., XX, 1906, p. 40, not described.

Ancylus hinkleyi Walker, Naut., XXI, 1908, p. 139, pl. IX, figs. 11-13.

Type locality: Ohio River, Golconda, Ills.

Section RHODOCEPHALA Walker, 1917.

RHODACMEA RHODACME Walker.

Rhodacmea rhodacme Walker, Naut., XXXI, 1917, p. 8, pl. I, figs. 1, 2 and 8.

Type locality: Coosa River, Williamsville, Shelby Co., Ala.

RHODACMEA GWAWTKINIANA Walker.

Rhodacmea gwatkiniana Walker, Naut., XXXI, 1917, p. 9, pl. I, figs. 3, 7 and 9.

Type locality: Coosa River, Butting Ram Shoals, Coosa Co., Ala.

Subfamily NEOPLANORBINÆ Hannibal, 1912.
Genus NEOPLANORBIS Pilsbry, 1906.

NEOPLANORBIS CARINATUS Walker.
Neoplanorbis carinatus Walker, Naut., XXI, 1908, p. 127, pl. 9, figs. 17-18.
Type locality: Duncan's Riffle, Coosa River, Coosa Co., Ala.

NEOPLANORBIS SMITHII Walker.
Neoplanorbis smithii Walker, Naut., XXI, 1908, p. 126, pl. 9, figs. 1-2.
Type locality: Higgins Ferry, Coosa River, Chilton Co., Ala.

NEOPLANORBIS TANTILLUS Pilsbry.
Planorbis tantillus "Pilsbry" Hinkley, Naut., XVIII, 1904, p. 54. Nude name.
Neoplanorbis tantillus Pilsbry, Naut., XX, 1906, p. 51, pl. 3, figs. 3-5.
Type locality: Wetumpka, Ala.

NEOPLANORBIS UMBILICATUS Walker.
Neoplanorbis umbilicatus Walker, Naut., XXI, 1908, p. 126, pl. 9, figs. 3-4.
Type locality: The Bar, Coosa River, Chilton Co., Ala.

Genus AMPHIGYRA Pilsbry.

Amphigyra Pilsbry, Naut., XX, 1906, p. 49.
Type: *Amphigyra alabamensis* Pils.

AMPHIGYRA ALABAMENSIS Pilsbry.
Amphigyra alabamensis Pilsbry, Naut., XX, 1906, p. 50, pl. III, figs. 1-2.
Type locality: Wetumpka, Ala.

Subclass STREPTONEURA.
Order PECTINIBRANCHIA.
Suborder TÆNIOGLOSSA.
Superfamily PLATYPODA.
Family AMPULLARIDÆ.
Genus AMPULLARIA Lamarck, 1799.

AMPULLARIA BOREALIS Valenciennes.

W. G. Binney (12, p. 430), has definitely ascertained that this species was based on the well known *Natica heros* Say.

AMPULLARIA CALIGINOSA Rve.

Ampullaria caliginosa Reeve, Con. Icon., Ampullaria, 1856, pl. XXV, fig. 118.

Type locality: Unknown. Not listed by Sowerby in his recent catalogue (119, pp. 345-362).

Listed from several localities in Florida by Dall and Simpson.

AMPULLARIA MIAMIENSIS Pilsbry.

Ampullaria miamiensis Pilsbry, Pr. A. N. S. P., 1899, p. 365.

Type locality: Miami, Dade Co., Fla.

AMPULLARIA PALUDOSA Say.

This name must be used for Say's species as his first name *depressa* was preoccupied by Lamarck.

AMPULLARIA PINEI Dall.

Ampullaria pinei Dall, Naut., XII, 1898, p. 75.

Type locality: Homosassa River, Fla.

AMPULLARIA ROTUNDATA Say.

Sowerby has recently (119, p. 357) referred this species with doubt to *paludosa,* overlooking Say's statement that the operculum was calcarceous and Binney's figure in his edition of Say, pl. 75. It is no doubt an Old World species as suggested by Binney. In a recent letter, Mr. Sowerby says that he has "not the slightest doubt that it is a small specimen of the Indian *A. globosa* Sw."

Family VIVIPARIDÆ.

Genus VIVIPARUS Montfort, 1810.

VIVIPARUS CONTECTUS (Millet).

This European species has become fully acclimatized at Washington, D. C., and at Philadelphia, Pa. (Bailey, 2, p. 60).

VIVIPARUS CONTECTIODES W. G. Binney.

Tryon's contention (132, p. 17) that this species should be known as *V. lineata* Küster *non* Val. (Con. Cab., Paludina, 1852, p. 10, pl. 2, figs. 6-9) is not well founded. *Lineata* is preoccupied and *linearis* (Ibid., p. 19) is "of course" a misprint for *lineata* as stated by Tryon (131, p. 197) and Binney (13, p. 295).

This species has been introduced and fully acclimated in Fairmont Park, Philadelphia, Pa. (Vanatta, 139, p. 84), and in the Public Garden in Boston, Mass. (Johnson, 62, p. 72).

VIVIPARUS CONTECTOIDES COMPACTUS Pilsbry.
Viviparus contectoides compactus Pilsbry, Naut., XXX, 1916, p. 42.
Type locality: Doherty, Ga.

VIVIPARUS CONTECTOIDES IMPOLITUS Pilsbry.
Viviparus contectoides impolitus Pilsbry, Naut., XXX, 1916, p. 41.
Type locality: Paint Rock River, Jackson Co., Ala.

VIVIPARUS GEORGIANUS ALTIOR Pilsbry.
Vivipara georgiana altior Pilsbry, Naut., V, 1892, p. 142.
Type locality: Hitchin's Creek, Fla.

VIVIPARUS GEORGIANUS FASCIATUS Tryon.
Vivipara georgiana fasciata Tryon, Mon., 1870, p. 17.
Type locality not specified.

VIVIPARUS GEORGIANUS LIMNOTHAUMUS Pilsbry.
Vivipara georgiana limnothauma Pilsbry, Naut., VIII, 1895, p. 116.
Type locality: Hitchin's Creek, Fla. Also Lake George, opposite Drayton's Island, Fla.

VIVIPARUS HALDEMANIANUS "Shuttleworth" Frauenfeld.
Vivipara haldemaniana "Shuttleworth" Frauenfeld, Verh. k. k. zool.-bot. Gesell. Wien, 1862, p. 1162.
Type locality: Black Creek, Fla.

Tryon (130, p. 374) says that this is "doubtless" *V. lineata* Val. (*contectoides* W. G. Binn.), but this is not likely as that species does not range so far south. It is more probable that it is either *georgianus* (Lea) or *waltonii* Try. If the latter, it would have priority. Tryon (131, p. 197) suggests that the Florida *contectoides* listed by Binney are "perhaps" his *waltonii*.

VIVIPARUS HALEANUS (Lea).

This is apparently a valid species as stated by Tryon. It also occurs in Itchaway-Notchway Creek, Baker Co., Ga., and fossil in a peat bed at Lake Panasoffkee, Fla.

VIVIPARUS INTERTEXTUS (Say).

Hannibal (53, p. 193) has proposed a new subgenus, *Callina,* having this species as the type. The distinction seems to be based on the rounded whorls and perforate shell of this species as compared with the imperforate shell and subcarinate body-whorl of typical *Viviparus*. But as the embryonic

young of *intertextus* are strongly angulated and those of *V. viviparus* are quite acutely carinated the distinction does not seem to be well taken. If, however, for any valid reason, it should be found desirable hereafter to separate the two groups, the name will be available.

VIVIPARA LINEATA (Valenciennes).

W. G. Binney (13, p. 295) from an examination of the type states that this is the *V. bengalensis* (Lam.) from India.

VIVIPARUS MALLEATUS Reeve.

This Japanese species has been introduced into a number of localities on the Pacific Coast and has been listed under various names:—

Paludina japonica Wood, Naut., V, 1892, p. 114; Ibid., VI, 1892, p. 51.
Vivipara stelmaphora Stearns, Naut., XV, 1901, p. 91.
Vivipara lecythoides Hannibal, Naut., XXII, 1908, p. 33.
Viviparus malleatus Hannibal, Naut., XXV, 1911, p. 31.

Hannibal (53, p. 194) has made this species the type of a new subgenus, *Cipangopaludina,* which he refers to *Idiopoma* Pils., (98, p. 189) originally proposed as a subgenus, but which he raises to generic rank. As the validity of both of these changes must be ultimately determined by a study of the Asiatic species, they may well be held in abeyance until that has been done.

VIVIPARUS JAPONICUS v. Martens.

This species has been introduced into British Columbia (Pilsbry and Johnson, 110, p. 144) and California (Hannibal, 52, p. 32).

It has also recently appeared in the Muddy River, Brookline, Mass. (Johnson, 60, p. 35 and 61, p. 48).

Hannibal (53, p. 194) refers it to *Idiopoma* Pils.

VIVIPARA MULTICARINATA (Haldeman).

This name was proposed by Haldeman for the *Paladina carinata* Val., which was erroneously stated by the author to be from Mexico, *carinata* having already been used by Swainson for an Indian species of the same genus. W.G. Binney (12, p. 430), states that the types in the Jardin des Plantes, Paris, are labelled in Valenciennes' handwriting "Philippines." It is undoubtedly a form of *V. burroughianus* Lea.

VIVIPARUS WALKERI Pilsbry and Johnson.

Viviparus walkeri Pilsbry and Johnson, Naut., XXVI, 1912, p. 48, pl. XXX, figs. 6-7.

Type locality: Juniper Creek, Lake Co., Fla.

VIVIPARUS WALTONII Tryon.
Vivipara waltonii Tryon, Am. J. of Con., II, 1866, p. 108, pl.10, fig. 2.
Type locality: St. Johns River, Fla.

VIVIPARUS WAREANUS (Shuttleworth).

This species is distinct from *georgianus* Lea.

Genus CAMPELOMA Rafinesque, 1819.

Melanthro W.G. Binney *non* Bowditch.

Pilsbry has recently (105, p. 111) proposed to substitute *Ambloxis* Raf. for *Campeloma* Raf. For the same reasons that I have urged in support of the retention of *Anculosa* Say, it seems to me that the preference should be given to *Campeloma*.

CAMPELOMA DECISUM (Say).

The undescribed forms of this species from Michigan listed as vars. *flava* Currier MSS. and *melanostoma* Currier MSS. (Walker, 142, p. 138) are of doubtful validity.

Binney is in error in referring the following species to *decisum* as synonyms: *integrum* Say, *geniculum* Con., *milesii* Lea, *obesum* Lewis, *rufum* Hald., and *subsolidum* Anth.

Melantho fecunda mentioned, but purposely left undescribed, by Lewis in 1868 (66, p. 135) and listed as a distinct species in 1869 (67, p. 34) does not seem to be separable from *decisum*, judging from the author's original specimens now in my collection. Call's remark (17, p. 135) that this is the female of *obesum* Lewis is wholly wrong.

CAMPELOMA FLORIDENSE Call.
"Campeloma floridense Call MSS." (as synonym of *C. limum*), Call, Bull. Washb. Coll. Lab. of Nat. Hist., I, 1886, p. 159, pl. 6, fig. 7; Pilsbry, Naut., XXX, 1917, p. 42.
Type locality not specified. Apparently restricted to the St. John's River and tributary creeks in Florida.

It has very generally been considered to be the *C. limum* (Anth.).

CAMPELOMA GENICULUM (Con.).

The exact status of this species still remains to be settled. Call at one time considered it a valid species (15a, p. 157), but later (17, p. 134) treated it as a variety of *decisum*. Lewis remarks (71, p. 41) that all the Alabama species exhibit this peculiarity. Under this aspect of the case, the species, to which Conrad's form should be referred, can only be determined by an examination of his original type.

CAMPELOMA INTEGRUM (Say).

Is a valid species and quite distinct from *decisum*.

CAMPELOMA INTEGRUM OBESUM ("Lewis" Tryon).

? Paludina obesa "Lewis" W. G. Binney, L. and F. W. Shells, III, 1865, p. 47, fig. 95.
Melantho obesa Lewis, Am. J. of Con., IV, 1868, p. 134.
Melantho obesus Lewis, Pr. A. N. S. P., 1875, p. 336, pl. XXIII, figs. 4-5.
Vivipara obesa "Lewis" Tryon, Mon., 1870, p. 25, pl. 13, fig. 6.
Type locality: Ohio Canal, Columbus, O., and Michigan.

Tryon seems to have been the first to have formally described this well marked form, although Lewis had already referred to it by that name in his papers on *Melantho* in 1868 and 1869. Binney figured what he supposed to be it, but Lewis seems to think (l. c.) that he did not do so. Binney states that *"Paludina obesa"* is preoccupied, but I have not been able to check the reference. If that is true and Binney's figure represents the true *obesa* of Lewis, his remarks and figure are sufficient to fix that name on the form and consequently it would have to receive a new name.

Typically very distinct, this form seems to bear the same relation to *integrum* that *gibbum* does to *rufum*.

Call's statement (17, p. 135) that Lewis' type of this form is the male and the type of his undescribed *fecunda* the female of the same species is an error.

CAMPELOMA LEWISII Walker.

Campeloma lewisii Walker, Naut., XVIII, 1915, p. 126, pl. V, fig. 3.
Type locality: Yallabusha River, Grenada, Miss.

This is the *Melantho coarctata* of W. G. Binney. For full synonymy see Walker, 154, p. 126.

CAMPELOMA LIMUM (Anthony).

According to Pilsbry (103, p. 43) *Melantho decampii* W. G. Binn. is a synonym of this species, which has been very generally misunderstood. The Florida form usually known by this name is *C. floridense* Call.

CAMPELOMA MILESII (Lea).

Is apparently a valid species. If not, it should be referred to *decisum* rather than to *subsolidum*. See Walker, 146, p. 121.

CAMPELOMA PONDEROSUM COARCTATUM (Lea).

This is the *Paludina coarctata* and *P. incrassata* of Lea and the *Vivipara nolani* of Tryon.

For full synonymy see Walker, 154, p. 125.

CAMPELOMA RUFUM (Haldeman).

Is a valid species.

CAMPELOMA RUFUM GIBBUM (Currier).
Melantho gibba Currier, Am. J. of Con., III, 1867, p. 112, pl. 6, fig. 3.
Type locality: Grattan, Mich.

CAMPELOMA RUFUM GENICULIFORME Pilsbry.
Campeloma rufum geniculiforme Pilsbry, Naut., XXX, 1916, p. 42.
Type locality: Dooley Co., Ga.

CAMPELOMA RUFUM MERIDIONALE Pilsbry.
Campeloma rufum meridionale Pilsbry, Naut., XXX, 1916, p. 42.
Type locality: Crozier's Branch, Cabarrus Co., N. C. Also Little Sugar Creek, N. C. and Georgia.

CAMPELOMA SPILLMANII (Lea).
Paludina spillmanii Lea, Pr. A. N. S. P., 1867, p. 81; Jour. A. N. S. P., VI, 1868, p. 343, pl. 44, fig. 29; Obs., XII, 1868, p. 103, pl. 44, fig. 29.
Lioplax spillmanii Tryon, Mon., 1870, p. 35, pl. 14, fig. 7; pl. 15, fig. 8.
Type locality: Jackson Co., Ala.

Tryon (l. c.) gives the type locality as Jackson Co., Miss. Numerous specimens from several streams near Mooresville, Limestone Co., Ala., collected by Rev. H. E. Wheeler agree with the descriptions and figures given by Lea and Tryon and are *Campelomæ*. The embryonic young are strongly and acutely bicarinated, differing in this respect from all the other species of the genus. The operculum is wholly concentric. These shells agree very exactly with the cotypes of *C. decampii* W. G. Binn. in the DeCamp collection. If this identification and approximation are correct, *spillmanii* Lea will follow *decampii* into the synonymy of *C. limum* (Anth.).

CAMPELOMA SUBSOLIDUM (Anthony).

Is a valid species. Whether the *Paludina exilis* of Anthony is a sexual form as believed by Lewis and others or an individual or local mutation is unsettled. The fact that it has not been found in southwestern Michigan, where the species is a common one would seem to cast a doubt on its being a sexual variation.

Genus LIOPLAX Troschel, 1856.

LIOPLAX ELLIOTTII (Lea).

Is a valid species.

LIOPLAX PILSBRYI Walker.
Lioplax pilsbryi Walker, Naut., XVIII, 1905, p. 133, pl. IX, figs. 1-3.
Type locality: Chipola River, Fla. Also Econfine River and Mud Creek, Fla.

Genus TULOTOMA Haldeman, 1840.

TULOTOMA ANGULATA (Lea).

The opinion of Lewis (71, p. 24) and Wetherby (164, p. 207) that this is specifically distinct from *magnifica* Con. is no doubt correct.

TULOTOMA COOSAENSIS (Lea).

This species described as a *Paludina* and referred to *Vivipara* by Binney and to *Lioplax* by Tryon (132, p. 36) is a *Tulotoma* as stated by Wetherby (164, p. 212).

Family VALVATIDÆ.

Genus VALVATA O. F. Müller, 1774.

VALVATA BICARINATA Lea.

Is a valid species. See Walker, 146, p. 124 and 147, p. 29.

VALVATA BICARINATA CONNECTANS Walker.

Valvata bicarinata connectans Walker, Naut., XX, 1906, p. 30.

Type locality: Lake Michigan, New Buffalo, Mich.

VALVATA BICARINATA NORMALIS Walker.

Valvata bicarinata normalis Walker, Naut., XV, 1902, p. 125, fig. 5.

Type locality: Not specified.

Habitat: Muscatine, Ia. and Utica, Ills.

VALVATA BICARINATA PERDEPRESSA Walker.

Valvata bicarinata perdepressa Walker, Naut., XX, 1906, p. 30, pl. 1, figs. 15-16.

Type locality: Lake Michigan, Michigan City, Ind.

VALVATA CALLI Hannibal, Naut., XXIII, 1910, p. 107.

Type locality: Marl-deposit, Upper Lahontan Quaternary, Summer Lake, Or.

VALVATA HUMERALIS CALIFORNICA Pils.

Valvata humeralis californica Pilsbry, Naut., XXII, 1908, p. 82.

Type locality: Bear Lake, San Bernardino Co., Cal.

VALVATA LEWISI Currier.

Valvata striata Lewis, Pr. A. N. S. P., 1856, p. 260; *non striata* Philippi, 1836-1844; Binney, L. and F. W. Shells, pt. III, 1865, p. 13, fig. 18.

Valvata lewisi Currier, Kent Sci. Inst. Misc. Pub., 1868, p. 9.

Type locality: Little Lakes, N. Y.

VALVATA LEWISI HELICOIDEA Dall.

Valvata lewisi helicoidea Dall, Rep. Harriman Exp., XIII, 1905, p. 123, pl. II, figs. 1-2.

Type locality not specified.

Range: "With the type form, to some extent everywhere, but especially toward the Northwest."

VALVATA MERGELLA West.

Valvata mergella Westerlund, Vega Exped. Vetens. Iakt., IV, 1885, p. 209, pl. V, figs. 22a-d.

Type locality: Port Clarence, near Bering Strait, Alaska.

VALVATA OBTUSA Drap.

This European species has been listed from the mouth of the Genessee River, N. Y., by Baker (3, p. 71).

VALVATA PISCINALIS Müller.

This European species has recently been found by Latchford (65, p. 10) at Honisher Bay, Toronto, Ont.

VALVATA SINCERA DANIELSI Walker.

Vatvata sincera danielsi Walker, Naut., XX, 1906, p. 28, pl. 1, figs. 10-11.

Type locality: Cannon Lake, Rice Co., Minn.

VALVATA SINCERA NYLANDERI Dall.

Valvata (*sincera* var.?) *nylanderi* Dall, Rep. Harriman Exp., XIII, 1905, p. 122.

Type locality: Aroostook Co., Me.

VALVATA TERRÆ-NOVÆ Férussac.

Type locality: ?

Specimens under this name are in the Museum of Paris according to Binney (12, p. 430), but it does not appear to have ever been described.

VALVATA TRICARINATA Say.

This species is the type (by designation) of the subgenus *Tropidina* H. and A. Adams, 1858, but as it is based upon the carinated whorls of the typical form and the species varies from ecarinate to tricarinate, it does not seem worthy of recognition.

VALVATA TRICARINATA BASALIS Vanatta.

Valvata tricarinata basalis Vanatta, Naut., XXVIII, 1915, p. 105, fig.
Type locality: Hudson River, N. Y.

VALVATA TRICARINATA INFRACARINATA Vanatta.

Valvata tricarinata infracarinata Vanatta, Naut., XXVIII, 1915, p. 104, fig.
Type locality: White Pond, N. J.

VALVATA TRICARINATA PERCONFUSA Walker.

Valvata tricarinata confusa Walker, Naut., XV, 1902, p. 124, fig. *2, non V. confusa* West. (1897).
Valvata tricarinata perconfusa Walker, Naut., XXXI, 1917, p. 36.
Type locality not specified.

VALVATA UTAHENSIS Call.

Valvata sincera utahensis Call, Bull. U. S. Geol. Surv., No. 11, 1884, p. 44, pl. VI, figs. 1-3.
Valvata utahensis Call, Pr. Davenport A. N. S., V, 1886, p. 4, pl. 1, figs. 1-3.
Type locality: Utah Lake, Utah.

Family AMNICOLIDÆ.
Subfamily BYTHININÆ Stimpson, 1865.
Genus BYTHINIA Leach, 1818.

BYTHINIA PERFECTA Frauenfeld.

Bythinia perfecta Frauenfeld, Verh. der k. k. zool.-bot. Ges. Wien, 1862, p. 1154; Ibid., 1865, p. 527, pl. IX.
Type locality: Columbia, North America.

Frauenfeld states that as the types are without the opercula, he could not tell whether the species was a *Bythinia* or an *Amnicola*. If the locality is correct, it is surely not a *Bythinia*. It may be a *Fluminicola*.

BYTHINIA TENTACULATA (L.).

This well known European species has been introduced by commerce and has spread from the Hudson west to Lake Michigan.

Subfamily AMNICOLINÆ Gill, 1871.
Genus AMNICOLA Gould and Haldeman, 1840.

AMNICOLA AUGUSTINA Pilsbry.
Amnicola augustina Pilsbry, Naut., XVII, 1904, p. 113; Walker, Naut., XIX, 1906, p. 117, pl. V, figs. 13-14.
Type locality: St. Augustine, Fla. Also at Tuscumbia, Ala., and fossil in a peat deposit at Lake Panasoffkee, Fla.

AMNICOLA BAKERIANA Pilsbry, Naut., XXXI, 1917, p. 44.
Type locality: Oneida Lake, N. Y.

AMNICOLA BAKERIANA NIMIA Pilsbry.
Amnicola bakeriana nimia Pilsbry, Naut., XXXI, 1917, p. 45.
Type locality: Oneida Lake, N. Y.

AMNICOLA CLARKEI Pilsbry.
Amnnicola clarkei Pilsbry, Naut., XXXI, 1917, p. 45.
Type locality: Oneida Lake, N. Y.

AMNICOLA COMALENSIS Pilsbry and Ferriss.
Amnicola comalensis Pilsbry and Ferriss, Pr. A. N. S. P., 1906, p. 171, fig. 37; Pilsbry, Naut., XIII, 1910, p. 98.
Type locality: Comal Creek, New Braunfels, Texas. Also Guadalupe River at the same place.

AMNICOLA DESERTA Pilsbry.
Amnicola deserta Pilsbry, Naut., XXIX, 1916, p. 111.
Type locality: Washington Co., Utah.

AMNICOLA FERRUGINEA Calkins.
Amnicola ferruginea Calkins, Valley Nat., II, 1880, p. 6, text fig.
Type locality: Calumet River, Ill.
Baker (4, p. 331) refers this to *A. limosa* Say.

AMNICOLA FLORIDANA Frauenfeld.
Amnicola floridana Frauenfeld, Verh. der k. k. zool.-bot. Ges. Wein, 1863, p. 1028; Ibid., 1865, p. 529, pl. X.
Type locality: East Florida.

AMNICOLA FLORIDANA CONVEXA Pilsbry.
Amnicola floridana convexa Pilsbry, Trans. Wag. Free Inst. Sci., III, pt. II, 1892, p. 338.
Type locality: Pliocene marl of the Caloosahatchie and Shell Creek, Fla.; also living in the fresh-water of Florida at the present time.

AMNICOLA HARPERI Dall.
Amnicola harperi Dall, Naut., XXIV, 1913, p. 2.
Type locality: Marl deposit, lake Panasoffkee, Fla.

AMNICOLA JOHNSONI Pilsbry.
Amnicola johnsoni Pilsbry, Naut., XIII, 1899, p. 21.
Type locality: St. Augustine, Fla. Also fossil at Lake Panasoffkee, Fla.

AMNICOLA LIMOSA (Say).
Includes *A. ferruginea* Calkins according to Baker.
The figure given for this species by Dall (32, p. 117, fig. 84) is incorrect, being a copy of Binney's figure (No. 165) of *A. pallida* Hald.

AMNICOLA LIMOSA PORTA (Say).
Includes *A. orbiculata* Lea as a synonym according to Pilsbry (92, p. 44).

AMNICOLA LUSTRICA Pilsbry.
Amnicola lustrica Pilsbry, Naut., IV, 1890, p. 53.
Type locality not specified.
Range: "New York to Illinois and Minnesota."

AMNICOLA MICROCOCCUS Pilsbry.
Amnicola micrococcus Pilsbry, N. Am. Fauna, No. 7, pt. II, 1893, p. 277, fig. 1; U. S. Nat. Mus., XXIV, 1901, p. 286, fig. 4.
Type locality: Oasis Valley, Nev. Also Death Valley, Inyo Co., Cal.

AMNICOLA MILIARIA Parreys.
Frauenfeld (40, p. 1027) states that in the Cuming Collection there is a set of this European species labelled "Spring Garden Lake, East Florida." He considers the shells to belong to this species without doubt, so that as he suggests there has probably been a mixing of labels.

AMNICOLA MISSOURIENSIS Pilsbry.
Amnicola missouriensis Pilsbry, Naut., XII, 1898, p. 43.
Type locality: Carter Co., Mo.

AMNICOLA NEOMEXICANA Pilsbry.
Amnicola neomexicana Pilsbry, Naut., XXIX, 1916, p. 111.
Type locality: Socorro, New Mexico.

AMNICOLA NUTTALLIANA "Lea" Frauenfeld.
Amnicola nuttalliana Frauenfeld, Verh. der k. k. zool.-bot. Ges. Wien, 1863, p. 1029.

The form thus listed by Frauenfeld from Silver Spring, Fort King, Fla., is probably *Gillia wetherbyi* Dall, as suggested by Dall (28, p. 258).

AMNICOLA OLIVACEA Pilsbry.
Amnicola olivacea Pilsbry, Naut., VIII, 1895, p. 115.
Type locality: Huntsville, Ala.

AMNICOLA ONEIDA Pilsbry.
Amnicola oneida Pilsbry, Naut., XXXI, 1917, p. 46.
Type locality: Oneida Lake, N. Y.

AMNICOLA PALLIDA Haldeman.

The figure given by Dall for this species (32, p. 117, fig. 85) is a copy of Binney's figure (No. 168) of *A. cincinnatiensis.*

AMNICOLA PARVA Lea.

Is a valid species. See Pilsbry, 92, p. 44.

AMNICOLA PILSBRYI Walker.
Amnicola parva Marsh, Con. Ex., II, 1888, p. 91.
Amnicola pilsbryi Walker, Naut., XIX, 1906, p. 116, pl. V, figs. 11 and 16.
Type locality: Rockford, Ills.

AMNICOLA SANCTIJOHANNIS Pilsbry.
Amnicola sanctijohannis Pilsbry, Naut., XIII, 1899, p. 20.
Type locality: St. John's River, Astor, Fla. Also Silver Spring Run, Marion Co., and Wekiva River, Fla.

AMNICOLA SCHROKINGERI Frauenfeld.
Amnicola schrokingeri Frauenfeld, Verh. der k. k. zool.-bot. Ges. Wien, 1863, p. 1030; Ibid., 1865, p. 528, pl. X.
Type locality: Massachusetts.

If the specimens from several localities in Maine are correctly identified, this species seems to be distinct from *limosa,* to which it is referred by Tryon (132, p. 52).

Closely related to, but very much smaller than *A. winkleyi* according to Pilsbry (102, p. 1).

AMNICOLA WALKERI Pilsbry.
Amnnicola walkeri Pilsbry, Naut., XII, 1898, p. 43; Walker, Naut., XIX, 1906, p. 117, pl. V, fig. 12.
Type locality: High Island Harbor, Beaver Ids., Lake Michigan.
Range: Upper St. Lawrence drainage from Ottawa, Ont., to Lake Michigan.

AMNICOLA WINKLEYI Pilsbry.
Amnicola winkleyi Pilsbry, Naut., XXVI, 1912, p. 1, pl. I, figs. 9-10.
Type locality: Saco, Me.

Section CINCINNATIA Pilsbry, 1891.

AMNICOLA CINCINNATIENSIS (Anth.).
Amnicola scarboroughi Tryon MSS. is a synonym according to Tryon (132, p. 54).

Baker's remark (4, p. 336), that Binney's fig. 162 is an error is incorrect. That figure does not represent this species, but is the radula of *A. sayana* Anth. (*Pomatiopsis cincinnatiensis* Lea). The same author (loc. cit., pp. 335 and 343) has reversed the synonymy of the two species, which explains his remark that Haldeman's figures of the two species are interchanged.

The figure given for this species by Dall (32, p. 118, fig. 87) is also incorrect, being Binney's fig. 166 of *A. limosa*.

AMNICOLA EMARGINATA (Küster).
Paludina obtusa Lea, Pr. Am. Phil. Soc., II, p. 34, (1841), *non P. obtusa* Phil. (1837).
Pauldina emarginata Küster, Con. Cab., Paludina, 1852, p. 50, pl. 10, figs. 3-4.
Cincinnatia binneyana Hann., Pr. Mal. Soc. Lond., X, 1912, p. 190.

There seems to be no valid ground for the new name proposed by Hannibal.

AMNICOLA PERACUTA Pilsbry and Walker.
Amnicola peracuta Pilsbry and Walker, Pr. A. N. S. P., 1889, p. 88, pl. III, fig. 20.
Type locality: Spivey's Lake, Navarro Co., Texas.

Genus PALUDESTRINA d'Orbigny, 1841.

Bythinella Moq.-Tand., 1851.
Stimpsonia Clessin, Mal. Blätt., XXV, 1878, p. 151.

Except as noted, all the species referred to *Bythinella* by Binney belong to this genus.

PALUDESTRINA ACUTISSIMA "Whit." (Frauenfeld).
? Amnicola acutissima "Whit.", Frauenfeld, Verh. der k. k. zool.-bot. Ges. Wien, 1863, p. 207.
Hydrobia acutissima "Whit.", Frauenfeld, Ibid., 1863, p. 1021.
Type locality: ?

Frauenfeld queries as to who "Whit." is. The fact that *Pal. emarginata* and other North American species are in the Cuming Collection named by "Whit." makes it a possibility that this is also an American species. It is possible that "Whit." stands for T. J. Whittemore, who was a well known collector in Massachusetts in 1840.

PALUDESTRINA ÆQUICOSTATA (Pilsbry).
Bythinella æquicostata Pilsbry, Pr. A. N. S. P., 1889, p. 86, pl. III, fig. 16.
Type locality: Sumpter Co. and Haulover Canal, Fla.

PALUDESTRINA ALDRICHI (Call and Beecher).
Bythinella aldrichi Call and Beecher, Bull. Wash. Coll., I, 1886, p. 190, pl. VII, figs. 11-14.
Type locality: Tributary of Black River, Reynolds Co., Mo.

PALUDESTRINA BREVISSIMA (Pilsbry).
Bythinella brevissima Pilsbry, Naut., IV, 1890, p. 64.
Type locality: Haulover Canal, Indian River, Fla.

"HYDROBIA" CALIFORNICA Tryon.
Hydrobia californica Tryon, Am. J. of Con., I, 1865, p. 221, pl. 22, fig. 11.
Is an *Assimenia* according to Pilsbry (96, p. 123).

PALUDESTRINA CORRIGATA (Frauenfeld).
Hydrobia corrigata Frauenfeld, Verh. der k. k. zool.-bot. Ges. Wien, 1863, p. 1021; Ibid, 1865, p. 525, pl. VIII.
Type locality: Boston, Mass.

PALUDESTRINA DIABOLI Pilsbry and Ferriss.
Paludestrina diaboli Pilsbry and Ferriss, Pr. A. N. S. P., 1906, p. 170, fig. 36.
Type locality: Devil's River, Val Verde, Texas. Also Rio San Filipe in the same county.

PALUDESTRINA HEMPHILLI (Pilsbry).
Bythinella hemphilli Pilsbry, Naut., IV, 1890, p. 63.
Type locality: Kentucky Ferry, Snake River, Idaho.

PALUDESTRINA IMITATOR Pilsbry.
Paludestrina imitator Pilsbry, Naut., XII, 1899, p. 124.
Type locality: Santa Cruz, Cal.

PALUDESTRINA LONGINQUA (Gould).
Amnicola longinqua Gould, Pr. B. S. N. H., V, 1855, p. 130.
Pomatiopsis intermedia Tryon, Am. J. of C., I, 1865, p. 220, pl. 22, fig. 8.
Bythinella intermedia Tryon, Mon., 1870, p. 49.
See Pilsbry, 96, p. 122.

PALUDESTRINA MINUTA (Totten).
Turbo minutus Totten, Am. Jour. Sci., O. S., XXVI, 1834, p. 369, fig. 6.
Cingula minuta Gould, Rep. Invert. Mass., 1841, p. 265, fig. 171.
Type locality: Mass. and Rhode Island.
This species is referred to *Paludestrina* by Pilsbry (99, p. 90).

PALUDESTRINA MONAS Pilsbry.
Paludestrina monas Pilsbry, Naut., XIII, 1899, p. 21.
Type locality: Wekiva River, Fla.

PALUDESTRINA MONROENSIS (Dall).
Bythinella monroensis Dall, Pr. U. S. Nat. Mus., VIII, 1885, p. 256, pl. 17, fig. 99.
Type locality: Brook from Benson's mineral spring into Lake Monroe, Enterprize, Fla.

PALUDESTRINA NICKLINIANA (Lea).
This species is the type of Clessin's genus *Stimpsonia*.

PALUDESTRINA NICKLINIANA ATTENUATA (Haldeman).
Amnicola attenuata Hald., Mon., pt. 4, 1842, p. 3 of wrapper; Mon., 1844, p. 22, pl. I, fig. 13.
Bythinella attenuata Binney, L. and F. W. Shells, pt. III, 1865, p. 68, fig. 132.

PALUDESTRINA PROTEA (Gld.).
Amnicola protea Gould, Pr. Bost. S. N. H., V, March, 1855, p. 129.
Melania exigua Conrad, Pr. A. N. S. P., April, 1855, p. 269.
Tryonia protea Binney, L. and F. W. Shells, III, 1865, p. 72, fig. 140.
Bythinella protea Stearns, N. Am. Fauna, No. 7, pt. II, 1893, p. 278.
Paludestrina protea Stearns, Pr. U. S. Nat. Mus., XXIV, 1901, p. 277, pl. XIX-XXI.

Hydrobia seemani Frauenfeld, Verh. der k. k. zool.-bot. Gesell. Wien, 1863, p. 1025; Ibid., 1865, p. 525, pl. VIII.
Bythinella seemani Pilsbry, N. Am. Fauna, No. 7, pt. II, 1893, p. 278.

For an elaborate and fully illustrated account of the variation of this protean species, see Stearns' paper cited above.

PALUDESTRINA SALSA Pilsbry.
Paludestrina salsa Pilsbry, Naut., XIX, 1905, p. 90, pl. III, fig. 10.
Type locality: Cohasset, Mass., in brackish water.

PALUDESTRINA STEARNSIANA Pilsbry.
Paludestrina stearnsiana Pilsbry, Naut., XII, 1899, p. 124.
Type locality: Oakland, Cal. Also Marin, Tuolumne, Contra Costa and Santa Cruz counties, Cal. Also Ash Canyon and Tanner Canyon, Huachuca Mts., Ariz., Pilsbry and Ferriss (106a, p. 516)

Genus TRYONIA Stimpson, 1865.

Pilsbry (96, p. 122), states that *Tryonia* is probably only a subgenus of *Paludestrina*.

TRYONIA CLATHRATA Stimpson.

This species, described from fossil specimens, has been found living in the Pahranagat Valley, Nev. (Stearns, 123, p. 281).

Genus PYRGULOPSIS Call and Pilsbry, 1886.

Pyrgulopsis Call and Pilsbry. Pr. Davenport A. N. S., V, 1886, p. 9.
Type: *Pyrgula nevadensis* Stearns.

PYRGULOPSIS LETSONI (Walker).
Amnicola letsoni Walker, Naut., XIV, p. 113 (1901); Letson, Bull. Buffalo Soc. Nat. Sci., VII, 1901, p. 241, fig. 165.
Type locality: Post-Glacial deposit, Goat Island, Niagara River, N. Y. Also fossil at Bowmanville, Ills. and living at La Plaisance Bay, Lake Erie, Monroe Co., Mich.

Goodrich (*in lit.*) has suggested that this species should be referred to *Pyrgulopsis* and I fully agree with him.

PYRGULOPSIS NEVADENSIS (Stearns).
Pyrgula nevadensis Stearns, Pr. A. N. S. P., 1883, p. 173, text fig.; Call and Beecher, Am. Nat., XVIII, 1884, pp. 851-855; Call and Pilsbry, Pr. Davenport Acad. Nat. Sci., V, 1886, p. 10, pl. II, figs. 1-10.
Type locality: Walker and Pyramid Lakes, Nev.

PYRGULOPSIS SCALARIFORMIS (Wolf).
Pyrgula scalariformis Wolf, Am. J. of Con., V, 1869, p. 198, pl. 17, fig. 3.
Pyrgulopsis scalariformis Shimek, Bull. Lab. Nat. Hist. St. Univ. Ia., II, 1892, p. 168, pl. xiii, figs. 3a-d.
Pyrgula scalariformis mississippiensis Pilsbry, Am. Nat., 1886, p. 5. No description.
Pyrgulopsis mississippiensis Call and Pilsbry, Pr. Davenport A. N. S., V, 1886, p. 13, pl. II, figs. 14-16; Walker, Naut., XIX, 1906, p. 116, pl. 5, fig. 15.
Type locality: Illinois River, Tazwell Co., Ills. Holocene.
According to Shimek (l. c.) *mississippiensis* is a synonym of *scalariformis*.

PYRGULOPSIS OZARKENSIS Hinkley,
Pyrgulopsis ozarkensis Hinkley, Pr. U. S. Nat. Mus., 49, 1915, p. 588, pl. 78, fig. 2.
Type locality: North Fork of White River, above Norfolk, Ark.

PYRGULOPSIS SHELDONI (Pilsbry).
Amnicola sheldoni Pilsbry, Naut., IV, 1890, p. 52.
Type locality: Lake Michigan, Racine, Wis.
This species seems to be a *Pyrgulopsis* rather than an *Amnicola*.

PYRGULOPSIS WABASHENSIS Hinkley.
Pyrgulopsis wabashensis Hinkley, Naut., XXI, 1908, p. 117.
Type locality: Wabash River, The Chains, Posey Co., Ind.

Genus POTAMOPYRGUS Stimpson, 1865.

POTAMOPYRGUS CORONATUS (Pfeiffer).
Paludina coronata Pfeiffer, Wiegm. Archiv., I, 1840, p. 253.
Type locality: Cuba.
Listed from Miami River, Fla., by Rhoads (113, p. 47).

POTAMOPYRGUS SPINOSUS (Call and Pilsbry).
Pyrgulopsis spinosa Call and Pilsbry, Pr. Davenport A. N. S., V., 1886, p. 14, pl. II, figs. 17-19.
Hydrobia texana Pilsbry, Ibid., V, 1886, p. 33, pl. III, figs. 1-6.
Type locality: *spinosus,* Comal Creek, Texas; *texana,* Guadelupe River and Comal Creek, Tex.
According to Pilsbry (91, p. 327) this species is a *Potamopyrgus* and is doubtfully distinct from *coronatus*. *Texana* is the ecarinate form.

Genus LITTORIDINA Souleyet, 1852.

LITTORIDINA MONROENSIS (Frauenfeld).
Hydrobia monroensis Frauenfeld, Verh. der k. k. zool.-bot. Gesell. Wien, 1863, p. 1023; Pilsbry, Pr. A. N. S. P., 1889, p. 88, pl. III, figs. 17-19.
Bythinella monroensis Tryon, Mon., 1870, p. 48.
Type locality: Lake Monroe, Fla.

The generic position of this species, which was doubtfully referred to *Littoridina* by Pilsbry (94, p. 22) has since been confirmed by him. It is not the *Bythinella monroensis* of Dall (28, p. 256).

Subfamily LYTHOGLYPHINÆ Fischer, 1885.
Genus COCHLIOPA Stimpson, 1865.

COCHLIOPA ROWELLI Tryon.

The occurrence of this species in California is considered doubtful by Pilsbry (100, p. 91) and by Pilsbry and Ferriss (106, p. 172). Rowell however insists that the types were collected by him "near Baulinas Bay (not Clear Lake), Mann Co., Cal." (114, p. 10).

It is known to inhabit Nicaragua.

COCHLIOPA RIOGRANDENSIS Pilsbry and Ferriss.
Cochliopa riograndensis Pilsbry and Ferriss, Pr. A. N. S. P., 1906, p. 171, pl. IX, figs. 10-13.
Type locality: Rio San Filipe, near the Rio Grande, Val Verde Co., Texas. Also Devil's River in the same county.

Genus FLUMINICOLA Stimpson, 1865.

Hannibal (53, p. 186) has proposed a new subgenus *Heathella,* "readily distinguished by its globose form," having *F. seminalis* Hds. as the type and including *F. fusca, merriami, erythropoma, columbiana* and *minutissima.*

FLUMINICOLA COLUMBIANA Hemphill.
Fluminicola columbiana "Hemphill," Pilsbry, Naut., XII, 1899, p. 125; Pr., U. S. Nat. Mus., XXIV, 1901, p. 285, fig. 3.
Type locality: Columbia River, Washington, near Wallula and near mouth of Snake River; Snake River, near Weiser, Idaho.

FLUMINICOLA ERYTHROPOMA Pilsbry.
Fluminicola fusca minor Stearns, N. Amer. Fauna, No. 7, pt. II, 1893, p. 282. No description.
Fluminicola erythropoma Pilsbry, Naut., XII, 1899, p. 125.
Type locality: Ash Meadows, Nye Co., Nev.

FLUMINICOLA MERRIAMI Pilsbry and Beecher.
Fluminicola merriami Pilsbry and Beecher, Naut., V, 1892, p. 143; Stearns, N. Am. Fauna, No. 7, pt. II, 1893, p. 282, fig. 2.
Type locality: Pahranagat Valley, Nev.

FLUMINICOLA MINUTISSIMA Pilsbry.
Fluminicola minutissima Pilsbry, Naut., XXI, 1907, p. 76, pl. IX, fig. 1.
Type locality: Price Valley, Weiser Canyon, Washington Co., Idaho.

FLUMINICOLA MODOCI Hannibal.
Fluminicola modoci Hannibal, Pr. Mal. Soc. Lond., X, 1912, p. 187, pl. VII, fig. 30.
Type locality: Fletcher's Spring, south end of Goose Lake, Cal.

FLUMINICOLA NEVADENSIS Walker.
Fluminicola nevadensis Walker, Occ. Pap. Mus. Zool., Univ. Mich., No. 29, 1916, p. 6, text-fig.
Type locality: Cortez foot-hills, Humboldt Valley, Elko Co., Nev.

FLUMINICOLA SEMINALIS (Hinds).
Paludina seminalis Hinds, Voy. Sulphur, 1844, p. 59, pl. 16, fig. 22.
Lithoglyphus cumingii Frauenfeld, Verh. der k. k. zool.-bot. Ges. Wien, 1863, p. 195; Ibid., 1865, p. 530, pl. XI.
Amnicola tubiniformis Tryon, A. J. of Con., I, 1865, p. 219, pl. 22, fig. 5.
Type locality: *seminalis,* Sacramento River, Cal.
cumingii, California.
turbiniformis, Crane Lake Valley and Surprise Valley, Cal.
This synonymy is according to Pilsbry (96, p. 123).

FLUMINICOLA SEMINALIS DALLI (Call).
Amnicola dalli Call, Bull. U. S. Geol. Surv., No. XI, 1884, p. 45, pl. VII, figs. 4-6.
Fluminicola seminalis dalli Pilsbry, Naut., XIII, 1899, p. 123.
Type locality: Mountain streams near Pyramid Lake, Nev.

Genus SOMATOGYRUS Gill, 1863.

For a description of the peculiar apical sculpture of this genus, see Walker, 156.

SOMATOGYRUS ALDRICHI Walker.
Somatogyrus aldrichi Walker, Naut., XIX, 1901, p. 114, pl. V, fig. 9.
Type locality: Coosa River, Chilton Co., Ala.

SOMATOGYRUS AMNICOLOIDES Walker.
Somatogyrus amnicoloides Walker, Naut., XXIX, 1915, p. 52, fig. 3.
Type locality: Ouachita River, Arkadelphia, Ark.

SOMATOGYRUS AUREUS Tryon.
Somatogyrus aureus Tryon, A. J. of Con., I, 1865, p. 220, pl. 22, fig. 9.
Type locality: Tennessee River.

SOMATOGYRUS BIANGULATUS Walker.
Somatogyrus biangulatus Walker, Naut., XIX, 1906, p. 99, pl. V, fig. 6.
Type locality: Tennessee River, Florence, Ala.

SOMATOGYRUS CONSTRICTUS Walker.
Somatogyrus constrictus Walker, Naut., XVII, 1904, p. 135, pl. V, fig. 3.
Type locality: Coosa River, Wetumpka, Ala.

SOMATOGYRUS COOSAENSIS Walker.
Somatogyrus coosaensis Walker, Naut., XVII, 1904, p. 137, pl. V, figs. 6-8.
Type locality: Coosa River, Wetumpka, Ala.

SOMATOGYRUS CRASSILABRIS Walker.
Somatogyrus crassilabris Walker, Naut., XXIX, 1915, p. 53, fig. 4; Hinkley, Pr. U. S. Nat. Mus., XLIX, 1915, p. 589, pl. 78, fig. 1.
Type locality: North Fork of White River, Norfolk, Ark.

SOMATOGYRUS CRASSUS Walker.
Somatogyrus crassus Walker, Naut., XVII, 1904, p. 138, pl. V, figs. 11-12.
Type locality: Coosa River, Wetumpka, Ala.

SOMATOGYRUS CURRIERIANUS (Lea).
Amnicola currieriana Lea, Pr. A. N. S. P., 1863, p. 118; Jour. A. N. S. P., VI, 1866, p. 186, pl. XXII, fig. 118; Lea, Obs., XI, 1866, p. 142, pl. XXII, fig. 118.
Somatogyrus currierianus Walker, Naut., XVII, 1904, p. 137, pl. II, figs. 8-9.
Type locality: Huntsville, Ala.

SOMATOGYRUS DECIPIENS Walker.
Somatogyrus decipiens Walker, Naut., XXII, 1909, p. 80, pl. I, figs. 10-11.
Type locality: Coosa River, The Bar, Chilton Co., Ala.

SOMATOGYRUS EXCAVATUS Walker.
Somatogyrus excavatus Walker, Naut., XIX, 1906, p. 100, pl. V, fig. 7.
Type locality: Shoal Creek, Florence, Ala.

SOMATOGYRUS GEORGIANUS Walker.
Somatogyrus georgianus Walker, Naut., XVII, 1904, p. 139, pl. V, fig. 2.
Type locality: Chattooga River. Chattooga Co., Ga.

SOMATOGYRUS HENDERSONI Walker.
Somatogyrus hendersoni Walker, Naut., XXII, 1909, p. 87, pl. VI, fig. 2.
Type locality: Coosa River, Duncan's Riffle, Chilton Co., Ala.

SOMATOGYRUS HINKLEYI Walker.
Somatogyrus hinkleyi Walker, Naut., XVII, 1904, p. 135, pl. V, figs. 1-2; Naut., XXII, 1909, p. 87, pl. VI, figs. 8-9.
Type locality: Coosa River, Wetumpka, Ala.

SOMATOGYRUS HUMEROSUS Walker.
Somatogyrus humerosus Walker, Naut., XIX, 1906, p. 98, pl. V, fig. *2*.
Type locality: Tennessee River, Florence, Ala.

SOMATOGYRUS INTEGER (Say).

Includes *Paludina fontinalis* Phil. erroneously referred to *subglobosus* by Binney. Both *integer* and *fontinalis* are referred to *Lithoglyphus* by Frauenfeld (39, pp. 194 and 179).

SOMATOGYRUS NANUS Walker.
Somatogyrus nanus Walker, Naut., XVII, 1904, p. 136, pl. V, fig. 4.
Type locality: Coosa River, Wetumpka, Ala.

SOMATOGYRUS OBTUSUS Walker.
Somatogyrus obtusus Walker, Naut., XVII, 1904, p. 138, pl. V, fig. 10.
Type locality: Coosa River, Farmer, Ala.

SOMATOGYRUS PARVULUS Tryon.
Somatogyrus parvulus Tryon, A. J. of Con., I, 1865, p. 221, pl. 22, fig. 10.
Type locality: Powell's River, Tenn.

Binney's figure of "*Gillia* sp?" (L. and F. W. Shells, III, p. 115, fig. 230) is this species according to Tryon (131, p. 198).

SOMATOGYRUS PENNSYLVANICUS Walker.

Somatogyrus pennsylvanicus Walker, Naut., XVII, 1904, p. 140, pl. V, figs. 15-16; Naut., XIX, 1906, p. 116, pl. 5, figs. 17-18.

Type locality: Columbia, Pa. Also Potomac River, Harper's Ferry, Va.

SOMATOGYRUS PILSBRYANUS Walker.

Somatogyrus pilsbryanus Walker, Naut., XVII, 1904, p. 142, pl. V, figs. 20-21.

Type locality: Tallapoosa River, Tallassee, Ala.

SOMATOGYRUS PUMILUS (Conrad).

Anculotus pumilus Conrad, New F. W. Shells, 1834, p. 62; Binney, L. and F. W. Shells, III, 1865, p. 80.

Anculosa pumila Conrad, A. J. of Con., II, 1866, p. 278, pl. XV, fig. 5.

Somatogyrus pumilus Walker, Naut., XIX, 1906, p. 115, pl. V, fig. 10.

Type locality: Black Warrior River, Ala. Also Cahatchee Creek, Shelby Co., Ala.

In his original description, Conrad quotes his species from Bayou Teche, La., but for some reason did not in his subsequent one in 1866.

SOMATOGYRUS PYGMÆUS Walker.

Somatogyrus pygmæus Walker, Naut., XXII, 1909, p. 88, pl. VI, fig. 3.

Type locality: Coosa River, The Bar, Chilton Co., Ala.

SOMATOGYRUS QUADRATUS Walker.

Somatogyrus quadratus Walker, Naut., XIX, 1906, p. 98, pl. V, figs. 3-4.

Type locality: Tennessee River, Florence, Ala.

SOMATOGYRUS SARGENTI Pilsbry.

Somatogyrus sargenti Pilsbry, Naut., VIII, 1895, p. 102; Walker, Naut., XVII, 1904, p. 139, pl. V, fig. 14.

Type locality: Mud Creek, a tributary of the Tennessee River, Ala.

SOMATOGYRUS STRENGI Pilsbry and Walker.

Somatogyrus strengi Pilsbry and Walker, Naut., XIX, 1906, p. 99, pl. V, fig. 5.

Type locality: Tennessee River, Florence, Ala. Also Wabash River, Posey Co., Ind.

SOMATOGYRUS SUBGLOBOSUS (Say).

Subglobosus (1825) has priority over *isogonus* (1829). *Paludina fontinalis* Phil. doubtfully referred to this species by Binney is a synonym of *integer* Say.

SOMATOGYRUS SUBSTRIATUS Walker.
Somatogyrus substriatus Walker, Naut., XIX, 1906, p. 97, pl. V, fig. 5.
Type locality: Tennessee River, Florence, Ala.

SOMATOGYRUS TENNESSEENSIS Walker.
Somatogyrus tennesseensis Walker, Naut., XIX, 1906, p. 114, pl. V, fig. 8.
Type locality: Shoal Creek, Florence, Ala.

SOMATOGYRUS TROTHIS Doherty.
Somatogyrus trothis Doherty, Quar. J. of Con., I, 1878, p. 341, pl. IV, fig. 1.
Type locality: Ohio River, Campbell Co., Ky.

SOMATOGYRUS UMBILICATUS Walker.
Somatogyrus umbilicatus Walker, Naut., XVII, 1904, p. 137, pl. V, fig. 5.
Type locality: Coosa River, Wetumpka, Ala.

SOMATOGYRUS VIRGINICUS Walker.
Somatogyrus virginicus Walker, Naut., XVII, 1904, p. 141, pl. V, figs. 18-19.
Type locality: Barnard's Ford, Rapidan River, Va.

SOMATOGYRUS WALKERIANUS Aldrich.
Somatogyrus walkerianus Aldrich, Naut., XVIII, 1905, p. 140, text-fig.
Type locality: Conecut (Conecuh?) River, Escambia Co., Ala.

SOMATOGYRUS WHEELERI Walker.
Somatogyrus wheeleri Walker, Naut., XXIX, 1915, p. 51, figs. 1-2.
Type locality: Ouachita River, Arkadelphia, Ark.

Genus GILLIA Stimpson, 1865.

GILLIA WETHERBYI (Dall).
Hydrobia ? wetherbyi Dall, Pr. U. S. Nat. Mus., 1885, p. 258, pl. XVII, fig. 10.
?Amnicola nuttalliana Frauenfeld, Verh. der k. k. zool.-bot. Ges. Wien, 1863, p. 1029.
Type locality: Lake Eustis, Fla.

Genus CLAPPIA Walker, 1909.

Clappia Walker, Naut., XXII, 1909, p. 89.
Type: *Clappia clappi* Walker.

CLAPPIA CLAPPI Walker.
Clappia clappi Walker, Naut., XXII, 1909, p. 89, pl. VI, figs. 1, 4 and 7.
Type locality: Coosa River, Duncan's Riffle, Chilton Co., Ala.

Subfamily LYOGYRINÆ Pilsbry, 1916.
Genus LYOGYRUS Gill, 1863.

LYOGYRUS BROWNII (Carpenter).
Amnicola brownii Carpenter, Central Falls (R. I.) Weekly Visitor, April, 1872.
Valvata (*Lyogyrus*) *brownii* Carpenter, Naut., III, 1889, p. 69.
Type locality: Cunliffs Pond, Elmville, R. I.

The citation of this species from Minnesota by Sargent (115, p. 126) is no doubt erroneous.

LYOGYRUS DALLI Pilsbry and Beecher.
Lyogyrus dalli Pilsbry and Beecher, Naut., VI, 1892, p. 62.
Type locality: Wekiva River, Fla.

LYOGYRUS GRANUM (Say).
Paludina grana Say, J. A. N. S. P., II, 1822, p. 378.
Amnicola granum W. G. Binney, L. and F. W. Shells, III, 1865, p. 86, fig. 170.

This species is known only from the Atlantic drainage in southeastern Pennsylvania and New Jersey. Western records for it and *L. brownii* are in all probability based upon some of the smaller species of *Amnicola*.

LYOGYRUS LEHNERTI Ancey.
Liogyrus lehnerti Ancey, Con. Ex., II, 1887, p. 79.
Type locality: Potomac River, Washington, D. C.

According to Pilsbry (87, p. 113) and part of the original lot in my collection, this is a reversed *Amnicola limosa* Say.

Genus HORATIA Bourguignat, 1887.

Horatia Bourguignat, Étude sur les noms gen. des petites Paludinidees &c., 1887, p. 47.

Westerlund (163, 4th Supp., p. 23) remarks that these small shells have the form of the smallest Pseudamnicolas, the structure of Lithoglyphus, the color of many Bythinellas and are allied to the Valvatas in their operculum. Typical *Horatia* is not represented in the North American fauna.

Subgenus HAUFFENIA Pollonera, 1898.

Hauffenia Pollonera, Boll. Mus. Zool. ed. Anat. Comp. Univ. Torino, XIII, 1898, p. 3.

HORATIA (HAUFFENIA) MICRA (Pilsbry and Ferriss).
Valvata micra Pilsbry and Ferriss, Pr. A. N. S. P., 1906, p. 172, pl. IX, figs. 7-9.
Horatia (*Hauffenia*) *micra* Pilsbry, Naut., XXX, 1916, p. 83.
Type locality: Guadalupe River, New Braunfels, Texas.

HORATIA MICRA NUGAX (Pilsbry and Ferriss).
Valvata micra nugax Pilsbry and Ferriss, Pr. A. N. S. P., 1906, p. 173, pl. IX, fig. 6.
Horatia (Hauffenia) micra nugax Pilsbry, Naut., XXX, 1916, p. 83.
Type locality: Guadalupe River, New Braunfels, Texas.

Subfamily POMATIOPSINÆ Stimpson, 1865.
Genus POMATIOPSIS Tryon, 1862.

POMATIOPSIS BINNEYI Tryon.
Pomatiopsis binneyi Tryon, Pr. A. N. S. P., 1863, p. 148, pl. I, fig. 10.
Bythinella binneyi W. G. Binney, L. and F. W. Shells, III, 1865, p. 69, figs. 136-137.
This species is a true *Pomatiopsis* according to Pilsbry (96, p. 123).

POMATIOPSIS CALIFORNICA Pilsbry.
Pomatiopsis californica Pilsbry, Naut., XII, 1899, p. 126.
Type locality: San Francisco, Cal.

POMATIOPSIS CINCINNATIENSIS (Lea).
Cyclostoma cincinnatiensis Lea, Pr. Am. Phil. Soc., I, 1840, p. 289.
Amnicola sayana "Anthony" Haldeman, Mon., 1844, p. 19, pl. I, fig. 11.
This species having proved to be a *Pomatiopsis,* Lea's name takes precedence over that of Anthony which was proposed on the supposition that the species was an *Amnicola.*
Baker (4, p. 343) has erroneously attributed the species to Anthony and his description, figures and synonymy are those of *Amnicola cincinnatiensis* Anth.

POMATIOPSIS HINKLEYI Pilsbry, Naut., X, 1896, p. 37.
Type locality: Black Falls, Florence, Ala.

POMATIOPSIS LAPIDARIA (Say).
Paludina lustrica Say, quoted as *Amnicola lustrica* by Haldeman and authors generally and as *Pomatiopsis lustrica* by Binney according to Pilsbry (89, p. 53) is the young of this species.

POMATIOPSIS ROBUSTA Walker.
Pomatiopsis robusta Walker, Naut., XXI, 1908, p. 97, text-fig.
Type locality: Jackson Lake, Wyo.

PLEUROCERIDÆ.

It has been suggested that the family name should be properly *Pleuroceratidæ*. But Stejneger (Herpetology of Japan, Bull. 58, U. S. Nat. Mus., p. 24) in a similar case has decided that the change is not necessary.

The errata given by Tryon on p. 427 of his "Strepomatidæ" are not included in his index and have, therefore, been noted under the several species as they are likely to be overlooked.

Pilsbry (Pilsbry and Rhoads, 111, p. 496) has proposed the following re-arrangement of this family:

Genus IO Lea.
Type *Fusus fluvialis* Say.

Genus LITHASIA Haldeman.
Type *Anculosa* (*Lithasia*) *geniculata* Hald.
Section ANGITREMA Haldeman.
Type *Melania armigera* Say.

Genus PLEUROCERA Rafinesque.
Type ?
Section STREPHOBASIS Lea.

Types *S. spillmani, cornea* and *clarkii* Lea (all = *plena* Anth.)

Genus ELIMIA H. and A. Adams.
Type *Melania acutocarinata* Lea.

Genus GYROTOMA Shuttleworth.
Genus ANCULOSA Say.

Dr. Pilsbry has more recently decided that *Goniobasis* should be restored to its former position as a generic term, on the ground that *Elimia* was a composite group.

It will be noticed that no mention is made of *Eurycælon* in this arrangement. While, as Tryon remarks (134, p. 341), the genus as aggregated by him is made up of incongruous elements and upon a revision of the family will no doubt be dismembered, the typical group, of which *anthonyi* and *crassa* are leading terms form a very distinct group, which seems entitled to recognition.

Genus LITHASIA Haldeman, 1840.

LITHASIA CURTA Lea.
Lithasia curta Lea, Pr. A. N. S. P., 1868, p. 153; Lea, Jour. A. N. S. P., VI, 1868, p. 340, pl. 54, fig. 24; Obs., XII, 1868, p. 100, pl. 54, fig. 24.
Type locality : Northern Alabama and Tuscumbia.

LITHASIA CYLINDRICA Lea.

Lithasia cylindrica Lea, Pr. A. N. S. P., 1866, p. 133; Jour. A. N. S. P., VI, 1868, p. 341, pl. 54, fig. 26; Obs., XII, 1868, p. 101, pl. 54, fig. 26.

Type locality: Coosa River, Ala.

LITHASIA OBOVATA (Say).

Pilsbry (101, p. 47) has figured the operculum of this species.

For an account of the early stages of growth in this species, see Walker, No. 143.

LITHASIA OBOVATA BICONICA Pilsbry.

Lithasia obovata biconica Pilsbry, 27th Ann. Rep. Dep't. Geol. & Nat. Resc. Ind., 1908, p. 604, fig. 23a.

Type locality: Wabash River, Gibson Co., Ind.

LITHASIA PLICATA Wetherby.

Lithasia plicata Wetherby, Jour. Soc. N. H. Cin., 1876, p. 9, pl. I, fig. 1.

Type locality: Green River, Jackson Co., Ind.

LITHASIA PURPUREA Lea.

Lithasia purpurea Lea, Pr. A. N. S. P., 1868, p. 153; Jour. A. N. S. P., VI, 1868, p. 340, pl. 54, fig. 23; Obs., XII, 1868, p. 100, pl. 54, fig. 23.

Type locality: Cahawha River, Centreville, Bibb Co., Ala.

LITHASIA WHEATLEYI Lea.

Lithasia wheatleyi Lea, Pr. A. N. S. P., 1866, p. 133; Jour. A. N. S. P., VI, 1868, p. 341, pl. 54, fig. 25; Obs., XII, 1868, p. 101, pl. 54, fig. 25.

Type locality: Cahawba River, Ala.

Section ANGITREMA Haldeman, 1841.

LITHASIA ANGULATA (Wetherby).

Angitrema angulata Wetherby, Jour. Cin. Soc. N. H., 1876, p. 11, pl. I, fig. 5.

Type locality: Stone's River, Rutherford Co., Tenn.

LITHASIA PARVA (Wetherby).

Angitrema parva Wetherby, Jour. Cin. Soc. N. H., 1876, p. 9, pl. I, fig. 2.

Type locality: Stone's River, Rutherford Co., Tenn.

PLEUROCERA Rafinesque, 1818.

Pilsbry (105, p. 114) from a consideration of the literature concludes that the type of *Pleurocera* Raf. is *verrucosa* Raf. and that it consequently takes the place of *Angitrema* Hald. and that for this group *Ceriphasia* Sw. should be used. This has been controverted by Walker, No. 161, who argues that the type of *Pleurocera* had never been properly designated and designates *P. acuta* Raf. as the type, thus retaining the name for the group with which it has commonly been known. In a similar case, Dall (29, p. 1141) had already taken the same position as advocated by Walker.

PLEUROCERA ACUTA Rafinesque.
Pleurocera acuta Rafinesque, Enumeration and Account, 1831, p. 3; Walker, Occ. Pap. Mus. Zool., U. of M., No. 38, p. 8.

Is identical with and has precedence over *P. subulare* Lea and is the type of *Pleurocera* Raf. It includes according to Goodrich (49, p. 122) *tractum* Anth., *neglectum* Anth., *intensum* Rve., *pallidum* Lea and *labiatum* in Lea.

PLEUROCERA AFFINE (Lea).
Trypanestoma affine Lea, Obs., XI, 1866, p. 101, pl. 23, fig. 57.

PLEUROCERA ALTIPETUM (Anthony).
Trypanostoma corneum Lea, Obs., XI, 1866, p. 104, pl. 23, fig. 63.

PLEUROCERA ALVEARE (Conrad).
Includes *P. plicatum* Tryon.

PLEUROCERA ARATUM (Lea).
Trypanostoma cinctum Lea, Obs., XI, 1866, p. 103, pl. 23, fig. 60.

PLEUROCERA BICINCTUM Tryon.
Pleurocera bicinctum Tryon, Am. J. of Con., II, 1866, p. 4, pl. II, fig. 2.
Type locality: Bridgeport, Ala.

PLEUROCERA CARINATUM (Lea).
Trypanostoma carinatum Lea, Obs., XI, 1866, p. 104, pl. 23, fig. 62.

This species as suggested by Tryon is probably the young of some other species. If, however, it should prove to be a valid one, it will have renamed as, *Pleurocera* (*Strephobasis*) *carinatum* Lea has priority.

PLEUROCERA CASTANEUM (Lea).
Trypanostoma castaneum Lea, Pr. A. N. S. P., 1868, p. 152; Jour. A. N. S. P., VI, 1868, p. 335, pl. 54, fig. 20; Obs., XII, 1868, p. 98, pl. 54, fig. 20.
Type locality: Coosa River, Ala.

PLEUROCERA CURRIERIANUM (Lea).
Trypanostoma currierianum Lea, Obs., XI, 1866, p. 103, pl. 23, fig. 61.

PLEUROCERA CYLINDRACEUM (Lea).
Trypanostoma cylindraceum Lea, Obs., XI, 1866, p. 98, pl. 23, fig. 51.
Includes *P. roanense* Lea, according to Pilsbry (111, p. 498).

PLEUROCERA EXIMIUM (Anthony).
Has priority over *gradatum* (Anth.).

PLEUROCERA GLANDULUM (Anthony).
Is undoubtedly the young of one of the earlier described species of *Strephobasis* included in the synonymy of *plena*.

PLEUROCERA GRADATUM (Anthony).
Trypanostoma curtatum Lea, Jour. A. N. S. P., VI, 1866, p. 143, pl. 23, fig. 53; Obs., XI, 1866, p. 99, pl. 23, fig. 53.

PLEUROCERA LESLEYI (Lea).
Trypanostoma lesleyi Lea, Obs., XI, 1866, p. 102, pl. 23, fig. 59.

PLEUROCERA LEWISII (Lea).
As suspected by Tryon this form is only a striate variety of *elevatum*.

PLEUROCERA LYONII (Lea).
Trypanostoma lyonii Lea, Jour. A. N. S. P., VI, 1866, p. 144, pl. 23, fig. 55; Obs., XI, 1866, p. 100, pl. 23, fig. 55.

PLEUROCERA NAPOIDEUM (Lea).
Trypanostoma napoideum Lea, Obs., XI, 1866, p. 99, pl. 23, fig. 54.

PLEUROCERA NUCIFORME (Lea).
Trypanostoma nuciforme Lea, Pr. A. N. S. P., 1868, p. 152; Jour. A. N. S. P., VI, 1868, p. 337, pl. 54, fig. 19; Obs., XII, 1868, p. 97, pl. 54, fig. 19.
Type locality: Connesauga Creek, Whitfield Co., Ga.

PLEUROCERA PUMILUM (Lea).
Is probably the young of some other species. If valid however, it will have to be renamed, as *Pleurocera* (*Stephobasis*) *pumilum* Lea has priority, unless that too should prove to be a synonym.

PLEUROCERA ROANENSE (Lea).
Trypanostoma roanense Lea, Obs., XI, 1866, p. 98, pl. 23, fig. 52.

PLEUROCERA SUBROBUSTUM (Lea).
Trypanostoma subrobustum Lea, Obs., XI, 1866, p. 97, pl. 23, fig. 50.

PLEUROCERA TEREBRALE (Lea).
Trypanostoma terebrale Lea, Pr. A. N. S. P., 1868, p. 153; Jour. A. N. S. P., VI, 339, pl. 54, fig. 22; Obs., XII, 1868, p. 99, pl. 54, fig. 22.
Type locality: Jackson Co., Ala.

PLEUROCERA UNDULATUM (Say).
Includes *M. excurata* Con. and *rorata* Rve., *T. moniliferum* Lea and *spillmani* Lea, and *Io nobilis* Lea, *nodosa* Lea, *robusta* Lea and *variabilis* Lea according to Pilsbry (111, p. 497).

PLEUROCERA UNIVITTATUM (Lea).
Trypanostoma univittatum Lea, Obs., XI, 1866, p. 101, pl. 23, fig. 58.

PLEUROCERA VENUSTUM (Lea).
Trypanostoma venustum Lea, Pr. A. N. S. P., 1864, p. 12; Jour. A. N. S. P., VI, 1866, p. 149, pl. 23, fig. 66; Obs., XI, 1866, p. 107, pl. 23, fig. 66.
Type locality: Big Prairie Creek, Ala.

PLEUROCERA WHEATLEYI (Lea).
Trypanostoma wheatleyi Lea, Pr. A. N. S. P., 1868, p. 153; Jour. A. N. S. P., VI, 1868, p. 338, pl. 54, fig. 21; Obs., XII, 1868, p. 99, pl. 54, fig. 21.
Type locality: Coosa River, Ala.

Section STREPHOBASIS Lea, 1861.

PLEUROCERA CURTUM (Haldeman).
Dr. James Lewis (68, p. 224) suggested a long synonymy for this species, "not as being conclusive, but as being in many particulars deserving of inquiry." Tryon (133, p. 88) in a review of Lewis' paper, states that upon the invitation of Dr. Lea, he had re-examined the types of the species included in the proposed synonymy, which resulted in a renewed assurance that his original determinations respecting them were correct. Later, (Tryon, 134. p. 424) Lewis states that on reviewing the matter, he had ascertained "that one of Say's species (hitherto treated as superfluous) was really entitled to take precedence of *curtum*."

PLEUROCERA BITÆNIATUM (Conrad).

According to Pilsbry (111, p. 499) *Strephobasis clarkii* Lea is not a synonym of this species, but of *plena* Anth.

PLEUROCERA LYONII (Lea).

Strephobasis lyonii Lea, Jour. A. N. S. P., VI, 1866, p. 151, pl. 23, fig. 65; Obs., XI, 1866, p. 107, pl. 23, fig. 65.

The figure given by Tryon (134, p. 46, fig. 93) for this species is erroneous and is that of *Eurycælon umbonatum* (loc. cit. fig. 658).

If *Pleurocera (Trypanostoma) lyonii* Lea is a valid species, it has priority over this one, which, if also a valid species, will have to have a new name. But in the present chaotic state of our knowledge of the family, it does not seem advisable to propose one until the double question of synonymy is definitely settled.

PLEUROCERA PLENUM (Anthony).

Includes *clarkii* (Lea), *corneum* (Lea) and *spillmani* (Lea) according to Pilsbry (111, p. 499) and *P. glandulum* (Anth.).

"STREPHOBASIS" HARTMANIANA Lea MSS.

Is listed by Lewis (l. c.) among the probable synonyms of *P. curtum* (Hald.). It does not appear to have ever been described.

Genus GONIOBASIS Lea, 1862.

Hannibal (53, p. 179) has designated *G. osculata* Lea as the generic type.

GONIOBASIS ACUTIFILOSA (Stearns).

Melania (? Goniobasis) acutifilosa Stearns, Pr. U. S. Nat. Mus., XIII, 1890, p. 211, pl. XV, fig. 9.

Type locality: Eagle Lake, Cal.

GONIOBASIS ACUTIFILOSA SISKIYOUENSIS Pilsbry.

Goniobasis acutifilosa siskiyouensis Pilsbry, Naut., XIII, 1899, p. 65.

Type locality: Fall River, Siskiyou Co., Cal.

GONIOBASIS ALBANYENSIS Lea.

Goniobasis albanyensis Lea, Pr. A. N. S. P., 1864, p. 4; Jour. A. N. S. P., VI, 1866, p. 140, pl. 23, fig. 49; Obs., XI, 1866, p. 97, pl. 23, fig. 49.

Type locality: Albany and Blue Spring, Baker Co., Ga.

GONIOBASIS ARACHNOIDEA (Anthony).
Includes *baculum* Anth. according to Lewis (69, p. 114).

GONIOBASIS ARATA Lea.
Goniobasis arata Lea, Pr. A. N. S. P., 1868, p. 151; Jour. A. N. S. P., VI, 1868, p. 329, pl. 54, fig. 4; Obs., XII, 1868, p. 89, pl. 54, fig. 4.
Type locality: Connesauga Creek, Whitfield Co., Ga.

GONIOBASIS ATERINA Lea.
Goniobasis aterina Lea, Jour. A. N. S. P., VI, 1866, p. 136, pl. 23, fig. 42; Obs., XI, 1866, p. 92, pl. 23, fig. 42.

GONIOBASIS BACULOIDES Lea.
Goniobasis baculoides Lea, Pr. A. N. S. P., 1869, p. 125; Jour. A. N. S. P., VIII, 1874, p. 62, pl. 21, fig. 18; Obs., XIII, 1874, p. 66, pl. 21, fig. 18.
Type locality: Coosa River, Ala.

GONIOBASIS BIFASCIATA Lea.
Goniobasis bifasciata Lea, Pr. A. N. S. P., 1868, p. 151; Jour. A. N. S. P., VI, 1868, p. 331, pl. 54, fig. 7; Obs., XII, 1868, p. 91, pl. 54, fig. 7.
Type locality: Jackson Co., Ala.

GONIOBASIS BOYKINIANA (Lea).
Includes *hallenbeckii* Lea according to Pilsbry (90, p. 124). See also *catenaria*.

GONIOBASIS BULBOSA (Gould).
Includes *newberryi* Lea according to Pilsbry (95, p. 66).

GONIOBASIS CALIFORNICA (Clessin).
Melania californica Clessin, Mal. Blætt., V, 1882, p. 189, pl. 4, figs. 9-9.
Type locality: California.
See *nigrina*.

GONIOBASIS CATENARIA (Say).
Includes *G. sublirata* (Con.), *floridensis* (Rve.), *etowahensis* (Lea), *papillosa* (Anth.), and *downieiana* Lea and probably also *boykiniana* (Lea), *hallenbeckii* Lea, *bentonensis* Lea and *couperi* Lea, according to Pilsbry (90, p. 124).

GONIOBASIS CINGENDA Anthony.
Goniobasis cingenda Anthony, Am. J. Con., II, 1866, p. 146, pl. 7, fig. 3.
Type locality: North Carolina.

GONIOBASIS CIRCUMLINEATA Tryon.

Goniobasis circumlineata Tryon, Am. J. of Con., II, 1865, p. 244, pl. 24, figs. 14-15.

Type localities: Mission San Antonio, Shasta Co.; Pit River and Feather River, Cal.

Probably only a variety of *G. nigrina* according to Pilsbry (95, p. 66).

GONIOBASIS CLATHRATA Lea.

Goniobasis clathrata Lea, Pr. A. N. S. P., 1868, p. 151; Jour. A. N. S. P., VI, 1868, p. 331, pl. 54, fig. 8; Obs., XII, 1868, p. 91, pl. 54, fig. 8.

Type locality: Jackson Co., Ala.

GONIOBASIS CLAVULA Lea.

Goniobasis clavula Lea, Pr. A. N. S. P., 1868, p. 152; Jour. A. N. S. P., VI, 1868, p. 335, pl. 54, fig. 15; Obs., XII, 1868, p. 95, pl. 54, fig. 15.

Type locality: Jackson Co., Ala.

GONIOBASIS COCHLIARIS Lea.

Goniobasis cochliaris Lea, Pr. A. N. S. P., 1868, p. 152; Jour. A. N. S. P., VI, 1868, p. 336, pl. 54, fig. 16; Obs., XII, 1868, p. 96, pl. 54, fig. 16.

Type locality: Shelby Co., Ala.

GONIOBASIS COLUMBIENSIS Whiteaves.

Goniobasis columbiensis Whiteaves, Naut., XIX, 1905, p. 61, pl. II, figs. 11-12.

Type locality: Upper Columbia River, B. C.

This is probably only a form of *livescens*.

GONIOBASIS COMALENSIS Pilsbry.

Goniobasis pleuristriatus comalensis Pilsbry, Naut., IV, 1890, p. 49.

Goniobasis comalensis Pilsbry and Ferriss, Pr. A. N. S. P., 1906, p. 167, figs. 24-31.

Type locality: Comal Creek, New Braunfels, Texas.

Melania pluristriata Say is a *Pachycheilus* and is not found in Texas. All the Texan records of that species refer to *comalensis*.

The var. *marmocki* mentioned, but not described by Wetherby (Am. Nat., XII, 1868, p. 254) seems to have been abandoned by him. His shells came from Helotes, Bexar Co., Texas and the set of *"pleuristriata"* in his collection, now in my possession, includes both the striate and smooth forms. There are none labelled var. *marmocki*.

GONIOBASIS COMALENSIS FONTINALIS Pilsbry and Ferriss.

Goniobasis comalensis fontinalis Pilsbry and Ferriss, Pr. A. N. S. P., 1906, p. 168, figs. 32-35.

Type locality: Spring, New Braunfels, Texas.

GONIOBASIS CONNESAUGAENSIS Lea.

Goniobasis connesaugaensis Lea, Pr. A. N. S. P., 1868, p. 152; Jour. A. N. S. P., VI, 1868, p. 333, pl. 54, fig. 11; Obs., XII, 1868, p. 93, pl. 54, fig. 11.

Type locality: Connesauga Creek, Whitfield Co., Ga.

GONIOBASIS CONTIGUA Lea.

Goniobasis contigua Lea, Pr. A. N. S. P., 1868, p. 152; Jour. A. N. S. P., VI, 1868, p. 334, pl. 54, fig. 12; Obs., XII, 1868, p. 94, pl. 54, fig. 12.

Type locality: Connesauga Creek, Whitfield Co., Ga.

GONIOBASIS CRANDALLI Pilsbry.

Goniobasis crandalli Pilsbry, Pr. A. N. S. P., 1890, p. 301, pl. V, figs. 4-5.

Type locality: Mammoth Spring, Ark.

GONIOBASIS CUMBERLANDENSIS Lea.

Goniobasis cumberlandensis Lea, Pr. A. N. S. P., 1863, p. 155; Jour. A. N. S. P., VI, 1866, p. 132, pl. 23, fig. 35; Obs., XI, 1866, p. 88, pl. 23, fig. 35.

Tryon (134, p. 272) considers this a synonym of *G. adusta* (Anth.), and erroneously quotes it as *G. cumberlandiensis*

GONIOBASIS DECAMPII Lea.

Goniobasis decampii Lea, Jour. A. N. S. P., VI, 1866, p. 138, pl. 23, fig. 45; Obs., XI, 1866, p. 94, pl. 23, fig. 45.

GONIOBASIS DEPYGIS (Say).

Is considered a variety of *livescens* by Baker (4, p. 327) and Sterki (124A, p. 385), but is distinct.

GONIOBASIS EMERYENSIS Lea.

Goniobasis emeryensis Lea, Pr. A. N. S. P., 1864, p. 3; Jour. A. N. S. P., VI, 1866, p. 127, pl. 23, fig. 43; Obs., XI, 1866, p. 93, pl. 23, fig. 43.

Type locality: Rocky Creek, Head Branch of Emery River, Tenn.

GONIOBASIS FRATERNA Lea.

Goniobasis fraterna Lea, Pr. A. N. S. P., 1864, p. 111; Jour. A. N. S. P., VI, 1866, p. 139, pl. 23, fig. 46; Obs., XI, 1866, p. 95, pl. 23, fig. 46.

Type locality: Bibb Co. and Cahawba River, Ala.

GONIOBASIS GESNERI Lea.

Goniobasis gesneri Lea, Pr. A. N. S. P., 1868, p. 151; Jour. A. N. S. P., VI, 1868, p. 330, pl. 54, fig. 5; Obs., XII, 1868, p. 90, pl. 54, fig. 5.

Type locality: Uchee River, Ala.

GONIOBASIS GOULDIANA Lea.

Goniobasis pulchella Lea, Pr. A. N. S. P., 1868, p. 151, *non pulchella* Anth. (1850).

Goniobasis gouldiana Lea, Jour. A. N. S. P., VI, 1868, p. 332, pl. 54, fig. 9; Obs., XII, 1868, p. 92, pl. 54, fig. 9.

Type locality: North Alabama.

GONIOBASIS GRANATOIDES Lea.

Goniobasis granatoides Lea, Pr. A. N. S. P., 1868, p. 152; Jour. A. N. S. P., VI, 1868, p. 335, pl. 54, fig. 14; Obs., XII, 1868, p. 95, pl. 54, fig. 14.

Type locality: Connesauga Creek, Whitfield Co., Ga.

GONIOBASIS INDIANENSIS Pilsbry.

Goniobasis indianensis Pilsbry, 27th Ann. Rep. Dep't. Geol. and Nat. Res. Ind., 1903, p. 606, fig. 28.

Type locality: Blue River, Wyandotte, Crawford Co., Ind.

GONIOBASIS LÆVIGATA (Lea).

This species, if a valid one, will have to be called *leaii* Brot as *Melania lævigata* is preoccupied by Lamarck.

GONIOBASIS LAQUEATA (Say).

Includes *deshayesiana* (Lea) and "probably" also *cerea, corrugata, costulata, cinerella, circincta, lyonii, plicatula, rugosa* and *sparus,* all of Lea and *athleta* and *glauca* of Anthony according to Pilsbry (111, p. 499).

GONIOBASIS LAWRENCEI Lea.

Goniobasis lawrencei Lea, Pr. A. N. S. P., 1869, p. 125; Jour. A. N. S. P., VIII, 1874, p. 62, pl. 21, fig. 17; Obs., XIII, 1874, p. 66, pl. 21, fig. 17.

Type locality: Washita River, Hot Springs, Ark.

GONIOBASIS LUTEOCELLA Lea.

Goniobasis luteocella Lea, Pr. A. N. S. P., 1868, p. 151; Jour. A. N. S. P., VI, 1868, p. 332, pl. 54, fig. 10; Obs., XII, 1868, p. 92, pl. 54, fig. 10.

Type locality: Connesauga Creek, Whitfield Co., Ga. and Oconee River.

GONIOBASIS MILESII Lea.

Goniobasis milesii Lea, Jour. A. N. S. P., VI, 1866, p. 135, pl. 23, fig. 10; Obs., XI, 1866, p. 90, pl. 23, fig. 40.

GONIOBASIS MURRAYENSIS Lea, Pr. A. N. S. P., 1868, p. 152; Jour. A. N. S. P., VI, 1868, p. 334, pl. 54, fig. 13; Obs., XII, 1868, p. 92, pl. 54, fig. 13.

Type locality: Swamp Creek, Whitfield Co., Ga.

GONIOBASIS NIGRINA Lea.

Includes *californica* (Cless.) and *draytonii* Lea and perhaps should be included in *bulbosa* (Gld.) according to Pilsbry (95, p. 66).

GONIOBASIS ORNATA Lea.

Goniobasis ornata Lea, Pr. A. N. S. P., 1868, p. 152; Jour. A. N. S. P., VI, 1868, p. 337, pl. 54, fig. 18; Obs., XII, 1868, p. 97, pl. 54, fig. 18.

Type locality: Connesauga Creek, Whitfield Co., Ga.

GONIOBASIS OSCULATA Lea.

Erroneously printed as *"inosculata"* by Tryon (134, p. 302) but corrected in the errata. Is the type by designation of *Goniobasis* Lea.

GONIOBASIS OZARKENSIS Call.

Goniobasis ozarkensis Call, Bull. Washburne Coll., I, 1886, p. 189, pl. 7, figs. 1-10.

Type locality: Blue Spring, Shannon Co., Mo.

GONIOBASIS PENNSYLVANICA Pilsbry.

Goniobasis pennsylvanica Pilsbry, Naut., XXX, 1916, p. 4.

Type locality: Ohio River, Coraopolis, Pa.

GONIOBASIS PLEBEIUS Anthony.

Is a valid species and includes *cubicoides* (Anth.) according to Pilsbry (97, p. 458).

GONIOBASIS PLICATA-STRIATA Wetherby.

Goniobasis plicata-striata Wetherby, Jour. Cin. Soc. Nat. Hist., 1876, p. 10, pl. I, fig. 3.

Type locality: Stone River and Mill Creek, Rutherford Co. and Sinking Creek, Shelbyville, Tenn.

GONIOBASIS PLICIFERA Lea.

Includes *silicula* (Gld.), *rudens* (Rve.), *bairdiana* Lea and *shastensis* (Lea) according to Pilsbry (95, p. 66).

GONIOBASIS PLICIFERA BULIMOIDES Tryon.

Goniobasis plicifera bulimoides Tryon, Am. J. of Con., I., 1865, p. 238, pl. 24, figs. 5-6.

Type locality: Wahlamat River, Ore.

GONIOBASIS PLICIFERA OREGONENSIS Tryon.

Goniobasis plicifera oregonensis Tryon, Am. J. of Con., I., 1865, p. 238, pl. 24, fig. 4.

Type locality not specified.

GONIOBASIS PORRECTA Lea.

Goniobasis porrecta Lea, Jour. A. N. S. P., VI, 1866, p. 139, pl. 23, fig. 47; Obs., XI, 1866, p. 25, pl. 23, fig. 47.

GONIOBASIS PROXIMA (Say).

Includes *symmetrica* as a variety according to Pilsbry (111, p. 499).

Reeve in his errata states that the shell figured by him (Fig. 275) as this species does not represent it according to Anthony. The figure is not cited by Tryon and has not, apparently, been identified.

GONIOBASIS PULLA Lea.

Goniobasis pulla Lea, Pr. A. N. S. P., 1864, p. 112; Jour. A. N. S. P., VI, 1866, p. 130, pl. 23, fig. 32; Obs., XI, 1866, p. 86, pl. 23, fig. 32.

Type locality: Cumberland Gap, Tenn.

GONIOBASIS PUPÆFORMIS Lea.

Goniobasis pupæformis Lea, Pr. A. N. S. P., 1864, p. 112; Jour. A. N. S. P., VI, 1866, p. 130, pl. 23, fig. 31; Obs., XI, 1866, p. 86, pl. 23, fig. 31.

Type locality: Coosa River, Ala.

GONIOBASIS ROMÆ Lea.

Goniobasis romæ Lea, Pr. A. N. S. P., 1864, p. 111; Jour. A. N. S. P., VI, 1866, p. 129, pl. 23, fig. 30; Obs., XI, 1866, p. 85, pl. 23, fig. 30.

Type locality: Rome, Ga.

GONIOBASIS RUFESCENS (Lea).

Reeve in his errata states that he had been informed by Anthony that the shell figured by him as this species (Fig. 279) does not represent the species. This figure is not cited by Tryon and, apparently, has not been identified.

GONIOBASIS SIMILIS Lea.

Goniobasis similis Lea, Pr. A. N. S. P., 1868, p. 151; Jour. A. N. S. P., VI, 1868, p. 328, pl. 54, fig. 2; Obs., XII, 1868, p. 88, pl. 54, fig. 2.

Type locality: Connesauga Creek, Whitfield Co., Ga.

GONIOBASIS SMITHSONIANA Lea.

Goniobasis smithsoniana Lea, Pr. A. N. S. P., 1864, p. 112; Jour., A. N. S. P., VI, 1866, p. 137, pl. 23, fig. 44; Obs., XI, 1866, p. 93, pl. 23, fig. 44.

Type locality: North Georgia and East Tennessee.

GONIOBASIS STEARNSIANA Call.

Goniobasis stearnsiana Call, Pr. Davenport Acad. Nat. Sci., V, 1886, p. 6, fig. 43.

Type locality: Dyke's Creek, Floyd Co., Ga.

GONIOBASIS SUBRHOMBICA Lea.

Goniobasis subrhombica Lea, Pr. A. N. S. P., 1864, p. 111; Jour. A. N. S. P., VI, 1866, p. 132, pl. 23, fig. 34; Obs., XI, 1866, p. 88, pl. 23, fig. 34.

Type locality: Hog Creek, North Georgia.

GONIOBASIS SULCATA Lea.

Goniobasis sulcata Lea, Pr. A. N. S. P., 1868, p. 151; Jour. A. N. S. P., VI, 1868, p. 329, pl. 54, fig. 3; Obs., XII, 1868, p. 89, pl. 54, fig. 3.

Type locality: Cahawba River, Ala.

GONIOBASIS UNDULATA Tryon.

Goniobasis undulata Tryon, Am. J. of Con., II, 1866, pl. II, fig. 4.

Type locality: Georgia.

GONIOBASIS VENUSTA Lea.

Goniobasis venusta Lea, Pr. A. N. S. P., 1868, p. 152; Jour. A. N. S. P., VI, 1868, p. 336, pl. 54, fig. 17; Obs., XII, 1868, p. 96, pl. 54, fig. 17.

Type locality: Coosa River, Ala.

GONIOBASIS VERSA Lea.

Melania blanda Lea, Pr. A. N. S. P., 1861, p. 122, *non blanda* Lea (1841).

Goniobasis blanda Lea, Jour. A. N. S. P., V, 1863, p. 242, pl. 35, fig. 44; Obs., IX, 1863, p. 64, pl. 35, fig. 44.

Goniobasis versa Lea, Jour. A. N. S. P., VI, 1866, p. 127; Obs., XI, 1867, p. 93.

Goniobasis leai Tryon, L. and F. W. Shells, Pt. IV, 1873, p. 163, *non* Brot (1862-8).

Type locality: Yellowleaf Creek, Ala.

GONIOBASIS VIRGINICA Gmelin.

Add to the synonymy, *Gon. virginica bilirata* De Gregorio (35, p. 39).

GONIOBASIS VIRIDISTRIATA Lea.

Goniobasis viridistriata Lea, Pr. A. N. S. P., 1864, p. 4; Jour. A. N. S. P., VI, 1866, p. 140, pl. 23, fig. 48; Obs., XI, 1866, p. 96, pl. 23, fig. 48.

Type locality: Flint River, Ga.

GONIOBASIS WHEATLEYI Lea.

Goniobasis wheatleyi Lea, Pr. A. N. S. P., 1868, p. 151; Jour. A. N. S. P., VI, 1868, p. 328, pl. 54, fig. 1; Obs., XII, 1868, p. 88, pl. 54, fig. 1.

Type locality: Coosa River, Ala.

GONIOBASIS WHITFIELDENSIS Lea.

Goniobasis tenebrosa Lea, Pr. A. N. S. P., 1868, p. 151, *non Mel. tenebrosa* Lea (1841).

Goniobasis whitfieldensis Lea, Jour. A. N. S. P., VI, 1868, p. 330, pl. 54, fig. 6; Obs., XII, 1868, p. 90, pl. 54, fig. 6.

Type locality: Connesauga Creek, Whitfield Co., Ga.

Genus GYROTOMA Shuttleworth, 1845.

Schizostoma Lea (1842), *non* Brown (1835).

GYROTOMA LEWISII (Lea).

Schizostoma lewisii Lea, Pr. A. N. S. P., 1869, p. 125; Jour. A. N. S. P., VIII, 1874, p. 61, pl. 21, fig. 16; Obs., XIII, 1874, p. 65, pl. 21, fig. 16.

Type locality: Coosa River, Ala.

GYROTOMA SHOWALTERI (Lea).
Schizostoma showalteri Lea, Pr. A. N. S. P., 1864, p. 112; Jour. A. N. S. P., VI, 1866, p. 149, pl. 23, fig. 56; Obs., XI, 1866, p. 105, pl. 23, fig. 56.

This is a different species from that described by Lea under the same name in 1860, which proved to be a synonym of *G. cariniferum* (Anth). The name being preoccupied, this species will have to be re-named, if it should prove to be a valid one on a revision of the genus.

GYROTOMA WHEATLEYI (Lea).
Schizostoma wheatleyi Lea, Pr. A. N. S. P., 1868, p. 153; Jour. A. N. S. P., VI, 1868, p. 342, pl. 54, fig. 27; Obs., XII, 1868, p. 102, pl. 54, fig. 27.
Type locality: Coosa River, Ala.

Genus ANCULOSA Say, 1821.

Pilsbry has recently come to the conclusion (105, p. 109) that *Leptoxis* Raf. should be preferred for this genus. In my paper on *Pleurocera* (161, p. 1) I reluctantly acquiesced in his conclusion on the ground that the question was zoological rather than one of Code construction. Since that time I have again gone carefully over the ground and have become satisfied that, if all incompetent evidence is eliminated, there is not sufficient grounds to justify the change. I have therefore retained Say's well known name for the genus.

ANCULOSA ARKANSENSIS Hinkley.
Anculosa arkansensis Hinkley, Pr. U. S. Nat. Mus., 49, 1915, p. 587, pl. 78, fig. 3.
Type locality: North Fork of White River, above Norfolk, Ark.

ANCULOSA DOWNIEI Lea.
Anculosa downiei Lea, Pr. A. N. S. P., 1868, p. 153; Jour. A. N. S. P., VI, 1868, p. 342, pl. 54, fig. 28; Obs., XII, 1868, p. 102, pl. 54, fig. 28.
Type locality: Connesauga Creek, Whitfield Co., Ga. and Coosa River, Ala.

ANCULOSA HARPETHENSIS Pilsbry.
Anculosa harpethensis Pilsbry, Pr. A. N. S. P., 1896, p. 499.
Type locality: Big Harpeth River, Bellevue, Tenn.

ANCULOSA MINOR Hinkley.
Anculosa minor Hinkley, Naut., XXVI, 1912, p. 47, pl. I, figs. 7-8.
Type locality: Tennessee River, Florence, Ala.

ANCULOSA SUBGLOBOSA Say.

Does not include *A. tintinnabulum* Lea and *virgata* Lea as stated by Tryon (134, p. 404). See Walker (150, p. 110).

ANCULOSA TINTINNABULUM Lea.

Is a valid species and does not include *virgata* Lea. See Walker (l. c.).

ANCULOSA TRYONI Lewis.

Anculosa tryoni Lewis, Am. J. of Con., XI, 1870, p. 221, pl. 12, fig. 8.
Type locality: Holston River, Tenn.

Tryon (133, p. 87) considers this to be the *tæniata* Con., but the approximation is at the best very doubtful.

ANCULOSA UMBILICATA Wetherby.

Anculosa umbilicata Wetherby, Jour. Cin. Soc. Nat. Hist., 1876, p. 11, pl. I, fig. 4.
Type locality: Stone River, Rutherford Co., Tenn.

ANCULOSA VIRGATA Lea.

Is not the young of *tintinnabulum* as stated by Tryon (134, p. 404), but is a valid species. See Walker (150, p. 110).

Genus MESECHIZA Lea.

Has no standing. The type species is the young of *Angitrema verrucosa*. See Hinkley (57, p. 56).

Family NERITIDÆ.
Genus NERITINA Lamarck, 1809.

NERITINA RECLIVATA Say.

v. Martens (73, p. 472) considers that this is only a variety of *N. lineolata* Lam.

NERITINA RECLIVATA PALMÆ Dall.

Neritina reclivata palmæ Dall, Pr. U. S. Nat. Mus., 1885, p. 259.
Type locality: Palma Sola, Fla.

Genus LEPYRIUM Dall, 1896.

Lepyrium Dall, Naut., X, 1896, p. 15.
Type: *Neritina showalteri* Lea.

LEPYRIUM SHOWALTERI CAHAWBENSIS Pilsbry.

Lepyrium showalteri cahawbensis Pilsbry, Naut., XX, 1906, p. 51.
Type locality: Cahawba River, Ala.

Class LAMELLIBRANCHIA.
Order EULAMELLIBRANCHIA.
Suborder SUBMYTILACEA.
Family MARGARITANIDÆ.

Ortmann (79, p. 223) has raised the genus *Margaritana* to the rank of a family and (80, p. 13) has proposed a new genus, *Cumberlandia,* for *M. monodonta* (Say), both based upon anatomical peculiarities

For the distribution of the genus in this country, see Walker, Nos. 152 and 153, Ortmann (80, p. 14) and Utterback (135, p. 99).

MARGARITANA MARGARITIFERA (L.).
Unio ocmulgeensis dominus De Gregorio, Moll. di aq. dul. di Amer., 1914, p. 13, pl. 7, figs. a-c.

Family UNIONIDÆ.

Simpson's "Descriptive Catalogue of the Naiades" brings the subject down to January 1, 1913.

For the revised classification so far as it has progressed, see Part I.

In view of the relatively small number of species that have been examined anatomically and the consequent element of uncertainty as to the systematic position of the remainder that must continue until the animals can be critically examined, it has seemed better, for convenience of reference, in this porton of the work to retain the generic names given by Simpson, noting, however, under such species as have been examined anatomically their proper place in the revised classification.

Recent attempts to revive Rafinesque's names for many of the species have created considerable confusion as to the proper nomenclature to be followed.

Vanatta's valuable paper on 'Rafinesque's Types of Unio" (140, p. 549), reviewed by Walker (158, p. 43), has given definite information as to what Rafinesque in 1831 understood or claimed to be the species that he had described in 1820.

It has been too hastily assumed by some that these determinations have definitely settled the validity of all of the Rafinesqueian species involved. This is far from correct. It is not claimed, except in one instance, that the so-called types in the Poulson collection are the original types of Rafinesque. And, even if they were, reference to them for the purpose of determining an otherwise unidentifiable description is prohibited by the International Code (Op. Int. Co., I). The requisites for a sufficient description are definitely specified by the Code (Art. 25) and these provisions as defined by the decisions of the International Committee must be applied to each individual case.

Dr. Pilsbry in Vanatta's paper has very aptly stated the situation as follows: "The use of a Rafinesquian name depends upon whether it could be identified by descriptions published prior to any other recognizable name for the same species. That it can be recognized from the types or other specimens from Rafinesque does not entitle his names to acceptance unless the published descriptions are adequate. This question of the adequacy of published diagnoses must be considered for each species separately."

In the same connection, see Walker (157, p. 74).

Subfamily UNIONINÆ (Swainson, 1840), Ortmann, 1910.
Genus QUADRULA Rafinesque, 1820.

QUADRULA ASKEWI (Marsh).

Frierson (41, p. 136) refers this to *beadleiana* Lea. But Ortmann (81, p. 21) states that it does not group with that species, but is a *Fusconaia* of the *undata* group.

QUADRULA BEADLEIANA (Lea).

Includes Q. *chickasawhensis* (Lea) and *askewi* (Marsh) according to Frierson (41, p. 136). But Ortmann (79, p. 268) says that it is an *Elliptio*.

QUADRULA BURSAPASTORIS (B. H. Wright).

Is a *Fusconaia* according to Ortmann (81, p. 90).

QUADRULA COCCINEA (Conrad).

Is a *Pleurobema* according to Ortmann (77, p. 101) and a variety of *Q. obliqua* (Lam.) (78, p. 117 and 79, p. 263).

Utterback (135, p. 190) quotes *catillus* Con., which Simpson has considered a synonym of *Q. coccinea*, as a variety of *Q. obliqua* (Lam.) and on p. 193 of the same paper considers it identical with *Q. solida* (Lea), having priority and gives it specific rank as such.

QUADRULA COOPERIANA (Lea).

At first referred to *Pleurobema* by Ortmann (78, p. 117), this species is now included in *Plethobasus* by him (79, p. 261).

QUADRULA CYLINDRICA (Say).

Unio cylindricus propetypicus De Gregorio, Moll. di aq. dul. di Amer., 1914, p. 11, pl. 4, fig. 1.

Unio cylindricus acrispatus De Gregorio, Ibid., p. 11, pl. 4, fig. 2.

Vanatta (140, p. 556) states that the *Unio solenoides* Raf. of the Poulson collection is this species.

QUADRULA EBENUS (Lea).

Is *Obovaria obovalis* Raf. of the Poulson collection according to Vanatta (140, p. 558). If identifiable from the original description, *obovalis* would have precedence.

QUADRULA FRIERSONI (B. H. Wright).

Is a *Pleurobema* according to Ortmann (81, p. 30).

QUADRULA HEROS (Say).

This species is the type of *Megalonaias* Utterback.

Frierson (45, p. 61) has identified Barnes' *Unio giganteus* as this species and gives it priority.

QUADRULA INTERMEDIA (Conrad).

Unio tuberosus perlobatus De Gregorio, Moll. di aq. dul. di Amer., 1914, p. 9, pl. I, fig. 3.

QUADRULA KIRTLANDIANA (Lea).

Is a variety of *Q. subrotunda* (Lea) according to Ortmann (78, p. 166).

QUADRULA LACHRYMOSA (Lea).

This species has been identified as the *Obliquaria quadrula* Raf. by Say, Conrad and others and Vanatta (140, p. 556) states that the shell so labelled in the Poulson collection is Lea's *asperrimus*. If identifiable from the original description, it would have priority.

QUADRULA LACHRYMOSA CONTRARYENSIS Utterback.

Quadrula lachrymosa contraryensis Utterback, Amer. Mid. Nat., IV, 1915, p. 138, pl. XVIII, figs. 47a-b.

Type locality: Lake Contrary, St. Joseph, Mo.

PLEUROBEMA MISSOURIENSIS (Marsh).

The type of this species has been figured by Walker (155, p. 140, pl. V, figs. 1-2) and it appears to be a *Quadrula* allied to *Q. subrotunda* (Lea).

QUADRULA OBLIQUA (Lam.).

Includes *pyramidata* Lea, *cocinea* Con., and *plena* Lea according to Ortmann (78, p. 117 and 79, p. 264) and is a *Pleurobema*. Vanatta states (140, p. 557) that the *Obliquaria lateralis* Raf. of the Poulson collection is this species.

QUADRULA PERUVIANA (Lamarck).

Lamarck in his original description refers to the figure in the Encyc. Meth., pl. 248, fig. 7, but the reference was overlooked by Simpson in his Synopsis, but was supplied in the Desc. Catalogue. The species is the form commonly called *plicata* Say by collectors and is characterized by its prominent beaks. It is quite different from *plicata* Say from Lake Erie.

QUADRULA RARIPLICATA (Lamarck).

This species, which has been referred to *plicata* Say by Simpson and authors generally, is neither typical *peruviana* (Lam.) nor typical *plicata* (Say). The type which is still preserved in the Museum at Geneva, Switzerland, is the Ohio River form, which has commonly passed as *plicata* (Say), and is sufficiently distinct to have varietal rank at least. There is some reason to believe that Say's *plicata* is an off-shoot from this race rather than of *undulata* Bar. as has been suggested by Ortmann (79, p. 246). It is also possible that it rather than *undulata* should be considered the *costata* Raf.

QUADRULA PLICATA (Say).

As stated by Ortmann (79, p. 246) the type of this species came from Lake Erie and is undoubtedly the form described by Lea as *Unio hippopæus*. It has been referred to *undulata* Bar. by Ortmann (1. c.), but there is apparently some ground for considering it as more closely allied to *rariplicata* (Lam.). Pending the settlement of this question, it would seem better to keep it separate from either.

QUADRULA PLENA (Lea).

According to Ortmann (78, p. 117) this is probably only a form of *obliqua* (Lam.). Vanatta states (140, p. 558) that the *Obovaria cordata* Raf. of the Poulson collection is this species. If identifiable from the original description, Rafinesque's name would have priority.

QUADRULA PUSTULATA (Lea).

According to Vanatta (140, p. 557) the *Obliquaria nodulata* Raf. of the Poulson collection is this species. If identifiable from the original description, *nodulata* would have precedence.

QUADRULA PUSTULOSA (Lea).

According to Vanatta (140, p. 556) the *Obliquaria retusa* Raf. of the Poulson collection is "probably" this species. The specific name is not preoccupied by *Unio retusa* Lam. and, if identifiable from the original description, Rafinesque's name would have priority.

Utterback (135, p. 131) has suggested that the species should be known as *bullata* Raf., but see next note.

QUADRULA PUSTULOSA PERNODOSA (Lea).

According to Vanatta (140, p. 557) the *Obliquaria bullata* Raf. of the Poulson collection is this form, but the name is preoccupied by *Obliquaria flexuosa bullata* Raf. and Lea's name will stand.

QUADRULA PYRAMIDATA (Lea).

Unio plenus interduos De Gregorio, Moll. di aq. dul. di Amer., 1914, p. 18.

According to Ortmann this is probably only a form of *obliqua* (Lam.). Vanatta states (140, p. 557) that the *Obliquaria rubra* Raf. of the Poulson collection is this species. If identifiable from the original description, *rubra* would have priority.

QUADRULA REFULGENS (Lea).

Includes *sphærica* (Lea) according to Frierson (41, p. 136).

QUADRULA RUBIGINOSA (Lea).

Unio validus continuus De Gregorio, Moll. di aq. di Amer., 1914, p. 21.

This species has been identified as the *Obliquaria flava* Raf. by Say, Conrad and others. According to Vanatta (140, p. 557) the *O. flava* Raf. of the Poulson collection is this species. If identifiable from the original description, Rafinesque's name would have priority.

According to Ortmann (78, p. 116) *rubiginosa* is a variety of *undata* (Bar.).

FUSCONAIA SELECTA Wheeler.

Fusconaia selecta Wheeler, Naut., XXVIII, 1914, p. 76, pl. IV.
Type locality: Cache River, Nemo, Craighead Co., Ark.

QUADRULA SPHÆRICA (Lea).

Is a synonym of *refulgens* (Lea) according to Frierson (41, p. 136).

QUADRULA SUBROTUNDA (Lea)

According to Vanatta (140, p. 558) the *Obliquaria sintoxia* Raf. of the Poulson collection is this species. If identifiable from the original description, *sintoxia* would have precedence. The species is a *Fusconaia* according to Ortmann (79, p. 244).

FUSCONAIA SUBROTUNDA LEUCOGONE Ortmann.

Fusconaia subrotunda leucogone Ortmann, Naut., XXVII, p. 89.
Type locality: Elk River, Gassaway, Braxton Co., W. Va.

QUADRULA TRAPEZOIDES (Lea).

Bariosta ponderosus Raf. is a synonym and *Bariosta* Raf. is a synonym of *Amblema* Raf., unless the species should prove to be generically distinct according to Frierson (42, p. 7).

FUSCONAIA UNDATA TRIGONOIDES "Frierson" Utterback.

Fusconaia undata trigonoides "Frierson" Utterback, Amer. Mid. Nat., IV, 1915, p. 107, pl. XX, figs. 30A-D.

Type locality: Platte River, Agency Ford, Mo.

QUADRULA UNDULATA (Barnes).

This species has been identified as the *Amblema costata* Raf. by Conrad, Frierson and others. Vanatta states (140, p. 556) that the *Amblema costata* Raf. of the Poulson collection is also this species. If identifiable from the original description, Rafinesque's name would have priority. In considering this question attention should be given to the possibility that *costata* Raf. may be the *rariplicata* Lam.

Costata has been designated by Frierson (42, p. 7) as the type of *Amblema* Raf.

QUADRULA UNDULATA PILSBRYI (Marsh).

According to Utterback (135, p. 119) this is a synonym of *Q. perplicata quintardii* (Cragin).

Genus TRITOGONIA Agassiz, 1852.

The recent discovery of Sterki ('07, p. 48) that in the type species, *T. tuberculata,* all four of the gills are utilized for marsupia, removes the genus from the *Digenæ* of Simpson to the *Tetragenæ*. But in view of the remarkable dimorphism of the species, which is apparently a sexual and not a senile character as has been suggested by Ortmann, the subordination of the genus to *Quadrula* as proposed by him would seem to be inexpedient.

TRITOGONIA TUBERCULATA (Barnes).

Quadrula tritogonia Ortmann, Naut., XXII, 1909, p. 101.

Quadrula parkeri Geiser, The Academician, I, 1911, p. 15.

The new names proposed by Ortmann and Geiser can not be used, even if the species is referred to *Quadrula*. If *Rotundaria,* with *tuberculata* Raf. as its type, be given generic rank, Barnes' name can still be used in *Quadrula* (Ortmann, 78, p. 116); but if not, the species would take the name of *obesa* Simp. (Vanatta, Naut., XXIII, 1910, p. 102).

Obliquaria verrucosa Raf. is identified as this species by Conrad and the shells so labelled in the Poulson collection are also that species according to Vanatta (140, p. 554). If identifiable from the original description Rafinesque's name has priority.

Genus AMBLEMA Rafinesque, 1820.

Amblema Rafinesque, Monographie, 1820, p. 314.
Crenodonta Schluter, Verz. meiner Conch., 1836, p. 33; Simpson, Syn., 1900, p. 766; Desc. Cat., 1914, p. 813.
Type: *Amblema costata* Raf.

Genus MEGALONAIAS Utterback, 1915.

Megalonaias Utterback, Amer. Mid. Nat., IV, 1915, p. 123.
Type: *Unio heros* Say.

Genus ROTUNDARIA Rafinesque, 1820.

Rotundaria Rafinesque, Monographie, 1820, p. 308; Simpson, Syn., 1900, p. 794; Desc. Cat., 1914, p. 903.
Type: *Obliquaria tuberculata* Raf.

Genus FUSCONAIA Simpson, 1900.

Fusconaia Simpson, Syn., 1900, p. 784; Desc. Cat., 1914, p. 865.
Type: *Unio trigonus* Lea.

Genus PLETHOBASUS Simpson, 1900.

Plethobasus Simpson, Syn., 1900, p. 764; Desc. Cat., 1914, p. 805.
Type: *Unio æsopus* Green.

Genus PLEUROBEMA Rafinesque.

PLEUROBEMA ÆSOPUS (Green).

This species has been referred to *Obliquaria cyphya* Raf. by Conrad, Call, Ortmann and others. Vanatta (140, p. 556) states that the shell in the Poulson collection so labelled is this species. If identifiable from the original description, *cyphya* would have priority.

This species is the type of Simpson's section *Plethobasus,* which Ortmann (79, p. 259) has raised to generic rank.

PLEUROBEMA ARGENTEUM PANNOSUM Simpson.

This is a *Fusconaia* and a synonym of *F. ozarkensis* (Call) according to Ortmann (84, p. 63).

PLEUROBEMA BARNESIANUM (Lea).

Is a *Fusconaia* and includes *meredithii* Lea, *pudicum* Lea, *lyonii* Lea, *tellicoensis* Lea and *lenticulare* Lea according to Ortmann (84, p. 59).

PLEUROBEMA BIGBYENSE (Lea).

Is a *Fusconaia* and a variety of *F. barnesiana* (Lea) and includes *estabrookianum* Lea, *fassinans* Lea and *fassinans rhomboidea* Simp. according to Ortmann (84, p. 59).

PLEUROBEMA BREVE SUBELLIPTICUM Simpson.

Is a *Fusconaia* and a synonym of *F. ozarkensis* (Call) according to Ortmann (84, p. 63).

PLEUROBEMA CLAVUS (Lamarck).

Unio consanquineus De Gregorio, Moll. di aq. dul. di Amer., 1914, p. 16.

Unio anaticulus ohiensis De Gregorio, Moll. di aq. dul. di Amer., 1914, p. 21, pl. 10, fig. 3.

Vanatta (140, p. 555) states that *Unio elliptica* Raf., *Obliquaria scalenia* Raf. and *Pleurobema cuneata* Raf. as labelled in the Poulson collection are this species and expresses the opinion that *Pleurobema mytiloides* Raf. is also.

PLEUROBEMA CONRADI Vanatta.

This species was originally described by Conrad as *Unio maculatus,* but, as shown by Vanatta (140, p. 559), that name had already been used by Rafinesque for a variety of his *Unio nigra* and he has proposed *conradi* as a specific name for the *Pl. maculatum* (Con.) of Simpson's Desc. Catalogue.

PLEUROBEMA COR (Conrad).

The types of this species came from the Flint and Elk rivers in northern Alabama and as Frierson (44, p. 102) has shown is closely related to, if not identical with, *edgarianum* Lea or some other species of that group.

PLEUROBEMA CRUDUM (Lea).

Is a synonym of *Fusconaia barnesiana tumescens* (Lea) according to Ortmann (84, p. 59).

PLEUROBEMA ESTABROOKIANUM (Lea).

Is a *Fusconaia* and a synonym of *F. barnesiana bigbyensis* (Lea) according to Ortmann (84, p. 59).

PLEUROBEMA DOLLABELLOIDES (Lea).

Unio tornhatonii duckensis De Gregorio, Moll. di aq. dul. di Amer., 1914, p. 20, pl. 11, figs. 2a-c.

PLEUROBEMA FASSINANS (Lea).

This species and its variety *rhomboides* Simp. are Fusconaias and synonyms of *F. barnesiana bigbyensis* (Lea) according to Ortmann (84, p. 59).

PLEUROBEMA LENTICULARIS (Lea).

Is a *Fusconaia* and a synonym of *F. barnesiana* (Lea) according to Ortmann (84, p. 59).

PLEUROBEMA LEWISII (Lea).

That this species is distinct from *P. cor* (Con.), to which it was referred by Simpson, has been shown by Walker (160, p. 114) and *U. crapulus* Lea, if not distinct, is made a synonym.

PLEUROBEMA MEREDITHII (Lea).

Is a *Fusconaia* and a synonym of *F. barnesiana* (Lea) according to Ortmann (84, p. 59).

LAMPSILIS OZARKENSIS (Call).

Is a *Fusconaia* and includes *Pleurobema argenteum pannosum* Simp., *breve subellipticum* Simp. and *utterbacki* Fr. according to Ortmann (84, p. 63).

PLEUROBEMA PUDICUM (Lea).

Is a *Fusconaia* and a synonym of *F. barnesiana* (Lea) according to Ortmann (84, p. 59).

PLEUROBEMA SIMPSONI Vanatta.

Pleurobema simpsoni Vanatta, Pr. A. N. S. P., 1915, p. 559.

Originally described as *Unio striatus* Lea. Lea's name is not preoccupied by Rafinesque, but as suggested to me by Frierson it seems to have been by Goldfuss for a fossil species. I have not been able to examine, or to have examined, Goldfuss' original description. Lea refers to Goldfuss' species in his Synopsis, but as usual gives no exact citation. A palæontological friend has supplied the following references, which seem sufficient to settle the question. Goldfuss' description of his *Unio striatus* is to be found in his 'Pertrefakten Deutschlands," II, 1839, p. 182, pl. 132, fig. 3. Bronn in his "Index Paleontologicus," II, p. 1345, includes the species among his *"omnia dubii generis."* D'Orbigny in his "Prodrome de Paleontologie" includes it in his genus *Hesione* (1847). These facts were probably known to Lea and explain why he did not rename his species, as in other

instances he had claimed that the reference of the prior species in such cases to another genus "liberated" his own subsequent name. This under the Code is quite erroneous.

PLEUROBEMA UTTERBACKI Frierson.

Pleurobema utterbacki Frierson, Amer. Mid. Nat., IV, 1915, p. 197, pl. V, figs. 12a-b and pl. XX, figs. 63a-d.

Type locality: White River, Hollister, Mo.

This species is a *Fusconaia* and a synonym of *F. ozarkensis* (Call) according to Ortmann (84, p. 63).

Genus LEXINGTONIA Ortmann, 1914.

Lexingtonia Ortmann, Naut., XXVIII, 1914, p. 28.

Type: *Unio subplanus* Conrad.

"This genus stands near *Pleurobema* and *Elliptio* and differs from either chiefly by the subcylindrical, red placentæ, and by the beak sculpture."

Genus UNIO Retzius, 1788.

UNIO COMPLANATUS (Dill.).

Unio pullatus majusculus De Gregorio, Moll. di aq. dul. di Amer., 1914, p. 27, pl. 8, figs. a-d.

Haas has recently (50, p. 54) figured the original type of Spengler's *Unio violaceus*, which appears to be an abnormal specimen of this species and proposes to give precedence to Spengler's name. I have shown elsewhere (162, p. 3) that this is not competent under the Code and that Dillwin's name should be retained.

UNIO CRASSIDENS Lam.

According to Ortmann (79, p. 266) this is the *Unio nigra* Raf. Vanatta (140, p. 555) states that the shell so labelled in the Poulson collection is this species. If identifiable from the original description, Rafinesque's name would have priority. Utterback (135, p. 199) has quoted me as authority for the statement that *Quadrula trapezoides* (Lea) should be considered as the *Unio crassidens* of Lamarck. I have expressed that opinion in correspondence and if the process of elimination could be strictly applied that would be the result. But Dr. Pilsbry has suggested that the provisions of the Code in regard to designating generic types apply equally well to the cases of composite species, of which this is an example, and that, if this rule does apply, Lea's statement (Obs., I, p. 199) of his examination of Lamarck's types in 1832 amounted to such a designation and can not now

be changed. Pending further consideration and final decision of the questions involved, it would be better to allow the accepted idenfication of *crassidens* to stand.

UNIO GIBBOSUS Barnes.

Unio propeverutus De Gregorio, Moll. di aq. dul. di Amer., 1914, p. 8, pl. 3, figs. 1a-c.

This species has been referred to *Unio dilatata* Raf. by Conrad and others. Vanatta states (140, p. 355) that both *U. dilatata* Raf. and *Obliquaria sinuata* Raf. as represented in the Poulson collection are this species. If identifiable from the original descriptions, both of Rafinesque's names have priority. *Dilatata* has page priority in his Monograph.

UNIO PUSILLUS Lea.

Lea's name is not preoccupied in *Unio* by *Obliquaria pusilla* Raf. (1820) as stated by Vanatta (140, p. 555) and will stand.

UNIO RAFINESQUEI Vanatta.

Unio fuscatus Lea, Simpson, Desc. Cat., 1914, p. 643.

Vanatta has shown (140, p. 559) that *fuscata* was twice used by Rafinesque as varietal names for species of *Unio* and has proposed the name given above for Lea's species.

UNIO TUOMEYI Lea.

Unio arctior fisheropsis De Gregorio, Moll. di aq. dul. di Amer., 1914, p. 15, pl. 5, figs. 3a-c.

Genus LASTENA Rafinesque, 1820.

From an examination of the soft anatomy, Ortmann has recently (81, p. 106) shown that this group belongs in the *Unioninæ* and not in the *Anodontinæ*.

Hemistena Raf. is a synonym according to Frierson, (42, p. 7).

LASTENA LATA Raf.

Unio dehiscens oriensopsis De Gregorio, Moll. di aq. dul. di Amer., 1914, p. 39, pl. 7, figs. 2a-b.

This variety (?) is made the type of a new genus or subgenus, *Sayunio,* the author does not seem to know which it should be considered.

Genus GONIDEA Conrad, 1857.

Ortmann has recently found from an examination of the soft anatomy (83, p. 50) that this genus belongs to the *Unioninæ*.

Subfamily ANODONTINÆ Ortmann, 1912.
Genus STROPHITUS Rafinesque, 1820.

STROPHITUS EDENTULUS (Say).

Anodonta foliopsis De Gregorio, Moll. di aq. dul. di Amer., 1914, p. 33, pl. XI, figs. 4a-b.

There seems to be some uncertainty as to the proper name to be used for this species. Say described his *edentulus* in 1829. Swainson had already in 1822 described his *Anodon rugosus* from the "United States." Lea (Obs., I, p. 39) says that "it is well known" that Swainson's *rugosus* is the adult of Say's *undulata,* which has priority. Simpson, who considers *undulatus* and *edentulus* distinct, for some unexplained reason includes Swainson's species under *edentulus* as a synonym. Dall (32, p. 127) "on the face of the returns" gives the species to Swainson. I have not been able to examine Swainson's description and figure myself. Ortmann (78, p. 118) unites both species under the prior name of *undulatus.* If this is correct, the exact identity of Swainson's species becomes immaterial. Otherwise his description and figure should be critically examined again to determine, if possible, to which species it belongs.

STROPHITUS EDENTULUS SHÆFFERIANUS (Lea).

This seems to be a well marked race characteristic of the Tennessee drainage and as such entitled to varietal rank.

Genus ANODONTA Lamarck, 1799.

ANODONTA CATARACTA Say.

Anodonta ? subcylindracea propexilis De Gregorio, Moll. di aq. dul. di Amer., 1914, p. 33, pl. XII, figs. 1a-e.

ANODONTA GRANDIS Say.

Anodonta venusta De Gregorio, Moll. di aq. dul. di Amer., 1914, p. 35, pl. XII, fig. 2.

This species founded on a single deformed valve is made the type of a new subgenus, *Nayadina.*

ANODONTA IMBECILIS Say.

Anodonta phalena De Gregorio, Moll. di aq. dul. di Amer., 1914, p. 34, pl. XI, figs. 3a-e.

This species is *Lastena ohioensis* Raf. and a *Lastena* according to Utterback (135, p. 260).

ANODONTA SUBORBICULATA Say.

According to Utterback (135, p. 256) this species is a *Lastena.*

Genus ANODONTOIDES Simpson, 1898.

ANODONTOIDES FEUSSACIANUS (Lea).
Anodonta ferussaciana incertopsis De Gregorio, Moll. di aq. dul. di Amer., 1914, p. 34, pl. XI, fig. 5.

Genus LASMIGONA Rafinesque, 1831.

Symphynota Simpson (*non* Lea), Syn., 1890, p. 662; Desc. Cat., 1914, p. 480.

Frierson (Naut., XXVIII, 1914, p. 40) has shown that the original type of Lea's *Symphynota* was *Unio alatus* Say and it is therefore a synonym of *Proptera* Raf. and that consequently *Lasmigona* Raf. as the earliest available name becomes the generic type.

Subgenus PLATYNAIAS Walker, 1918.

Platynaias Walker, Occ. Pap., Mus. Zool., U. of M., No. 49, 1918, p. 1.
Type: *Symphynota compressa* Lea.

As the result of the disappearance of *Symphynota* Lea from this genus, the group typified by *S. compressa* Lea was left without any name and *Platynaias* has been proposed for it.

LASMIGONA COMPRESSA (Lea).
Unio compressa ? lindus De Gregorio, Moll. di aq. dul. di Amer., 1914, p. 14, pl. 6, figs. 1a-d.

Frierson (43, p. 57) has argued that Rafinesque's *Unio viridis* is this species and consequently has priority. This has been contested by Walker (157, p. 74). Vanatta (140, p. 554) states that Poulson's shell labelled *Unio viridis fuscata* from the Kentucky River, is the *Sym. viridis* Con. of Simpson's Synopsis. This I have verified from a personal inspection of the shell. For the reason stated by Walker, (l. c., p. 78) Lea's name is not superceded by *alasmodontina* Stimp. and will stand as the specific name.

LASMIGONA VIRIDIS Rafinesque.

For the conflicting opinions in regard to this species see the preceeding note. Under all of the evidence that has been adduced I think that Rafinesque's name should be given precedence, with *subviridis* Con. (24, App. p. 4), *viridis* "Con." Simp. and *tappanianus* Lea as synonyms.

Subgenus ALASMINOTA Ortmann, 1914.

Alasminota Ortmann, Naut., XXVIII, 1914, p. 41.
Type: *Margaritana holstonia* Lea.

Frierson (42, p. 7) has identified Rafinesque's *Alasmodon badium* as this species and has designated it as the type of *Sulcularia* Raf. If the species is identifiable from the original description and is Lea's *holstonia, Sulcularia* has precedence over *Alasminota*.

Genus ALASMIDONTA Say, 1818.
Subgenus PRESSODONTA Simpson, 1900.

I have recently (162, p. 2) proposed to supercede this name with that of *Calceola* Sw., 1840, on the ground of priority. Dr. Dall has since called my attention to the fact that *Calceola* had already been used by Lamarck in 1799 for a coral. Simpson's name will therefore stand.

Subgenus PROLASMIDONTA Ortmann, 1914.

Prolasmidonta Ortmann, Naut., XXVIII, 1914, p. 44.
Type: *Unio heterodon* Lea.

Subgenus PEGIAS Simpson, 1900.

According to Ortmann (81, p. 45) this group is a subgenus of *Alasmidonta*.

Subgenus RUGIFERA Simpson, 1900.

ALASMIDONTA MARGINATA Say.
Unio calceolus sciotincola De Gregorio, Moll. di aq. dul. di Amer., 1914, p. 24, pl. IX, fig. 3.

Frierson (42, p. 7) has identified *Alasmodon scriptum* Raf. with this species, but Say's name has priority.

ALASMIDONTA RAVENELIANA (Lea).

Frierson (42, p. 7) has identified *Alasmodon atropurpureum* Raf. as being this species. If identifiable from the original description, it has priority.

On the basis of these identifications, he would substitute *Decurambis* Raf., 1831, for *Rugifera* Simp. as the subgeneric name.

Genus SIMPSONICONCHA Frierson, 1914.

Hemilastena Simpson, *non* Agassiz, Syn., 1900, p. 673; Desc. Cat., 1914, p. 323.
Simpsonaias Frierson, Naut., XXVIII, 1914, p. 7. (Preoccupied.)
Simpsoniconcha Frierson, Naut., XXVIII, 1914, p. 40.
Type: *Alasmodonta ambigua* Say.

For note on this name, see Walker, 162, p. 4.

Subfamily LAMPSILINÆ Ortmann, 1912.
Genus PTYCHOBRANCHUS Simpson.

Frierson, having identified (42, p. 7) *Obliquaria fasciolaris* Raf. with *P. phaseolus* (Hild.), has designated it as the type of *Ellipsaria* Raf. and gives the latter priority as the generic name.

PTYCHOBRANCHUS PHASEOLUS (Hild.).

Unio compressissimus performosus De Gregorio, Moll. di aq. dul. di Amer., 1914, p. 23, pl. V, fig. 2.

Unio lanceolatus blandus De Gregorio, Ibid., p. 22, pl. VIII, fig. 2.

Unio imperitus De Gregorio, Ibid., p. 15, pl. IX, fig. 1.

Say, Conrad and Frierson (1914, p. 7) have identified the *Obliquaria fasciolaris* Raf. as this species and Vanatta (140, p. 554) states that the shell so labelled in the Poulson collection is also that species. If identifiable from the original description, Rafinesque's name would have priority.

PTYCHOBRANCHUS SUBTENTUS (Say).

Unio subteritus purcheornatus De Gregorio, Moll. di aq. dul. di Amer., 1914, p. 31, pl. IX, fig. 2.

Genus CYPROGENIA Agassiz, 1852.

CYPROGENIA IRRORATA (Lea).

Is *Obovaria stegaria* Raf. according to Conrad, and Vanatta (140, p. 554) states that the shell so labelled in the Poulson collection is this species. If identifiable from the original description *stegaria* has priority.

Genus PLAGIOLA (Rafinesque, 1819) Agassiz.

PLAGIOLA DONACIFORMIS (Lea).

Unio zig-zag illius De Gregorio, Moll. di aq. dul. di Amer., 1914, p. 11, pl. IV, fig. 3.

Is an *Amygdalonaias* according to Ortmann (81, p. 67).

PLAGIOLA ELEGANS (Lea).

Unio elegans elegantopsis De Gregorio, Moll. di aq. dul. di Amer., 1914, p. 11, pl. IV, fig. 6.

Unio elegans magnelegans De Gregorio, Ibid., p. 11, pl. V, figs. 1a-c.

This species is an *Amygdalonaias* according to Ortmann, (79, p. 328).

Say and Conrad have identified the *Truncilla truncata* as this species. Vanatta states (140, p. 553) that both the *T. truncata* Raf. and *Unio metaplata* Raf. as represented in the Poulson collection are this species. If identifiable from the original description, *truncala* would have precedence. *Metaplata* is subsequent to both.

PLAGIOLA SECURIS (Lea).

Both *Obliquaria depressa* Raf. and *O. lineolata* Raf. are identified by Say and Conrad as this species and both authors give the preference to *lineolata* as the specific name. According to Vanatta (140, p. 553) these two species and also *O. ellipsaria* Raf. as represented in the Poulson collection are *securis* Lea. If identifiable from the original description, any one of Rafinesque's names would have priority.

Genus PARAPTERA Ortmann, 1911.

The type of this genus is *U. gracilis* Bar. If, as claimed by Frierson and others, this is the *Unio fragilis* Raf., which the latter in 1831 made the type of his genus *Lasmonos*, this name would have priority over *Paraptera*.

Frierson (42, p. 6) has suggested that if *leptodon* Raf. should prove to belong to this genus, *Leptodea* Raf., of which *leptodon* is the type, would have to be used.

Genus OBOVARIA Rafinesque, 1819.

OBOVARIA CIRCULUS (Lea).

Obliquaria subrotunda Raf. has been identified as this species by Say and Conrad and the latter adds *Obovaria striata* Raf. as a synonym. The specimens under both of these names in the Poulson collection, according to Vanatta (140, p. 552), are this species. If identifiable from the original descriptions, either of Rafinesque's names would have priority.

OBOVARIA ELLIPSIS (Lea).

Conrad has identified *Amblema olivaria* Raf. as this species and according to Vanatta (140, p. 553) so also is the shell in the Poulson collection under that name. If identifiable from the original description Rafinesque's name has priority.

OBOVARIA LENS (Lea).

According to Ortmann (79, p. 323) this species is not specifically distinct from *O. circulus* (Lea). Vanatta (140, p. 552) states that the shell labelled *Unio levigata* Raf. in the Poulson collection is this species. If identifiable from the original description, *levigata* would have precedence.

OBOVARIA RETUSA (Lam.).

According to Vanatta (140, p. 552) this is the *Obovaria torsa* Raf. of the Poulson collection.

Genus CARUNCULINA Simpson, 1898.

This group is clearly entitled to generic rank as stated by Ortmann (81, p. 68), who has shown that the type is *Unio parvus* Bar. and not *texasensis* Lea.

Frierson (42, p. 7) has identified *C. glans* (Lea) as the *Unio* (*Toxolasma*) *lividus* Raf. and consequently substitutes *Toxolasma* Raf. for *Carunculina* Simp.

Genus LAMPSILIS Rafinesque, 1820.

LAMPSILIS ALATA (Say).

Vanatta (140, p. 552) states that the shell labelled *Metaptera megaptera* Raf. in the Poulson collection is this species. *Alata* is the type of *Proptera* Raf.

LAMPSILIS ANODONTOIDES (Lea).

This species belongs to *Lampsilis s. s.* according to Ortmann (79, p. 346). It has been identified with *U. teres* Raf. by Say, Conrad and others.

LAMPSILIS ARKANSENSIS (Lea).

This species is a *Micromya* according to Ortmann (81, p. 54).

LAMPSILIS AMŒNA (Lea).

Is a synonym of *L. nebulosa* (Con.) according to Ortmann (81, p. 64).

LAMPSILIS BOREALIS (Gray).

The citation of this species from Oneida Lake by Baker (9, p. 257) has proved to be erroneous. See Baker, (10, p. 75).

LAMPSILIS BREVICULA (Call).

Is a *Micromya* according to Utterback (135, p. 434).

LAMPSILIS CAPAX (Green).

Is a *Proptera* according to Coker and Surber, (21, p. 179) and Ortmann (81, p. 67).

LAMPSILIS CARIOSA (Say).

Unio pallescens Lea var. De Gregorio, Moll. di aq. dul. di Amer., p. 9, *non* Lea, 1845.

LAMPSILIS CONSTRICTA (Con.).

Is a *Micromya* according to Ortmann (81, p. 66).

LAMPSILIS ELLIPSIFORMIS (Con.).

Is a *Nephronaias* according to Utterback (135, p. 341).

LAMPSILIS FALLACIOSA Smith.

Is a *Lampsilis s. s.* and doubtfully distinct from *L. anodontoides* according to Ortmann (79, p. 347). But Surber (127, p. 5) states that the glochidia of the two species differ both in size and shape.

CARUNCULINA GLANS (Lea).

Unio castus mirus De Gregorio, Moll. di aq. dul. di Amer., 1914, p. 27.

Frierson (42, p. 7) has identified *Unio* (*Toxoclasma*) *lividus* Raf. as this species. If identifiable, and it is not at all certain that it might not be the *pullus* of Lea, it would have priority. If it can not be definitely determined what species it is, it should be rejected for indefiniteness.

LAMPSILIS GRACILIS Barnes.

This species has been identified by Frierson (42, p. 7) and others as the *Unio fragilis* Raf. (1820) and *Lasmonos fragilis* Raf. (1831) and either of these names, if identifiable from the original description, would have priority. The example under this name in the Poulson collection according to Vanatta (140, p. 552) is *gracilis* Bar.

Fragilis Raf. (1831) is the monotype of his genus *Lasmonos*.

LAMPSILIS IRIS (Lea).

Is a *Micromya* according to Ortmann (79, p. 341).

LAMPSILIS LEPTODON (Raf.).

Unio shepardianus f. duttonianus De Gregorio, Moll. di aq. dul. di Amer., 1914, p. 25.

This species is the type of *Leptodea* Raf. by designation (Frierson, 42, p. 6).

LAMPSILIS LIENOSA (Con.).

Is a *Micromya* according to Ortmann (79, p. 340).

LAMPSILIS LIGAMENTINA (Lam.).

Unio tecomensis De Gregorio, Moll. di aq. dul. di Amer., 1914, p. 26.

This species was at first referred to *Obovaria* by Ortmann (78, p. 119) and later to *Nephronaias* (79, p. 325). It should rather be referred to *Actinonaias* F. and C.

According to the specimens in the Poulson collection (Vanatta, 140, p. 551) *U. crassa* Raf., *fasciata* Raf. and *pallens* Raf. are this species.

LAMPSILIS LUTEOLA (Lam.).

Vanatta (140, p. 551) states that *L. fasciola* Raf. is this species.

LAMPSILIS NEBULOSA (Con.).

Is a *Micromya* according to Ortmann (81, p. 64).

LAMPSILIS NIGERRIMA (Lea).

Is a variety of *L. concestator* Lea according to Frierson (41, p. 135).

LAMPSILIS OCCIDENTALIS (Con.).

Is *Ptychobranchus clintonensis* Simp. and has priority according to Utterback (135, p. 317).

LAMPSILIS ORBICULATA (Hild.).

Belongs to *Lampsilis s. s.* and does not group with *L. ligamentina* Lam. according to Ortmann (79, p. 353).

LAMPSILIS OZARKENSIS (Call).

Is a *Nephronaias* according to Utterback (135, p. 344). Ortmann (84, p. 62) has more recently determined it to be a *Fusconaia*.

LAMPSILIS PARVA (Bar.).

Unio pertenuis De Gregorio, Moll. di aq. dul. di Amer., 1914, p. 31, pl. VI, figs. 4a-f, *non* Lea, 1863.

This species is the true type of *Carunculina* according to Ortmann (81, p. 68).

LAMPSILIS PERDIX (Lea).

Is a *Nephronaias* according to Ortmann (79, p. 326). It is rather an *Actinonaias*.

LAMPSILIS PERPURPUREA (Lea).

Is a *Micromya* according to Ortmann (81, p. 63).

LAMPSILIS PICTA (Lea).

Is a *Micromya* according to Ortmann (79, p. 342).

LAMPSILIS PLEASII (Marsh).

Is a *Nephronaias* according to Utterback (135, p. 343). It is rather an *Actinonaias*.

LAMPSILIS RADIATA (Gmel.).

Unio muhlfeldianus plurimaffinis De Gregorio, Moll. di aq. dul. di Amer., 1914, p. 8, pl. III, figs. 2a-d.

LAMPSILIS RADIATA ONEIDENSIS Baker.

Lampsilis borealis Baker, Tech. Pub. N. Y. Coll. For., 4, 1916, p. 257, fig. 44, nos. 1-4.
Lampsilis radiata oneidensis Baker, Naut., XXX, 1916, p. 74, pl. II.
Type locality: Oneida Lake, N. Y.

LAMPSILIS RECTA (Lam.).

Unio sageri Conrad, Mon., VI, 1836, p. 53, pl. xxix, fig. 1.
Lampsilis recta sageri Simpson, Desc. Cat., 1914, p. 96.

Lamarck's type came from Lake Erie and is the small form characteristic of the Great Lakes that Conrad described as *Unio sageri*. The large, normal form from the Ohio and elsewhere may be distinguished under Rafinesque's name.

LAMPSILIS RECTA LATISSIMA (Raf.).
Unio latissima Rafinesque, Mon., 1820, p. 297, pl. lxxx, figs. 14-15.
Unio angustatus cuniculus De Gregorio, Moll. di aq. dul. di Amer., 1914, p. 22, pl. X, fig. 1.
Type locality: Ohio River.
This is the form represented in the Poulson collection (Vanatta 140, p. 551).

LAMPSILIS SIMPSONI Ferriss.
Belongs to *Lasmonos* Raf. according to Utterback (135, p. 367).

LAMPSILIS SUBROSTRATA (Say).
Belongs to *Eurynia s. s.* according to Ortmann (81, p. 55).

LAMPSILIS TENERA (Ravenel, Mss.) Mazyck.
Lampsilis tenerus (Rav. Mss.) Mazyck, Cat. Moll. S. C., 1913, p. 23.
Type locality: Santee Canal, St. John's, Berkeley, S. C.
The specific name is preoccupied by Lea, 1840.

LAMPSILIS TRABALIS (Con.).
Is a *Micromya* according to Ortmann (79, p. 340).

LAMPSILIS VANUXEMENSIS (Lea).
Is a *Micromya* according to Ortmann (79, p. 342; 81, p. 65).

LAMPSILIS VENTRICOSA (Bar.).
According to Say and Conrad this is the *L. cardium* Raf., 1820, and if so, the latter name has priority. Vanatta (140, p. 551) states that the shell so labelled in the Poulson collection is the *ventricosa* Bar.
According to Ortmann (79, p. 351) it "is probably only a variety of *L. ovata* (Say)."

LAMPSILIS VENTRICOSA COHONGORONTA Ortmann.
Lampsilis ventricosa cohongoronta Ortmann, Naut., XXVI, 1912, p. 53.
Type locality not specified. Found in the Potomac River, Hancock, Washington Co., Md., and in the South Branch of the Potomac at Southbranch and Romney, W. Va., and in the Shenandoah River, Harper's Ferry, W. Va.

LAMPSILIS VENTRICOSA SATURA (Lea).
Frierson (41, p. 136) says that this is not a variety of *L. ventricosa,* but is the same as *L. excavata* Lea and has priority as the proper specific name. I do not agree with this. Ortmann (81, p. 56) deals with it as a form of *ventricosa* and intimates a "suspicion" that it may prove to be a distinct species.

LAMPSILIS VENUSTA (Lea).

Is a variety of *L. ellipsiformis* (Lea) according to Utterback (135, p. 343).

LAMPSILIS VIBEX (Con.).

Is a *Micromya* according to Ortmann (79, p. 340).

Genus MICROMYA (Agassiz, 1852) Simpson.

MICROMYA CÆLATA Conrad.

Unio propecælatus De Gregorio, Moll. di aq. dul. di Amer., 1914, p. 30, pl. VIII, figs. 1a-d.

This species has been identified by Frierson (42, p. 7) and Ortmann (82, p. 39) as *Unio* (*Lemiox*) *rimosus* Raf. and the latter (l. c.) has raised *Lemiox* to generic rank. The identification seems too doubtful (Walker, 162, p. 4) to be relied upon, the species should therefore retain Conrad's name and a new generic name proposed.

MICROMYA FABALIS (Say).

Unio donacopsis De Gregorio, Moll. di dul. di Amer., 1914, p. 30, pl. X, figs. 5 a-b.

Genus TRUNCILLA Rafinesque, 1819.

TRUNCILLA CURTISII Frierson and Utterback.

Truncilla curtisii Frierson and Utterback, Am. Mid. Nat., IV, 1916, p. 453, pl. VI, figs. 14a-d, pl. XXVIII, figs. 109A-D.

Tpe locality: White River, Hollister, Mo.

This is the form that was collected by Ferriss in 1900 and distributed by him as *T. deviata* (Anth.). It has also been found in Bear Creek, Franklin Co., Ala., a tributary of the Tennessee. It does not seem to be more than a light colored form of that species.

TRUNCILLA LEFEVREI Utterback.

Truncilla lefevrei Utterback, Am. Mid. Nat., IV, 1916, p. 455, pl. VI, figs. 13a-d, pl. XXVIII, figs. 108A-D.

Type locality: Black River, Williamsville, Mo.

TRUNCILLA FOLIATA (Hild.).

This species has been identified as Rafinesque's *Obliquaria flexuosa* by Conrad and the specimen in the Poulson collection under that name is stated by Vanatta (140, p. 550) to be this species. If identifiable from the original description, Rafinesque's name would have priority. It has also been identified by Frierson (42, p. 7) as Rafinesque's *Epioblasma biloba*.

TRUNCILLA BREVIDENS (Lea).

Vanatta (140, p. 550) states that the shell in the Poulson collection labelled *Obliquaria interrupta* Raf. is this species. If identifiable from the original description, Rafinesque's name has precedence.

TRUNCILLA PERPLEXA (Lea).

This species has been identified by Conrad and others as *Amblema torulosa* Raf. and *Amblema gibbosa* Raf. According to Vanatta (140, p. 550) the shells so labelled in the Poulson collection are this species. Either name, if identifiable from the original description, would have priority.

TRUNCILLA SULCATA (Lea).

Unio stewardsoni stevensoni De Gregorio, Moll. di aq. dul. di Amer., 1914, p. 15, pl. VI, fig. 3.

Unio propesulcatus De Gregorio, Ibid., p. 30, pl. X, fig. 2.

Vanatta (140, p. 550) states that the shell in the Poulson Collection under the name of *Obliquaria obliquata* Raf. is this species. If identifiable from the original description, it would take precedence.

TRUNCILLA TRIQUETRA Rafinesque.

Unio triangularis pergibbosa De Gregorio, Moll. di aq. dul. di Amer., 1914, p. 10, pl. II, fig. 4.

Unio triangularis longiusculus De Gregorio, Ibid., p. 10, pl. II, fig. 5.

TRUNCILLA TRIQUETRA TRIANGULARIS (Barnes).

Barnes' types of his *Unio triangularis* came from Bois Blanc Island in the Detroit River and the form is fairly entitled to varietal rank, being like nearly all of the *Unionidæ* of the Great Lakes a characteristically depauperate race.

TRUNCILLA WALKERI Wilson and Clark.

Truncilla walkeri Wilson and Clark, Bur. of Fish. Doc. No. 781, 1914, p. 46, pl. I, fig.1.

Type locality: East Fork of Stone's River, Walterville, Tenn.

Subgenus DYSNOMIA Agassiz, 1852.

Frierson (42, p. 7) identifies Rafinesque's *Unio* or *Epioblasma biloba* with *T. foliata* (Hild.) and consequently replaces Agassiz' subgeneric name by *Epioblasma* Raf.

Genus *incertæ sedis.*

COKERIA Marshall, 1916.

Cokeria Marshall, Naut., XXIX, 1916, p. 133.
Type: *Cokeria southalli* Marshall.

COKERI SOUTHALLI Marshall.
Cokeria southalli Marshall, Naut., XXIX, 1916, p. 133. pl. IV.
Type locality: James River, Huron, S. D.

This genus and species are founded on an unique specimen collected by the U. S. Bureau of Fisheries. It seems to combine the characters of both *Quadrula* and *Lampsilis,* although the preponderance of the characters appear to be Quadruline. Indeed, but for the hinge teeth, which are quite like those of *Lampsilis,* it would be considered a *Quadrula.* It is quite possibly an abnormality of *Quadrula undulata* (Bar.). Unfortunately nothing is known of the soft parts. Additional material is greatly to be desired.

Family CYRENIDÆ.
Genus CYRENA Lamarck, 1818.
Section POLYMESODA Rafinesque, 1820.

CYRENA ALABAMENSIS Clessin.
Cyrena alabamensis Clessin, Con. Cab., Cycladeen, 1869, p. 114, pl. XVIII, figs. 3-4.
Type locality: Alabama.

CYRENA DONACIFORMIS Sowerby.
Cyrena donaciformis Sowerby, Con. Icon., Cyrena, 1878, p. 108, pl. XIX, fig. 108.
Type locality: Florida.

Is *floridana* Con. according to von Martens (Zool. Rec., Moll., 1877, p. 81) and Dall (29, p. 1447).

CYRENA PROTEXTA Conrad.
Cyrena protexta Conrad, Am. J. of Con., V, 1869, p. 107, pl. XII, fig. 3.
Type locality: Tampa Bay, Fla.

Is *floridana* Con. according to Tryon (A. J. of C., V, 1870, p. 227) and Dall (29, p. 1447).

Family SPHÆRIIDÆ.

Sterki's "Preliminary Catalog" (125, p. 429) has brought the subject down to July 1, 1916.

For valuable papers on the anatomy, reproduction and growth of *Sphærium* and *Musculium,* see Drew (36, p. 173) and Gilmore (46, p. 16).

Genus SPHÆRIUM Scopoli, 1777.

SPHÆRIUM LENTICULARE Sowerby.
Sphærium lenticularis Sowerby, Con. Icon., Sphærium, Sp. 6, pl. I, fig. 6.
Type locality: ?

SPHÆRIUM MAGNUM Sterki Mss.
Sphærium magnum "Sterki," Springer, Pr. A. N. S. P., 1902, p. 513.

This undescribed species is quoted from Arroyo Pecos, Las Vegas, N. M. (pleistocene) by Springer.

SPHÆRIUM MEDIUM (Sowerby).
Cyclas medium "Sowerby," Richardson, Fauna Bor. Amer., III, 1836, p. 316.
Type locality: Methy Lake, Athabaska.

Probably never described, see Dall (32, p. 140).

SPHÆRIUM RUGOSUM "Whitmore" Sowerby.
Sphærium rugosum "Whitmore" Sowerby, Con. Icon., Sphærium, Sp. 16, pl. II, fig. 16.
Type locality: ?

SPHÆRIUM STAGNICOLUM (Sowerby).
Cyclas stagnicola "Sowerby" Richardson, Fauna Bor. Amer., III, 1836, p. 316.
Type locality: Methy Lake, Athabaska.

Probably never described, see Dall (32, p. 140).

Genus MUSCULIUM Link, 1807.

Musculium Link, Beschr. Rostock Samm I, 1807, p. 152.
Calyculina Clessin, Mal. Blätt., XIX, 1871, p. 150.
Primella Cooper, Pr. Cal. Acad. Sci., (2), III, 1891, p. 82.

MUSCULIUM COOPERIANUM (Prime) Mss.
Sphærium cooperianum Prime, Cat. Corbic., Am. J. of Con., V, 1869, p. 152.
Type locality: Johnson's Pass, Eldorado Co., Cal.

Listed as a new species, but never described. Probably the young of *M. raymondi* according to Cooper (26, p. 81).

MUSCULIUM ERRANS (Lewis).
Cyclas errans Lewis, *Ubi ?*

Lewis (Pr. A. N. S. P. 1872, p. 105) says that he "proposed" this species a number of years before, but that Prime considered it a synonym of *rosaceum*. That from further study, he is "induced" to reclaim his species. I have been unable to find any other reference to the species.

Genus PISIDIUM C. Pfeiffer, 1821.

The use of *Corneocyclas* Fér. for this genus proposed by Dall (30, p. 7 and 29, p. 1459) is disputed by Woodward (165, p. 367 and 166, p. 1) and has not been followed by Sterki (125, p. 473) and until the question has been definitely settled, it seems preferable to use the name that has been in common use for so many years.

PISIDIUM BOREALE Westerlund.
Pisidium boreale Westerlund, Kongl. Sv. Vet. Ak. Forh., 1877, p. 70. fig. 23.
Type locality: Lusino, Siberia. ? Port Clarence, Alaska.

PISIDIUM CALIFORNICUM (Newcomb ?).

Listed by Berry (Naut., XXIII, 1909, p. 79) from Bluff Lake, San Bernardino Co., Cal. I have not been able to find any other reference to it.

PISIDIUM COMPRESSUM LIMNICOLUM Sterki.
Pisidium compressum limnicolum Sterki, Naut., XIX, 1905, p. 81.
Type locality: Fox River, Wis.

PISIDIUM COMPRESSUM SMITHII Sterki.
Pisidium compressum smithii Sterki, Naut., XIX, 1905, p. 83.
Type locality: Shoal Creek, Ala.

PISIDIUM NOVEBORACENSE PROCLIVE Sterki.
Pisidium noveboracense proclive Sterki, Naut., XIX, 1906, p. 119.
Type locality: New Philadelphia, O.

PISIDIUM OBTUSALE C. Pfeiffer.

This European species has been listed from near Lake James, Steuben Co., Ind. by Sterki (Naut., XVII, 1903, p. 43).

PISIDIUM SIBIRICUM Westerlund.
Pisidium sibiricum Westerlund, Nachr. Blätt. Gess., 1876, p. 103; Clessin, Con. Cab., Cycladeen, 1877, p. 66, pl. VII, figs. 15-17.
Type locality: Yenesei River, Siberia.

? Port Clarence, Alaska according to Dall (32, p. 144). Dall's reference for this species in K. Svenska Vet. Ak. Forh. is erroneous. It should be p. 69, fig. 21, not p. 70, fig. 23.

Family CYRENELLIDÆ.

Genus CYRENELLA Deshayes, 1835.

CYRENELLA FLORIDANA (Dall).

Cyrenoida floridana Dall, Naut., X, 1896, p. 52; Pr. U. S. N. M., XXIII, 1901, p. 829, pl. XLII, fig. 7.

Type locality not specified.

Habitat: Brunswick, Ga., south to the Everglades on the east, and, on the west, north to Charlotte Harbor and vicinity.

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ADDENDA

Genus IO Lea, p. 149.

For an elaborate paper on "The Variations and Ecological Distribution of the Snails of the Genus Io" by Charles C. Adams, see Memoirs of the National Academy of Sciences, XII, 1915, Part II, Second Memoir.

The following "races and forms" are recognized and described:—

NAME.	PAGE.	TYPE LOCALITY.
Powellensis C. C. Ads.	11.	Powell R., Olinger, Va.
Clinchensis C. C. Ads.	11.	Clinch R., Cleveland, Va.
Fluvialis Say.	11.	N. Fork, Holston R., Saltville, Va.
Verrucosa Rve.	12.	S. Fork, Holston R., Bluff City, Tenn.
Lyttonensis C. C. Ads.	12.	Powell R., Pennington Gap, Va.
Paulensis C. C. Ads.	12.	Clinch R., St. Paul, Va.
Recta Rve.	12.	Holston R., Kingsport, Tenn.
Brevis Anth.	12.	Clinch R., Kyle Ford, Tenn.
Spinosa Lea.	13.	Holston R., Morristown, Tenn.
Unakensis C. C. Ads.	13.	Nolichucky R., Conkling, Tenn.
Nolichuckyensis C. C. Ads.	13.	Nolichucky R., White Pine, Tenn.
Angitremoides C. C. Ads.	14.	Tennessee R., Looney's Id., Knoxville, Tenn.
Loudonensis C. C. Ads.	14.	Tennessee R., Loudon, Tenn.
Turrita Anth.	14.	Tennessee R., Bellefonte, Tenn.

Genus STROPHITUS Rafinesque, p. 56.

Add:—

Section JUGOSUS Simpson, 1914.

Shell with the dorsal slope strongly subradially plicate; teeth unusually strong. Type: *S. wrightianus* Walker.

Genus SPHÆRIUM Scopoli, p. 188.

In his "Preliminary Catalog of the North American Sphæriidæ" (125, p. 472) Sterki recognizes three subgenera, but they are not so defined as to be included in the systematic portion of this paper. They are:—

Sphæriastrum Bourguignat.	Type: *S. rivicolum* (Leach).
Cyrenastrum Bourguignat.	Type: *S. solidum* Normand.
Corneola Clessin.	Type: *S. corneum* (Linné).

The first is not represented in our fauna.

As *Tellina cornea* L. is the type of the genus *Sphærium, Corneola* Cless. is equivalent to *Sphærium s. s.* and is entirely superfluous.

Subject to this amendment, his arrangement is the same as that proposed by Dall (30, p. 7) in 1903.

Genus PISIDIUM C. Pfeiffer, p. 189.

Dall (l. c.) has proposed the following arrangement for *Corneocyclas* (*Pisidium*).

Genus CORNEOCYCLAS Férussac, 1818.

Subgenus *Corneocyclas s. s.*	
Section *Corneocyclas s. s.*	Type: *C. pusilla* Gmelin.
Section *Phymesoda* Rafinesque.	Type: *Tellina virginica* Gmelin.
Section *Pisidium* C. Pfeiffer, 1821.	Type: *Tellina amnica* Müller.
Section *Cyclocalyx* Dall, 1903.	Type: *Pisidium scholtzi* Clessin.
Subgenus *Cymatocyclas* Dall, 1903.	Type: *Pisidium compressum* Prime.
Subgenus *Tropidocyclas* Dall, 1903.	Type: *Pisidium henslowianum* Sheppard.

Only the typical species are mentioned and no attempt is made to distribute the North American species among the different groups.

Sterki (l. c.) tentatively and without definition proposes the following "groups":—

Fluminina Clessin, 1879.	Type: *P. amnicum* (Müll.).

This is equivalent to *Pisidium s. s.* and therefore unnecessary.

Lacustrina Sterki, 1916.	Type: *P. idahoense* Roper.
Rivulina (Clessin, 1879) Sterki.	Type: *P. supinum* A. Schmidt.
Fontinalina Sterki, 1916.	Type: *P. fontinale* Pfr.
Fossarina Clessin, 1879 (restricted).	Type: *P. obtusale* Pfr.

PLEUROCERA, p. 151.

PLEUROCERA KNOXENSE (Lea).

According to Tryon (134, p. 427) this name will take the place of *P. modestum* (Lea), 1862, because *Io modesta* Lea, 1861, is also a *Pleurocera*. This, of course, is conditional upon the latter proving to be a valid species.

PLEUROCERA PARKERI Tryon.

This name has been proposed by Tryon (134, p. 427) for *Trypanostoma tortum* Lea (Ibid., p. 84), 1862, on the ground that *Melania torta* (Ibid., p. 117), 1845, has priority, being also a *Pleurocera*.

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STATUS OF THE FRESHWATER MUSSEL (BIVALVIA: UNIONIDAE) FAUNA IN THE CAHABA RIVER SYSTEM, ALABAMA

Stuart W. McGregor[1], Patrick E. O'Neil[1] and J. Malcom Pierson[2]

ABSTRACT

A study by the Geological Survey of Alabama documented 23 species of native freshwater mussels in 17 genera and one exotic bivalve in the Cahaba River downstream of Centreville in 45 collections. The first record from the Cahaba River system for one species, *Plectomerus dombeyanus,* was reported. Current status of all freshwater mussel species known from the Cahaba River system was discussed. Of the 23 species of freshwater mussels collected during that study, 14 were represented by live individuals, six by fresh dead shells, and three by relic shells only. The species most frequently encountered was *Lampsilis ornata* (34 stations), followed by *Quadrula asperata* (31 stations), *Obliquaria reflexa* (29 stations), *Elliptio crassidens* (21 stations), *Potamilus purpuratus* (20 stations), and *Lampsilis teres* (13 stations). No mussels were found at eight stations. Evidence of recent recruitment was observed for four species: *Q. asperata, L. ornata, L. teres,* and *O. reflexa.* A cumulative total of 43 species in 25 genera (adjusted to Turgeon *et al.,* 1998) from literature records and this study are reported from the drainage from 1933-94. Fresh dead specimens of threatened *Lampsilis altilis* and endangered *Ptychobranchus greenii* and relic specimens of endangered *Pleurobema decisum* are reported from this and other recent surveys.

Key words: freshwater mussels, Cahaba River, endangered species, Alabama

INTRODUCTION

Seventeen species of freshwater mussels historically known from the Mobile River basin are currently listed as endangered or threatened by the U.S. Fish and Wildlife Service. Eleven of those species historically occurred in the Cahaba River (Table 1). The decline of the mussel fauna is due to the collective effects of sedimentation, eutrophication, pollution, impoundment and channel modification (Hartfield, 1994). Other factors affecting the distribution and abundance of freshwater mussels in North America include possible competition by exotic species such as the Asian clam, *Corbicula fluminea* (Müller 1774) and the zebra mussel, *Dreissena polymorpha* (Pallas 1771). *Corbicula* invaded the Cahaba River some time after 1935 and had an unknown effect on the native mussel population (Baldwin, 1973). The zebra mussel had a well-documented and profound affect in a very short time on native mussel populations in northern lakes

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TABLE 1. Mussel species historically known to occur in the Cahaba River currently under Federal protection. E = Federally listed endangered. T = Federally listed threatened.

Species	Status/Year listed
Epioblasma metastriata (Conrad 1838)	E/1993
Epioblasma othcaloogensis (I. Lea 1857)	E/1993
Epioblasma penita (Conrad 1834)	E/1987
Lampsilis altilis (Conrad 1834)	T/1993
Lampsilis perovalis (Conrad 1834)	T/1993
Medionidus acutissimus (I. Lea 1831)	T/1993
Medionidus parvulus (I. Lea 1860)	E/1993
Pleurobema decisum (I. Lea 1831)	E/1993
Pleurobema perovatum (Conrad 1834)	E/1993
Pleurobema taitianum (I. Lea 1834)	E/1987
Ptychobranchus greenii (Conrad 1834)	E/1993

and rivers in the United States and Canada, but has not been reported from the Mobile River basin.

Numerous studies of the Cahaba River mollusk fauna and the river's water-quality have been published through the years. Lewis (1876) catalogued many freshwater and land shells of Alabama, including numerous species of freshwater mussels from the Cahaba River reported by various collectors. His locality information was vague, but included species listed from the Cahaba River drainage specifically and the Alabama River system generally. Other mussel collections from the Cahaba River have been reported by other authors, including Johnson (1967), Frey *et al.* (1976), and Stansbery (1983a,b,c). However, only two comprehensive mussel surveys of the drainage have been completed to date (van der Schalie, 1938; Baldwin, 1973).

In a report on freshwater mussels collected in the Cahaba River system in 1933 and 1935, van der Schalie (1938) stated that the Cahaba River was "unusually productive conchologically," yielding 42 species in 23 genera from 34 stations in the system (Table 2). He reported that the most prominent dangers to the Cahaba River mussel fauna were the possibility of pollution by acid-containing mine wastes, heavy concentrations of industrial wastes and sewage from Birmingham, and the disturbance of the natural conditions in the river by dam construction.

In a study of the changes in the Cahaba River mussel fauna over a 40-year period, Baldwin (1973) reported 31 species in 21 genera from 19 stations (Table 2). He reported that 12 species had increased in abundance and 34 species had decreased in abundance during that time period. Baldwin (1973) supported van der Schalie's (1938) predictions regarding potential impacts to the mussel fauna of the Cahaba River and commented that pollution from coal fields and strip

TABLE 2. Comparison of various surveys of Cahaba River mussel fauna.

Species	van der Schalie (1938)	Baldwin (1973)	Pierson (1991)	Shepard and others (1994)	Current study
Amblema plicata (Say 1817)	X	X	X	X	
Ellipsaria lineolata (Rafinesque 1820)	X	X	X		X
Elliptio arca (Conrad 1834)	X				
Elliptio arctata (Conrad 1834)	X	X	X		
Elliptio crassidens (Lamarck 1819)	X	X	X	X	X
Epioblasma metastriata (Conrad 1838)	X	X			
*Epioblasma penita** (Conrad 1834)					
*Fusconaia cerina*** (Conrad 1838)	X	X	X	X	X
Fusconaia ebena (I. Lea 1831)	X	X	X		X
Lampsilis altilis (Conrad 1834)	X	X		X	
Lampsilis ornata (Conrad 1835)	X	X	X	X	X
L. straminea claibornensis (I. Lea 1838)	X	X	X	X	X
Lampsilis teres (Rafinesque 1820)	X	X	X	X	X
Lasmigona complanata alabamensis Clarke 1985	X	X	X		X
Lasmigona holstonia (I. Lea 1838)	X				
Leptodea fragilis (Rafinesque 1820)	X	X	X		X
Ligumia recta (Lamarck 1819)	X	X		X	X
Medionidus acutissimus (I. Lea 1831)	X	X			
*Medionidus parvulus** (I. Lea 1860)	X				
Megalonaias nervosa (Rafinesque 1820)	X			X	X
Obliquaria reflexa Rafinesque 1820	X	X	X	X	X
*Obovaria jacksoniana**** (Frierson 1912)	?	?	X		
*Obovaria unicolor**** (I. Lea 1845)	?	?	X		X
Plecotmerus dombeyana (Valenciennes 1827)					X
Pleurobema decisum (I. Lea 1831)	X	X	X	X	
Pleurobema perovatum (Conrad 1834)	X				
Pleurobema rubellum (Conrad 1834)	X				
Pleurobema taitianum (I. Lea 1834)	X				
Potamilus purpuratus (Lamarck 1819)	X	X	X	X	X
Ptychobranchus greenii (Conrad 1834)	X	X		X	
Pyganodon grandis (Say 1829)			X		
Quadrula apiculata (Say 1829)	X	X	X		X
Quadrula asperata (I. Lea 1861)	X	X	X	X	X
Quadrula metanevra (Rafinesque 1820)	X	X	X		X
Quadrula rumphiana (I. Lea 1852)	X	X	X	X	X
Toxolasma ref. *corvunculus* (I. Lea 1868)	X				X
Tritogonia verrucosa (Rafinesque 1820)	X	X	X	X	X
Truncilla donaciformis (I. Lea 1828)	X		X		X
*Uniomerus tetralasmus***** (Say 1831)	X	X			
Utterbackia imbecillis (Say 1829)	X	X			
Villosa lienosa (Conrad 1834)	X	X	X	X	X
Villosa nebulosa (Conrad 1834)	X	X			
Villosa vanuxemensis umbrans (I. Lea 1857)	X				
Villosa vibex (Conrad 1834)	X	X			
Corbicula fluminea (Müller 1774)		X	X	X	X

*Collected in the early 20th century and reported by Stansbery (1983c).

** = Collected by Kevin Roe, University of Alabama, 1994.

***These species were not separated by van der Schalie (1938) or Baldwin (1973).

****This species was collected by H.H. Smith early in the 20th century and both van der Schalie and Baldwin reported the same collections.

mining had caused considerable acid run-off, and housing developments near the river in Birmingham had increased twofold the amount of waste entering the river from the time of van der Schalie's (1938) study. In 1994, Dr. David H. Stansbery of the Ohio State University Museum of Biological Diversity (OSUM) reexamined the shells collected during Baldwin's (1973) study and reported "at least" 31 species in a letter of findings to the U.S. Fish and Wildlife Service (USFWS).

In a status survey of the southern clubshell, *Pleurobema decisum* (I. Lea 1831), Pierson (1991) reported 27 species of freshwater mussels in 16 genera and *Corbicula*, including nine mussel species collected alive and 11 collected as fresh dead material, from nine stations in the main channel of the Cahaba River and in the lower Little Cahaba River (Table 2). Pierson (1991) observed that the Cahaba River continued to experience water quality problems such as organic enrichment from sewage treatment facilities, siltation from urban and suburban development, and chemical spills and run off from wood treatment facilities. Another concern he addressed was coal-seam methane drilling activities and related discharges. Badly eroded specimens of *P. decisum* were found at only one station during that study, near Heiberger in Perry County.

Shepard *et al.* (1994) reported results of water-quality and biological studies in the upper Cahaba River drainage. They indicated that water quality problems in the Cahaba River were symptomatic of a stressed aquatic community and that dissolved oxygen problems occurred in certain areas of the river, probably due to benthal and algal respiration. Improved dissolved oxygen levels downstream of one wastewater treatment plant were reported, but the potential for water-quality impairment upstream due to discharge of ammonia and chlorination by-products from other wastewater treatment plants remained high. Fish and benthic macroinvertebrate communities were reported to be present and functional, but their productivity and balance were not within the range expected in unimpaired communities. Nineteen species of freshwater mussels in 13 genera and *Corbicula* were recorded in six collections at four stations (Table 2). Specimens of eight of those mussel species were collected alive.

Other studies of the Cahaba River drainage have addressed other important aspects of this biologically diverse system. Harris and others (1984) cataloged 146 species of caddisflies (Trichoptera) from the Cahaba River. O'Neil (1984) in a review of historical water-quality data collected from the upper Cahaba River, noted that the river upstream of the confluence with Buck Creek, as well as Shades Creek and the upper Little Cahaba River, had experienced elevated levels of nitrogen and phosphorous compounds, heavy metals, and low dissolved oxygen levels. Mayden & Kuhadja (1989) stated that the Cahaba River is the most ichthyologically diverse free-flowing river in North America, relative to its size. Pierson *et al.* (1989) cataloged 131 fish species from the Cahaba River

system, including 18 endemic to the Mobile basin, and noted that the Cahaba River is an important refuge for many of these species. Fitzpatrick (1996) reported that though the Cahaba River rises in the Birmingham metropolitan area it retains most of its pristine qualities as an undisturbed watershed, and reported 24 species and subspecies of crawfishes from the drainage.

In 1994 the Geological Survey of Alabama (GSA) was contracted by the Alabama Department of Conservation and Natural Resources (ADCNR) to perform a survey of the lower Cahaba River for freshwater mussels, with specific attention to species listed as endangered or threatened by the Endangered Species Act. This report summarizes the results of that survey and comments on the current status of all species recorded from the drainage.

STUDY AREA

The Cahaba River is currently the longest free-flowing river in the state of Alabama, stretching about 305 kilometers (190 miles) from its headwaters in the Alabama Valley and Ridge Physiographic Section in St. Clair County to its confluence with the Alabama River in Dallas County in the East Gulf Coastal Plain Physiographic Section. It is a major south-flowing tributary of the Alabama River, draining an area of approximately 4,725 km^2 (1,825 mi^2) and ranges in elevation from about 290 meters (960 feet) in its headwaters to about 30 meters (100 feet) at its confluence with the Alabama River near Selma (Pierson *et al.*, 1989). The main channel flows through St. Clair, Jefferson, Shelby, Bibb, Perry, and Dallas counties, and also drains portions of Tuscaloosa and Chilton counties. Our study was confined to the lower half of the river, beginning at the Fall Line in Centreville and proceeding downstream in the Coastal Plain to just above the reservoir influence of the Alabama River in Perry County, covering about 130 kilometers (80 miles) of river.

METHODS

Collections were made using various techniques in an effort to examine all available habitats. Live specimens were hand-collected in shallow areas of the river, often with the aid of a viewing bucket. Mask and snorkel and SCUBA were employed in deeper water. Fresh dead and relic shells were found by walking stream banks, islands, and gravel and sand bars searching for deposited material and shell middens.

When mussels were found at a station efforts were continued until diminishing returns had been reached. Notes on the physical nature of the stream, such as clarity, substrate and presence or absence of vegetation were maintained. Terms for various zones of the river used in species accounts were determined by van der Schalie (1938). The small river zone includes the main channel from the vicinity of Trussville downstream to the mouth of the upper Little Cahaba River, the medium river zone proceeds from that point downstream to the vicinity of Centreville, and the large river zone begins about seven river miles downstream of Centreville and proceeds to the mouth.

Specimens collected were recorded as either alive, fresh dead, or relic. Most live specimens were identified and immediately returned to the substratum. Live specimens sacrificed for later identification were relaxed in a chilled cooler and are preserved in 80% ethanol. Voucher specimens of fresh dead and relic shells and some preserved specimens were accessioned into the reference collection at OSUM. Species reported herein follow current nomenclature presented in Turgeon *et al.* (1998).

RESULTS AND DISCUSSION

During this study, collections were made at 45 stations in the main channel of the Cahaba River from Centreville, Bibb County, downstream to the vicinity of Suttle, Perry County (Table 3). A total of 23 species of freshwater mussels in 17 genera was collected (Table 4). Collection localities described in Table 3 correspond to Table 4. A collection of relic *Plectomerus dombeyanus* (Valenciennes 1827) shells at a single station during this study represented a new tributary record for that species. *Corbicula* was encountered throughout the system, but *Dreisenna* not encountered. Four species displayed evidence of recent recruitment: *Lampsilis ornata* (Conrad 1835), *Lampsilis teres* (Rafinesque 1820), *Obliquaria reflexa* Rafinesque 1820, and *Quadrula asperata* (I. Lea 1861). No mussels were collected at eight stations (Table 4). In addition to the 23 species collected during this study, three additional species were collected at about the same time in the headwaters and reported by Shepard *et al.* (1994), bringing the total currently known from the drainage to 26 species. Among those species were relic specimens of *Pleurobema decisum* and a fresh dead *Ptychobranchus greenii*, both of which are federally endangered. The *P. decisum* specimens were collected near the upstream limit for that species defined by van der Schalie (1938) and Baldwin (1973).

The decline of mussel diversity in the Cahaba River noted by Baldwin (1973) is still in evidence and is manifested by the continued loss of species. He reported that 34 species had been reduced in number and 12 had increased in number, and that the total species number present in the drainage had fallen from 43 to 31 species from the time of van der Schalie's (1938) study. Results of the present study indicated that seven species have not been reported since van der Schalie (1938) and an additional five species have not been reported since Baldwin (1973). Two new species have been added since Baldwin (1973), bringing the cumulative total for the drainage to 43 species in 25 genera (Table 2).

Though the present survey only covered the lower reaches of the Cahaba River, all species known from the Cahaba River are discussed in the following species accounts. Collections from the Cahaba River made during this study deposited at OSUM occupy collection numbers OSUM:1994:0121-0123, OSUM:1994:0126-0131, OSUM:1994:0143 and OSUM:1994:0155.

TABLE 3. Summary information for collection stations in the lower Cahaba River, Alabama, August-September, 1994.

Station No.	Date	Location
1	Sept. 22	Island at unnamed tributary, Perry Co., T. 18 N., R. 9 .E, sec. 17
2	Sept. 22	Gravel bar on right bank, Perry Co., T. 18 N., R. 9 E., sec. 18
3	Sept. 22	Island above unnamed tributary, Perry Co., T. 18 N., R. 9 E., sec. 7, 18
4	Sept. 22	Below high bluff at tributary, Perry Co., T. 18 N., R. 8 E., sec. 12
5	Sept. 22	Gravel bars downstream of Rice Creek, Perry Co., T. 18 N., R. 8 E., sec. 11
6	Sept. 22	At sand island, Perry Co., T. 19 N., R. 8 E., sec. 1
7	Sept. 22	Gravel bar downstream of Radford, Perry Co., T. 19 N., R. 8 E., sec. 36
8	Sept. 22	Opposite Waters Creek, Perry Co., T. 19 N., R. 9 E., sec. 30
9	Sept. 22	Gravel bar in bend, Perry Co., T 19 N., R. 8 E., sec. 25
10	Sept. 22	Sand bars, Perry Co., T. 19 N., R. 8 E., sec. 11
11	Sept. 22	Pool, Perry Co. ,T. 19 N., R. 8 E., sec. 10
12	Sept. 22	Gravel bar downstream of "S" curve, Perry Co., T. 19 N., R. 8 E., sec. 2
13	Aug. 21	Downstream of AL. Hwy. 14 bridge, Sprott, Perry Co., T. 20 N., R. 8 E., sec. 35
14	Aug. 21	Gravel bar upstream of AL Hwy. 14 bridge, Perry Co., T. 20 N., R. 8 E., sec. 26
15	Aug. 21	Gravel shore below bend, Perry Co., T. 20 N., R. 8 E., sec. 23
16	Aug. 21	Downstream of Perry Lake, Perry Co., T. 20 N., R. 8 E., sec. 23
17	Aug. 21	Shallow riffle at sand bar SE of Perry Lake, Perry Co., T. 20 N., R. 8 E., sec. 23
18	Aug. 21	Sand bar NE of Round Lake, Perry Co., T. 20 N., R. 8 E., secs. 23, 24
19	Sept. 20	Gravel bar downstream of Old Town Creek, Perry Co., T. 20 N., R. 8 E., sec. 10
20	Sept. 20	Sand bank NE of Marietta Church, Perry Co., T. 20 N., R. 8 E., sec. 10
21	Sept. 20	Right bank at head of long pool, Perry Co., T. 20 N., R. 8 E., sec. 3
22	Sept. 20	Gravel bar, mouth of Potato Patch Creek, Perry Co., T. 21 N., R. 8 E., sec. 32
23	Sept. 20	Gravel bar, Perry Co., T. 21 N., R. 8 E., sec. 27
24	Sept. 15	Gravel bar downstream of Jericho Bridge, Perry Co., T. 21 N., R. 8 E., sec. 28
25	Sept. 13	At Jericho Bridge, Perry Co., T. 21 N., R. 8 E., sec. 28
26	Sept. 15	Gravel bar NE of Jericho Bridge, Perry Co., T. 21 N., R. 8 E., sec. 15
27	Sept. 15	Gravel bar upstream of Taylor's Creek, Perry Co., T. 21 N., R. 8 E., sec. 11
28	Sept. 15	Gravel bar upstream of Blue Girth Creek, Perry Co., T. 21 N., R. 8 E., sec. 11
29	Sept. 15	Gravel bar at lower end of long pool, Perry Co., T. 21 N., R. 9 E., sec. 6
30	Sept. 15	Near U.S. Forest Service Boundary, Bibb Co., T. 22 N., R. 9 E., sec. 32
31	Sept. 15	Gravel bar downstream Harrisburg Bridge, Bibb Co., T. 22 N., R. 9 E., sec. 32
32	Sept. 14	Gravel/mud shore, Bibb Co., T. 22 N., R. 9 E., sec. 29
33	Sept. 14	Gravel bar downstream of Cooper Island, Bibb Co., T. 22 N., R. 9 E., sec. 21
34	Sept. 14	Lower end of Cooper Island, Bibb Co., T. 22 N., R. 9 E., sec 21
35	Sept. 14	Upper end of Cooper Island, Bibb Co., T. 22 N., R. 9 E., secs. 15, 16, 21, 22
36	Sept. 14	Gravel bar upstream of Cooper Island, Bibb Co., T. 22 N., R. 9 E., secs. 15, 16
37	Sept. 14	Gravel bar, Bibb Co., T. 22 N., R. 9 E., sec. 14
38	Sept. 14	Gravel bank, Bibb Co., T. 22 N., R. 9 E., secs. 11, 14
39	Sept. 1	Stations 39-42 were at various locations in broad bend from downstream of Gully Creek to upstream of Sandy Creek, Bibb Co., T. 22 N., R. 9 E., secs. 1, 2, 11, 12
40	Sept. 1	"
41	Sept. 1	"
42	Sept. 1	"
43	Sept. 1	Old mill dam 0.5 mi. south of Fairdale, Bibb Co., T. 22 N., R. 9 E., sec. 2
44	Sept. 1	Pool 0.25 mi. downstream of U.S. Hwy. 82, Bibb Co., T. 22 N., R. 9 E., sec. 26
45	Sept. 1	At U.S. Hwy. 82 bridge, Bibb Co., T. 22 N., R. 9 E., sec. 26

TABLE 4. Mussel species and condition of specimens collected in the lower Cahaba River, Alabama, 1994.

Species	1	2	3	4	5	6	7	8	9	10
Ellipsaria lineolata (Rafinesque 1820)	-	-	-	-	-	-	-	-	R	-
Elliptio crassidens (Lamarck 1819)	R	-	FD	-	-	R	A	R	R	A
*Fusconaia cerina*** (Conrad 1838)	-	-	-	-	-	-	-	-	-	-
Fusconaia ebena (I. Lea 1831)	-	-	FD	-	-	-	FD	FD	FD	FD
Lampsilis ornata (Conrad 1835)	FD	R	A	-	R	A	FD	A	FD	FD
L. straminea claibornensis (I. Lea, 1838)	-	-	-	-	-	-	-	-	-	-
Lampsilis teres (Rafinesque 1820)	-	-	-	-	-	A	A	-	-	A
Lasmigona complanata alabamensis Clarke 1985	R	-	-	-	-	-	FD	-	-	FD
Leptodea fragilis (Rafinesque 1820)	-	-	-	-	-	FD	-	-	-	-
Ligumia recta (Lamarck 1819)	-	-	-	-	-	-	-	-	FD	-
Megalonaias nervosa (Rafinesque 1820)	-	-	-	-	-	-	-	-	-	-
Obliquaria reflexa Rafinesque 1820	FD	-	FD	-	R	R	A	FD	-	FD
Obovaria unicolor (I. Lea 1845)	-	-	R	-	-	R	-	R	-	-
Plectomerus dombeyanus (Valenciennes 1827)	-	-	-	-	-	-	-	-	-	R
Potamilus purpuratus (Lamarck 1819)	-	R	-	-	-	FD	R	-	-	FD
Quadrula apiculata (Say 1829)	-	-	-	-	-	R	-	-	-	-
Quadrula asperata (I. Lea 1861)	FD	R	FD	-	R	FD	FD	A	FD	FD
Quadrula metanevra (Rafinesque 1820)	-	-	FD	-	-	-	-	-	-	-
Quadrula rumphiana (I. Lea 1852)	-	-	-	-	-	-	-	-	-	A
Toxolasma ref. *corvunculus* (I. Lea 1868)	-	-	-	-	-	-	-	-	-	-
Tritogonia verrucosa (Rafinesque 1820)	-	-	-	-	-	-	-	R	-	-
Truncilla donaciformis (I. Lea 1828)	FD	-	-	-	-	-	-	-	-	FD
Villosa lienosa (Conrad 1834)	-	-	-	-	-	-	-	-	-	-

TABLE 4 (cont.).

Species	11	12	13	14	15	16	17	18	19	20	21	22
Ellipsaria lineolata	-	-	-	A	-	-	-	-	-	-	-	FD
Elliptio crassidens	-	R	-	-	-	-	-	FD	-	-	FD	FD
*Fusconaia cerina***	-	-	-	-	-	-	-	-	-	-	-	-
Fusconaia ebena	-	R	-	FD	-	-	-	-	-	-	-	R
Lampsilis ornata	-	FD	A	A	A	A	A	A	FD	-	FD	FD
L. straminea claibornensis	-	-	-	-	-	-	-	-	FD	-	-	R
Lampsilis teres	-	-	-	-	-	A	A	A	-	-	-	-
Lasmigona complanata alabamensis	-	-	FD	R	-	-	-	A	R	-	FD	-
Leptodea fragilis	-	-	-	-	-	-	-	-	R	-	-	-
Ligumia recta	-	R	-	-	-	-	-	-	-	-	-	-
Megalonaias nervosa	-	-	-	-	-	-	-	-	-	-	-	-
Obliquaria reflexa	-	-	A	A	-	A	-	A	FD	-	FD	-
Obovaria unicolor	-	-	-	-	-	-	-	-	-	-	-	R
Plectomerus dombeyana	-	-	-	-	-	-	-	-	-	-	-	-
Potamilus purpuratus	-	-	-	FD	-	-	A	-	R	-	-	FD
Quadrula apiculata	-	-	-	FD	-	-	-	-	R	-	-	-
Quadrula asperata	-	FD	FD	A	-	A	-	A	FD	-	FD	A
Quadrula metanevra	-	-	-	A	-	A	-	-	-	-	-	-
Quadrula rumphiana	-	-	-	FD	-	-	-	-	-	-	R	FD
Toxolasma sp.	-	-	-	-	-	-	A	-	-	-	-	-
Tritogonia verrucosa	-	-	-	-	-	-	-	-	-	-	-	-
Truncilla donaciformis	-	-	-	-	-	-	-	-	-	-	-	-
Villosa lienosa	-	-	-	-	-	-	-	-	R	-	-	-

TABLE 4 (cont.).

Species	23	24	25	26	27	28	29	30	31	32	33	34
Ellipsaria lineolata	-	R	-	-	FD	-	A	A	-	-	A	-
Elliptio crassidens	-	R	-	-	-	R	A	A	R	FD	R	-
*Fusconaia cerina***	-	-	-	-	-	-	-	A	-	-	-	-
Fusconaia ebena	-	-	-	-	-	-	R	A	-	-	-	-
Lampsilis ornata	FD	A	-	A	A	A	A	A	A	A	A	-
L. straminea claibornensis	-	-	-	-	-	-	-	-	-	-	-	-
Lampsilis teres	-	A	-	A	A	A	A	A	A	-	-	-
Lasmigona complanata alabamensis	R	-	-	-	A	R	R	A	A	-	-	-
Leptodea fragilis	-	-	-	-	-	-	-	-	-	-	-	-
Ligumia recta	-	-	-	-	-	R	-	-	-	-	-	-
Megalonaias nervosa	-	-	-	-	-	-	FD	-	-	-	R	R
Obliquaria reflexa	FD	-	-	A	A	A	A	A	R	FD	A	FD
Obovaria unicolor	-	-	-	A	-	-	-	FD	-	-	-	-
Plectomerus dombeyana	-	-	-	-	-	-	-	-	-	-	-	-
Potamilus purpuratus	FD	A	-	-	-	FD	FD	A	A	FD	-	A
Quadrula apiculata	-	-	-	-	-	-	-	-	-	-	-	-
Quadrula asperata	FD	A	-	FD	-	-	R	A	FD	A	A	A
Quadrula metanevra	-	-	-	-	-	-	-	-	-	-	-	-
Quadrula rumphiana	FD	-	-	-	-	-	-	A	-	-	-	-
Toxolasma sp.	-	-	-	-	-	-	-	-	-	-	-	-
Tritogonia verrucosa	-	-	-	-	-	-	-	-	-	-	-	-
Truncilla donaciformis	-	-	-	-	-	A	-	-	-	-	-	-
Villosa lienosa	-	-	-	-	-	-	-	-	-	-	-	-

TABLE 4 (cont.).

Species	34	35	36	37	38	39	40	41	42	43	44	45
Ellipsaria lineolata	-	-	R	R	-	-	-	-	-	-	-	-
Elliptio crassidens	-	A	-	R	-	-	-	-	-	-	-	FD
*Fusconaia cerina***	-	-	-	-	-	-	-	-	-	-	-	-
Fusconaia ebena	-	R	-	-	-	-	-	-	-	-	-	-
Lampsilis ornata	-	A	FD	FD	R	-	-	-	R	-	-	-
L. straminea claibornensis	-	-	-	-	-	-	-	-	-	-	-	-
Lampsilis teres	-	-	-	-	-	-	-	-	-	-	-	-
Lasmigona complanata alabamensis	-	-	-	R	-	-	-	-	-	-	-	-
Leptodea fragilis	-	-	-	-	-	FD	R	FD	-	-	-	-
Ligumia recta	-	-	-	-	-	-	-	-	-	-	-	R
Megalonaias nervosa	R	-	-	-	-	-	-	-	-	-	-	-
Obliquaria reflexa	FD	FD	FD	R	-	R	R	-	R	-	-	-
Obovaria unicolor	-	-	-	R	-	-	-	-	-	-	-	-
Plectomerus dombeyana	-	-	-	-	-	-	-	-	-	-	-	-
Potamilus purpuratus	A	-	FD	FD	-	R	-	-	R	-	-	-
Quadrula apiculata	-	-	-	-	-	-	-	-	-	-	-	-
Quadrula asperata	A	A	A	FD	-	R	-	-	-	-	-	FD
Quadrula metanevra	-	-	R	-	-	-	-	-	-	-	-	-
Quadrula rumphiana	-	-	-	-	-	-	-	-	-	-	-	-
Toxolasma sp.	-	-	-	-	-	-	-	-	-	-	-	-
Tritogonia verrucosa	-	-	R	-	-	-	-	-	-	-	-	-
Truncilla donaciformis	-	-	-	-	-	-	-	-	-	-	-	-
Villosa lienosa	-	-	-	-	-	-	-	-	-	-	-	-

Amblema plicata (Say 1817), threeridge

Van der Schalie (1938) collected *Amblema plicata* (reported as *Amblema perplicata)* in small to medium river zones from Centreville upstream. Baldwin (1973) reported *A. plicata* (as *A. perplicata)* to be the fourth most abundant species in the Cahaba River and the dominant species at Anita in Shelby County, and common throughout the river. Pierson (1991) reported relic shells only, and Shepard *et al.* (1994) reported fresh dead and relic shells. No specimens were found during the present study.

Ellipsaria lineolata (Rafinesque 1820), butterfly

Van der Schalie (1938) reported *Ellipsaria lineolata* (as *Plagiola lineolata*) in the large river zone. Baldwin (1973) reported this species (as *P. lineolata*) as far upstream as Centreville and stated that the numbers he collected compared favorably with those of van der Schalie (1938). Pierson (1991) reported collecting live specimens, while Shepard *et al.* (1994) did not report this species. *Ellipsaria lineolata* was collected alive at four stations during this study.

Elliptio arca (Conrad 1834), Alabama spike

This species was reported (as *Elliptio dilatatus*) by van der Schalie (1938) from a single specimen collected in the medium river zone. *Elliptio arca* has not been collected in the Cahaba River since.

Elliptio arctata (Conrad 1834), delicate spike

This species was reported (as *Elliptio arctatus*) to be rather abundant by van der Schalie (1938) and Baldwin (1973) in the small and medium river zones upstream of Centreville. Pierson (1991) reported weathered dead *E. arctata* in the Cahaba and Little Cahaba Rivers.

Elliptio crassidens (Lamarck 1819), elephantear

Van der Schalie (1938) reported *Elliptio crassidens* to be common in the large river zone of the Cahaba River. Baldwin (1973) reported it had increased in abundance since the time of van der Schalie's (1938) study. Pierson (1991) also reported live *E. crassidens,* and it accounted for 93.7% of the total yield of live specimens at four stations upstream of Centreville by Shepard *et al.* (1994). *Elliptio crassidens* was collected alive at five stations and as fresh dead and relic at 16 additional stations during this study.

Epioblasma metastriata (Conrad 1838), upland combshell

Epioblasma metastriata (reported as *Dysnomia metastriata*), currently listed as a federally endangered species, was reported to be common in the small to

medium river zone and found sparingly in the large river zone by van der Schalie (1938). Baldwin (1973) reported the species from the same river zones, but greatly reduced in numbers since the time of van der Schalie's (1938) study. Pierson (1991) and Shepard *et al.* (1994) did not report finding this species. No specimens were found during the present study.

Epioblasma penita (Conrad 1834), southern combshell

A single record of *Epioblasma penita*, currently listed as federally endangered, is known from the Cahaba River. It was collected by "Dr. Hartman" at "Cahawba (*sic*) R., Perry Co., Ala." in the 19th century and was deposited in the U.S. National Museum (USNM), catalog specimen USNM 84472 (Stansbery, 1983c).

Fusconaia cerina (Conrad 1838), Gulf pigtoe

Fusconaia cerina was reported by van der Schalie (1938) (as *Fusconaia rubida)* to be abundant throughout the lower two-thirds of the main channel of the river. Baldwin (1973) found the same distribution but reported the abundance to be "about one-half" that of van der Schalie's (1938) study. Pierson (1991) reported fresh dead specimens, while Shepard *et al.* (1994) reported a single live specimen and several fresh dead and relic shells. No specimens were found during this study. However, a fresh dead shell collected a short time after this study at the U.S. Highway 82 bridge in Centreville by Kevin Roe of the University of Alabama (UA) was brought to our attention and is included in Table 2.

Fusconaia ebena (I. Lea 1831), ebonyshell

Van der Schalie (1938) and Baldwin (1973) reported similar numbers ("relatively abundant") of *Fusconaia ebena* (as *F. ebenus*) in the lower reaches of the Cahaba. Pierson (1991) reported fresh dead specimens while Shepard *et al.* (1994) did not collect it in the headwaters. *Fusconaia ebena* was collected alive at one station during this study.

Lampsilis altilis (Conrad 1834), finelined pocketbook

Lampsilis altilis, currently listed as a federally threatened species, was reported (as *L. clarkiana*) to be abundant in the small to medium river zones by van der Schalie (1938) and Baldwin (1973). Pierson (1991) did not report the species. However, he did report *L. perovalis* from the lower Little Cahaba River downstream of Bulldog Bend. These morphologically similar species were both described from the Alabama River at Claiborne by Conrad in 1834, and their proper taxonomic status is currently considered problematic (Kevin Roe, UA, personal communication, 1999). The USFWS Final Rule (1993) designating *L. perovalis* a threatened species includes the Cahaba River system in the historic

range of the species. Shepard *et al.* (1994) did not report the species, and none were found during this study. However, a single fresh dead shell was collected at Bulldog Bend by GSA personnel during an unrelated study in 1991, and a live specimen was reported by Randy Haddock of the Cahaba River Society from the upper Little Cahaba River in March, 1998.

Lampsilis ornata (Conrad, 1835) southern pocketbook

Van der Schalie (1938) found *Lampsilis ornata* (reported as *L. excavata*) to be very common, with as many as 60 specimens at one station in the large river zone. He reported it to be more common in the small to large river habitat as opposed to creeks. Baldwin (1973) reported *L. ornata* (as *L. excavata*) to be the dominant species collected at one station in the large river zone, and commented that its numbers were reduced by "about one half" from the time of van der Schalie's (1938) study. Pierson (1991) reported finding this species alive in the lower Cahaba River during his study, and Shepard *et al.* (1994) reported the species as relic material upstream of Centreville. By far the dominant species collected during this study, *L. ornata* was encountered alive at 19 stations and fresh dead or relic at an additional 15 stations throughout the study area. Evidence of recent recruitment was indicated by the presence of many juveniles.

Lampsilis straminea claibornensis (I. Lea 1838), southern fatmucket

Lampsilis straminea claibornensis (reported as *L. claibornensis*) was reported by van der Schalie (1938) to be less abundant than other members of the genus. Baldwin (1973) found it to be the most abundant species in the genus, found throughout the river but most abundant in the medium river zones upstream of Centreville. Pierson (1991) reported relic shells, while Shepard *et al.* (1994) reported a few live specimens. One fresh dead and several relic specimens were found during this study at two stations.

Lampsilis teres (Rafinesque 1820), yellow sandshell

Van der Schalie (1938) and Baldwin (1973) both reported *Lampsilis teres* (reported as *L. anodontoides)* as common and preferring medium to large river habitats but found occasionally in the headwaters. Pierson (1991) and Shepard *et al.* (1994) reported live specimens. *Lampsilis teres* was the second most widespread species encountered alive during this study, collected alive at 13 stations. Very small specimens of *L. teres* were often collected, and the species displayed a marked preference for silty/sandy substrates.

Lasmigona complanata alabamensis Clarke 1985, Alabama heelsplitter

Van der Schalie (1938) reported *Lasmigona complanata alabamensis* (reported as *L. complanata*) as present, but uncommon, in the medium to large river zones of the Cahaba. Baldwin (1973) encountered about the same number of individuals (reported as *L. complanata)* during his study. Pierson (1991) reported fresh dead *L. c. alabamensis* during his survey, but it was not reported by Shepard *et al.* (1994). *Lasmigona c. alabamensis* was represented by a few specimens collected alive at four stations and fresh dead at several other stations during this study.

Lasmigona holstonia (I. Lea 1838), Tennessee heelsplitter

Van der Schalie (1938) reported this species from extreme headwater locations and suggested it is geologically a relatively recent invader to the Mobile River basin from the Tennessee River drainage. It is considered a species of the Cumberlandian fauna of the southern Appalachians and is generally restricted to headwater habitats. *Lasmigona holstonia* has not been reported from the Cahaba since van der Schalie (1938).

Leptodea fragilis (Rafinesque 1820), fragile papershell

Van der Schalie (1938) and Baldwin (1973) both reported *Leptodea fragilis* as common in the medium to large river zone as far upstream as Shelby County Highway 29, but absent in the headwaters. Pierson (1991) reported live specimens, but Shepard *et al.* (1994) did not report the species from the headwaters. This species was collected as fresh dead material at three stations during the present study.

Ligumia recta (Lamarck 1819), black sandshell

Van der Schalie (1938) reported *Ligumia recta* (as *L. r. latissima)* from three stations in the large river zone. Baldwin (1973) found the species at four stations, but reported it to be uncommon. Pierson (1991) did not report the species, and Shepard *et al.* (1994) found only relics in the headwaters. Fresh dead specimens of *L. recta* were found at one station and relic specimens at three other stations during this study.

Medionidus acutissimus (I. Lea 1831), Alabama moccasinshell

Van der Schalie (1938) reported 74 specimens of *Medionidus acutissimus*, which is currently listed as federally threatened, throughout the main channel of

the Cahaba River, while Baldwin (1973) found only four specimens. Pierson (1991) and Shepard *et al.* (1994) reported none, and none were found during this study.

Medionidus parvulus (I. Lea 1860), Coosa moccasinshell

Van der Schalie (1938) reported a large series of *Medionidus parvulus* taken at Lily Shoals in the early part of the 20th Century by R. E. Call and H. H. Smith and commented on morphological differences between it and *M. acutissimus*. He suggested that it was greatly reduced in abundance from the earlier collection. It has not been reported from the Cahaba River since.

Megalonaias nervosa (Rafinesque 1820), washboard

Van der Schalie (1938) reported *Megalonaias nervosa* (as *M. gigantea*) to be rare in the Cahaba, occurring at only one station in the large river zone. Baldwin (1973) and Pierson (1991) did not collect the species. Shepard *et al.* (1994) reported a single fresh dead specimen in the upper Cahaba. This commercially valuable species was collected as fresh dead material at one station and as relic material at a few others during this study.

Obliquaria reflexa Rafinesque 1820, threehorn wartyback

Obliquaria reflexa was reported by both van der Schalie (1938) and Baldwin (1973) as widely distributed in the medium to large river zones in the Cahaba River. Pierson (1991) and Shepard *et al.* (1994) also reported live specimens during their studies. *Obliquaria reflexa* was the third most widespread species encountered during this study, reported alive from 11 stations and fresh dead and relic from 18 additional stations. Juvenile specimens were frequently encountered.

Obovaria jacksoniana (Frierson 1912), southern hickorynut

Van der Schalie (1938) reported *Obovaria subrotunda* to be common, but restricted to the large river zone and Baldwin (1973) collected few specimens in the same zone. However, the current understanding is that *O. subrotunda* does not occur in the Cahaba River, and those specimens should be recognized as either *O. jacksoniana* or *O. unicolor.* Pierson (1991) reported relic shells of *O. jacksoniana*. Shepard *et al.* (1994) did not report the species from the headwaters and it was not collected during the present study.

Obovaria unicolor (I. Lea 1845), Alabama hickorynut

See discussion of *Obovaria jacksoniana* for van der Schalie (1938) and Baldwin (1973) accounts. Pierson (1991) reported fresh dead *O. unicolor* during his study, while Shepard *et al.* (1994) did not record either species in the headwaters. This species was collected alive at one station during this study and as fresh dead and relic material at several other stations.

Plectomerus dombeyanus (Valenciennes 1827), bankclimber

A new species record for the system was made when a relic shell of *Plectomerus dombeyanus* was found at a single locality during this study. The species is widespread and relatively common elsewhere in the Mobile basin. It prefers mud or mud-gravel stream beds with moderate to sluggish current (Oesch, 1995).

Pleurobema decisum (I. Lea 1831), southern clubshell

Pleurobema decisum (also reported as *P. instructum*), currently listed as a federally endangered species, was reported throughout the middle reaches of the Cahaba River, especially the medium river zones, by both van der Schalie (1938) and Baldwin (1973). Van der Schalie (1938) further commented that *P. decisum* was the most common member of the genus in the Cahaba River, but Baldwin (1973) indicated that numbers had decreased "by about half" from the time of van der Schalie's (1938) study. Pierson (1973) reported a few badly eroded valves at one station in the lower Cahaba River, while Shepard *et al.* (1994) reported a few relic specimens upstream near Helena, Shelby County. No specimens were found during this study.

Pleurobema perovatum (Conrad 1834), ovate clubshell

Pleurobema perovatum (reported as *P. nux* and *P. simulans*), currently listed as a federally endangered species, was reported by van der Schalie (1938) from throughout the main river channel but was not abundant. It has not been reported from the Cahaba River system since.

Pleurobema rubellum (Conrad 1834), Warrior pigtoe

Van der Schalie (1938) reported a single specimen of *Pleurobema rubellum* from the lower Cahaba River and suggested that it belongs to the *P. nux-simulans* complex. It was not reported in subsequent accounts. Hartfield (1994) states that there are no records of *P. rubellum* for at least 50 years, and therefore the USFWS presumes the species to be extinct.

Pleurobema taitianum (I. Lea 1834), heavy pigtoe

Three specimens of *Pleurobema taitianum* (as *P. cordatum*), currently federally listed as endangered, were reported from three stations in the medium and large river zones of the Cahaba (van der Schalie, 1938; Williams, 1982). It has not been reported in subsequent accounts.

Potamilus purpuratus (Lamarck 1819), bleufer

Potamilus purpuratus was reported (as *Proptera purpurata)* by van der Schalie (1938), to be common in the medium to large river zones and absent in the headwaters. Baldwin (1973) reported *P. purpuratus* to be very common throughout the medium and large river zones and one of the most abundant species in the river. Baldwin (1973) indicated it had increased in abundance since van der Schalie's (1938) study. Pierson (1991) reported fresh dead *P. purpuratus* during his survey. A single live *P. purpuratus* was reported from the headwaters by Shepard *et al.* (1994). One specimen was collected alive at each of five stations and fresh dead and relic specimens were found at 14 additional stations during this study.

Ptychobranchus greenii (Conrad 1834), triangular kidneyshell

Van der Schalie (1938) reported *Ptychobranchus greenii,* which is currently listed as federally endangered, to be more common in the small river zone upstream of Centreville, but occasionally collected further downstream. Baldwin (1973) reported similar numbers during his study. Pierson (1991) did not report the species. Shepard *et al.* (1994) reported a single fresh dead specimen upstream at Shelby County Highway 29. None were found during this study.

Pyganodon grandis (Say 1829), giant floater

Pyganodon grandis is apparently a recent invader of the Cahaba River, as Pierson (1991) first reported fresh dead specimens of the species from the system. It has not been reported since. According to Oesch (1995) it prefers quiet water with a mud or mud-gravel bottom and may adapt to a lake environment.

Quadrula apiculata (Say 1829), southern mapleleaf

Van der Schalie (1938) reported this species (as *Quadrula aspera*) to be closely related to *Q. quadrula* of the Tennessee River drainage, and indicated it is probably a southern race of that species. He found it throughout the river, though less common in the headwaters. Pierson (1991) reported fresh dead specimens. Shepard *et al.* (1994) did not report the species from the headwaters. *Quadrula apiculata* was collected fresh dead at one station and as relic material at two

stations during this study.

Quadrula asperata (I. Lea 1861), Alabama orb

Van der Schalie (1938) reported *Quadrula asperata* under three different names: *Q. pustulosa*, *Q. cahabensis*, and *Q. vallata*, and discussed the likelihood of synonymy within the group. Baldwin (1973) reported the species to be widely distributed (found at 16 stations), abundant (the sixth-most abundant species collected) and variable in form throughout the Cahaba River. Pierson (1991) and Shepard *et al.* (1994) also reported live specimens of *Q. asperata*. It was found alive at 12 stations and fresh dead or relic at 19 additional stations during this study. Numerous juveniles were collected.

Quadrula metanevra (Rafinesque 1820), monkeyface

Van der Schalie (1938) reported *Quadrula metanevra* as locally abundant in the lower Cahaba River, while Baldwin (1973) found only two specimens in the lower Cahaba. Pierson (1991) reported live specimens, but Shepard *et al.* (1994) collected none in the headwaters. *Quadrula metanevra* was collected alive at two stations during this study.

Quadrula rumphiana (I. Lea 1852), ridged mapleleaf

Van der Schalie (1938) reported *Quadrula rumphiana* as common in the medium to large river zones in the Cahaba and reported it as unique to Alabama and Georgia. Baldwin (1973) collected it in the same river zones and suggested that it had increased in abundance since the time of van der Schalie's (1938) study. Pierson (1991) reported fresh dead specimens, while Shepard *et al.* (1994) did not collect it in the headwaters. *Quadrula rumphiana* was collected alive at two stations and as fresh dead and relic material at four other stations during this study.

Toxolasma ref. *corvunculus* (I. Lea 1838), southern purple lilliput

Van der Schalie (1938) reported two species of *Toxolasma* (as *Carunculina corvunculus* and *C. cromwelli)* in the small to medium size zones far upstream of Centreville. He also reported them to be remarkably similar, with the best distinguishing characters nacre color and beak sculpture, which he admitted were dubious characters at best. Baldwin (1973), Pierson (1991), and Shepard *et al.* (1994) reported neither during their respective studies. *Toxolasma* ref. *corvunculus* was collected alive at one station during this study (unidentified past genus, the specimen is in the collection of Paul Hartfield, USFWS, Jackson, Mississippi). *Toxolasma cromwelli* is no longer recognized by Turgeon *et al.*

(1998). Jim Williams of the U.S. Geological Survey, Biological Resources Division (BRD) (personal communication, 2000) considers *T. cromwelli* a synonym of *T. paulus*, and reports records of *T. parvus* and *T. corvunculus* from the Cahaba. David Stansbery (OSUM, personal communication, 2000) indicated that the genus *Toxolasma* in the Gulf drainages is problematic and suggested the need for further study of the group. Richard Johnson (MCZ, personal communication, 2000) considers the group to be fairly small, and considers the species in the Cahaba River to be *T. parva*.

Tritogonia verrucosa (Rafinesque 1820), pistolgrip

Van der Schalie (1938) reported *Tritogonia verrucosa* to have an "unusually wide distribution" in the Cahaba River system, being especially abundant in the small river zone. He also commented on the tendency of specimens with purple nacre to be more common in the headwaters and less common downstream, where almost all specimens had white nacre, but acknowledged that this is probably a local characteristic. Baldwin (1973) found the species to be greatly reduced in numbers during his study, while Pierson (1991) reported fresh dead specimens and Shepard *et al.* (1994) reported relics. Only a few relic specimens were found at two stations during this study.

Truncilla donaciformis (I. Lea 1828), fawnsfoot

Van der Schalie (1938) reported the distribution of *Truncilla donaciformis* to be puzzling, since it did not seem to have a restricted distribution pattern and was found from the headwaters to the lowermost large river zones. However, he found it to be more abundant in the lower reaches of the Cahaba River. Baldwin (1973) did not report this species. Pierson (1991) reported fresh dead specimens, while Shepard *et al.* (1994) did not report the species from the headwaters. *Truncilla donaciformis* was collected alive at one station and fresh dead at two other stations during this study.

Uniomerus tetralasmus (Say 1831), pondhorn

Van der Schalie (1938) and Baldwin (1973) reported single specimens of *Uniomerus tetralasmus* from two locations in the Cahaba River, collected by H.H. Smith, from upstream and downstream of Centreville. It has not been reported from the Cahaba River since, and none were found during the present study.

Utterbackia imbecillis (Say 1829), paper pondshell

Van der Schalie (1938) reported *Utterbackia imbecillis* (as *Anodonta imbecillis*) from the zone of creeks and small river. Baldwin (1973) collected one specimen in

the headwaters. Neither Pierson (1991) nor Shepard *et al.* (1994) reported this species, and it was not found during the present study.

Villosa lienosa (Conrad 1834), little spectaclecase

Villosa lienosa is primarily a species of headwaters and small creeks, but was reported (as *Micromya lienosa)* by van der Schalie (1938) throughout the entire Cahaba River system. Baldwin (1973) found the species to be most abundant at the confluence of the lower Little Cahaba and Cahaba rivers in Bibb County. Pierson (1991) reported fresh dead specimens,while Shepard *et al.* (1994) reported relics only. One relic shell was collected during this study.

Villosa nebulosa (Conrad 1834), Alabama rainbow

Villosa nebulosa was reported (as *Micromya nebulosa*) by van der Schalie (1938) to be rare in the Cahaba and almost exclusively restricted to the headwaters. An exception was the presence of *V. nebulosa* at Lily Shoals in the medium river zone, suggesting that a creek-like environment existed at these shoals. He also discussed the resemblance of *V. nebulosa* in the Cahaba to members of that species complex in the Tennessee drainage and suggested that it probably invaded the Cahaba from the north as a result of stream capture. Baldwin (1973) reported the species from the small river zone but not from the headwaters. Neither Pierson (1991) nor Shepard *et al.* (1994) reported the species and it was not collected during the present study.

Villosa vanuxemensis umbrans (I. Lea 1857), Coosa creekshell

Villosa vanuxemensis umbrans was reported (as *Micromya vanuxemensis*) by van der Schalie (1938) to have a very irregular distribution, being found primarily in the medium river zone with a few specimens in the large river zone. It has not been reported since van der Schalie (1938) and was not encountered during the present study.

Villosa vibex (Conrad 1834), southern rainbow

Villosa vibex was reported (as *Micromya vibex*) by van der Schalie (1938) to be confined to creeks and the small river zone of the Cahaba. He stated that some of the specimens from the extreme headwaters were unusually thick, and suggested it is a reflection of ecological adjustments or possible crossbreeding with the related *V. nebulosa*. Baldwin (1973) collected one specimen in a tributary (Six Mile Creek). Pierson (1991) and Shepard *et al.* (1994) did not report the species and none were collected during the present study.

CONCLUSIONS

Comparison of the results of freshwater mussel surveys of all or parts of the Cahaba River by van der Schalie (1938), Baldwin (1973), and Pierson (1991), with results of surveys conducted as part of a study by Shepard *et al.* (1994), and this study indicate that the mussel fauna of the Cahaba River is in a state of decline. Results of water-quality studies by Shepard *et al.* (1994) provide evidence that there are severe impacts to the system attributable to various mechanisms, namely those causing increased nutrification or other water-quality effects from permitted wastewater discharge, and those associated with urban and other non-point stormwater runoff. These results substantiate the concerns to the quality and fate of the habitat expressed by earlier researchers. Recent collections in the lower Cahaba River of two species new to the drainage (*Plectomerus dombeyanus* and *Pyganodon grandis*) which are known to inhabit mud or mud-gravel substrate in lakes and sluggish streams and the preference for sandy habitats by one of the most abundant species in the river (*Lampsilis teres*) suggests that the stable gravel habitat once abundant in the Cahaba River might be compromised.

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THE PUPILLID GENUS *ANAUCHEN* IN THAILAND (PULMONATA: STYLOMMATOPHORA)

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ABSTRACT

The genus *Anauchen* is reported for the first time in Thailand, with two new species from limestone areas, Huaykhakang Wildlife Sanctuary, Utaithani Province, and a third new species from Angthong National Park, Surathani Province. ***Anauchen huaykhakang*** **Panha n. sp.** has a very small, pyramidal, high-spired shell, with five apertural barriers and noticeably shouldered ultimate whorl. Below (anterior to) the shoulder, the ultimate whorl slopes steeply anteriorly (basally; distally). The shell aperture lacks an angular barrier, but has well developed parietal, columellar, palatal (two), and basal barriers. ***Anauchen utaithaniensis*** **Panha n. sp.** has a similar shell that also has five major apertural barriers, of which the parietal lamella is bifid. Additional low, lamellar, ridges occur deeper within the palatal aperture. The ultimate whorl is moderately shouldered. ***Anauchen angthongense*** **Panha n. sp.** has a ovate-conic, narrowly umbilicate shell, with a slightly convex spire and rounded whorls. The peristome is expanded, and adnate. The aperture has five, well-developed barriers: parietal and columellar lamellae, and palatal (two) and basal plicae. A fourth *Anauchen* species now known for Thailand is *Anauchen chedi* (Panha), originally described under a different genus (*Hypselostoma*).

Key words: *Anauchen angthongense, A. chedi, A. huaykhakang, A. utaithaniensis,* Pupillidae, Stylommatophora, Pulmonata, Thailand.

INTRODUCTION

The genus *Anauchen* Pilsbry differs from related southeast Asian pupilloid snails by having only one major barrier ("tooth") on the parietal wall of the shell aperture. Previously there were four known species in the genus (Pilsbry, 1917), one in southern China (Gredler, 1885) and three in Vietnam (Mabille, 1887; Bavay & Dautzenberg, 1903). Four additional species, from Thailand, are now added to the genus, three named in this paper, and a fourth previously described (Panha, 1997), but assigned to another genus.

Anauchen huaykhakang **Panha n. sp.**

Description of holotype. Shell (Fig. 2) 2.6 mm high and 1.9 mm wide, with

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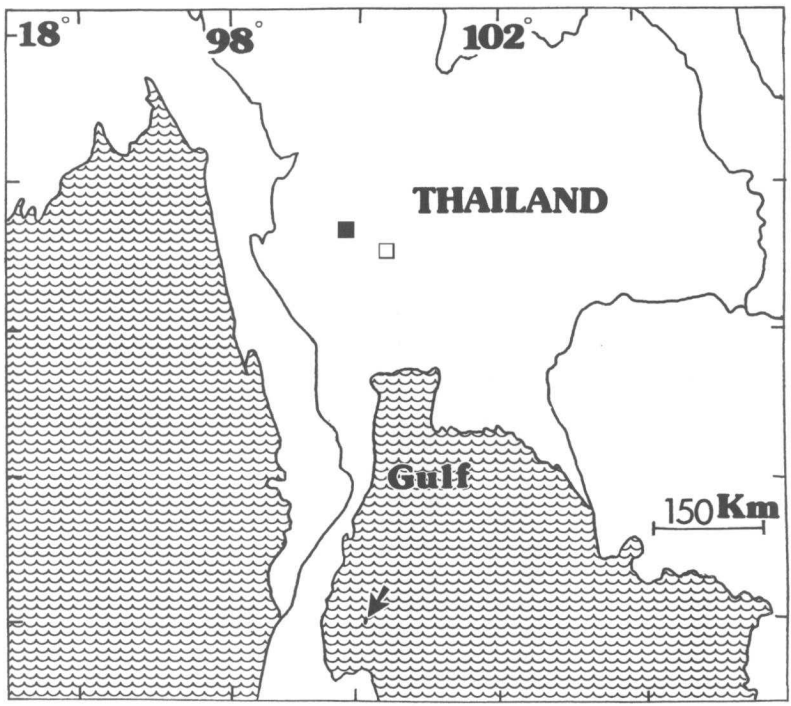

FIG. 1. Map showing locations of the limestone mountain area near Huaykhakang Wildlife Sanctuary, Utaithani Province (■); Angthong National Park, Surathani Province (arrow); Tebpratan Nature Reserve, Kampangpet Province (❑).

5 ¾ whorls. (Shell measurements of a type series are given in Table 1). The last whorl is greatly enlarged when compared to the preceding whorls, its height being almost three times that of the penultimate whorl. The spire is elongated, nearly straight-sided in silhouette. The sutures are well impressed. The umbilicus is open, and deep. The periphery of the last whorl is rather strongly shouldered. Anterior (basal) to the shoulder, the ultimate whorl slopes steeply distally. The peristome is complete, expanded, weakly adnate. The body whorl tilts up slightly near its proximal end, then, near the aperture, bends slightly downward. The teleoconch is sculptured with faint, close-set, spiral striae (threads), and transverse growth lines. Some indented spiral striae can be seen on the whorls of the umbilicus. The apertural barriers are five, well-developed, set back in the aperture from the peristome. The club-shaped parietal lamella is the most prominent of the barriers. An angular lamella is absent. The columellar lamella enters the aperture perpendicularly (horizontally). The palatal plicae are well developed, about the same height as the parietal and columellar lamel-

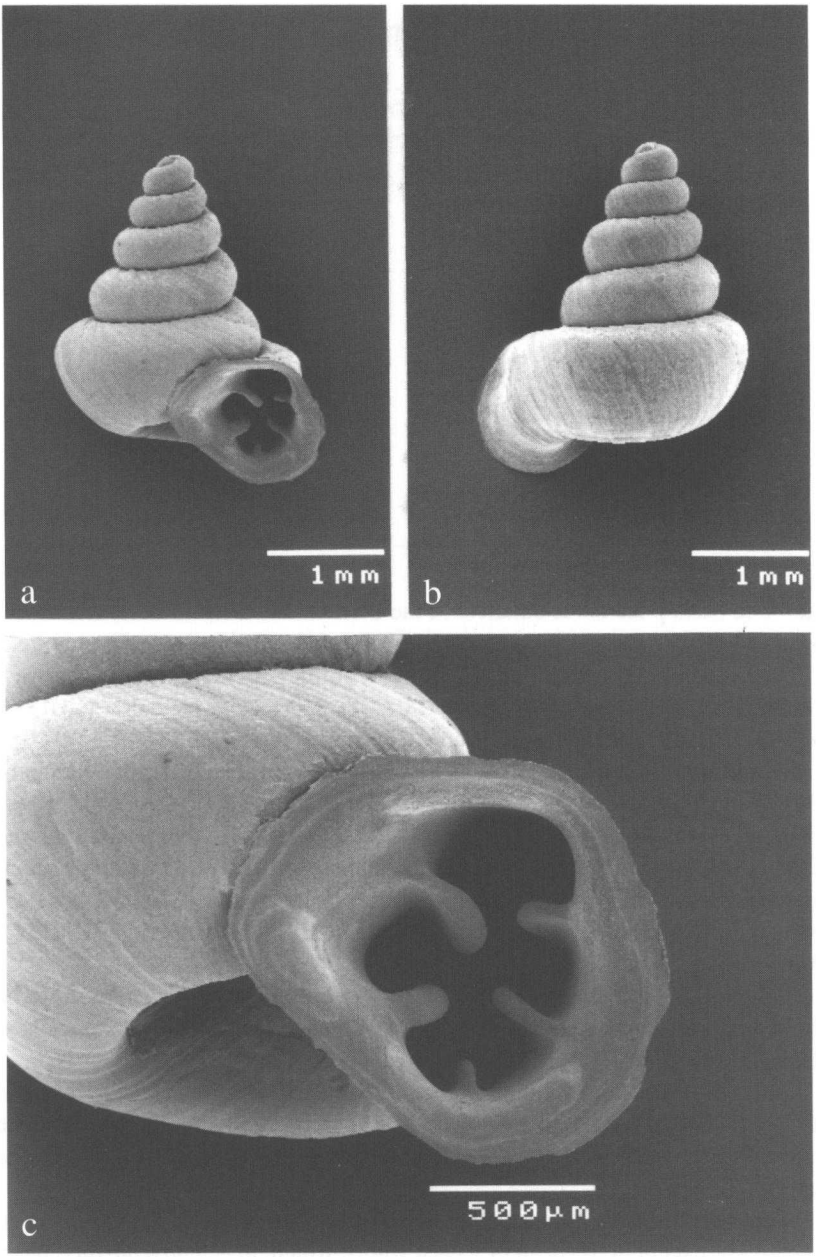

FIG. 2. *Anauchen huaykhakang*, holotype. **a**, Apertural view; **b**, abapertural view; **c**, aperture enlarged.

TABLE 1. Holotype and paratype dimensions of *Anauchen huaykhakang* n. sp.

Type	Dimensions (in mm)		
	Height	Width	Height of aperture
Holotype	2.6	1.9	1.4
Paratype number			
1	2.7	1.9	1.5
2	2.7	1.9	1.5
3	2.7	1.9	1.5
4	2.7	1.9	1.5
5	2.6	1.9	1.4
6	2.6	1.9	1.4
7	2.6	1.9	1.4
8	2.6	1.9	1.3
9	2.6	1.8	1.3
10	2.6	1.8	1.3
11	2.6	1.8	1.3

lae. The basal plica is the smallest of the barriers, but nevertheless well developed.

Type locality. Subkao, Huaykhakang Wildlife Sanctuary, Lansak District, Utaithani Province, 15°35'7" N, 99°18'8" E, 310 meters elevation (CUIZM, Ver 037), Thailand 1997 (leg. S. Panha). (See Fig. 1.)

Etymology. The specific epithet *huaykhakang* is from the name of Huaykhakang Wildlife Sanctuary, the locality of the snail.

Type material. The holotype (CUIZM, Ver 037) is deposited in the Chulalongkorn University Zoological Museum together with 11 paratype specimens (CUIZM, Ver 038). Another six paratype specimens (CUIZM, Ver 039) will be deposited in the University of Michigan Museum of Zoology (UMMZ), Ann Arbor.

Geographic distribution and habitat. *Anauchen huaykhakang* seems to be limited to western Thailand. Our specimens were found on limestone walls at the same habitat of *Hypselostoma khaowongensis* Panha.

Diagnosis. Shell pyramidal, high-spired, with *five apertural barriers* and noticeably *shouldered* ultimate whorl. The shell lacks an angular lamella. The anterior (distal) three-fourths of the ultimate whorl *slopes steeply anteriorly* (basally).

Remarks. *Anauchen huaykhakang* appears to be similar is all respects to *A. massageri,* except in the form of its last whorl, which, in A. *huaykhakang,* has a strong shoulder. Also, the ultimate whorl of *A. huaykhakang* slopes steeply anteriorly. *Anauchen massageri* is portrayed as having an evenly rounded body

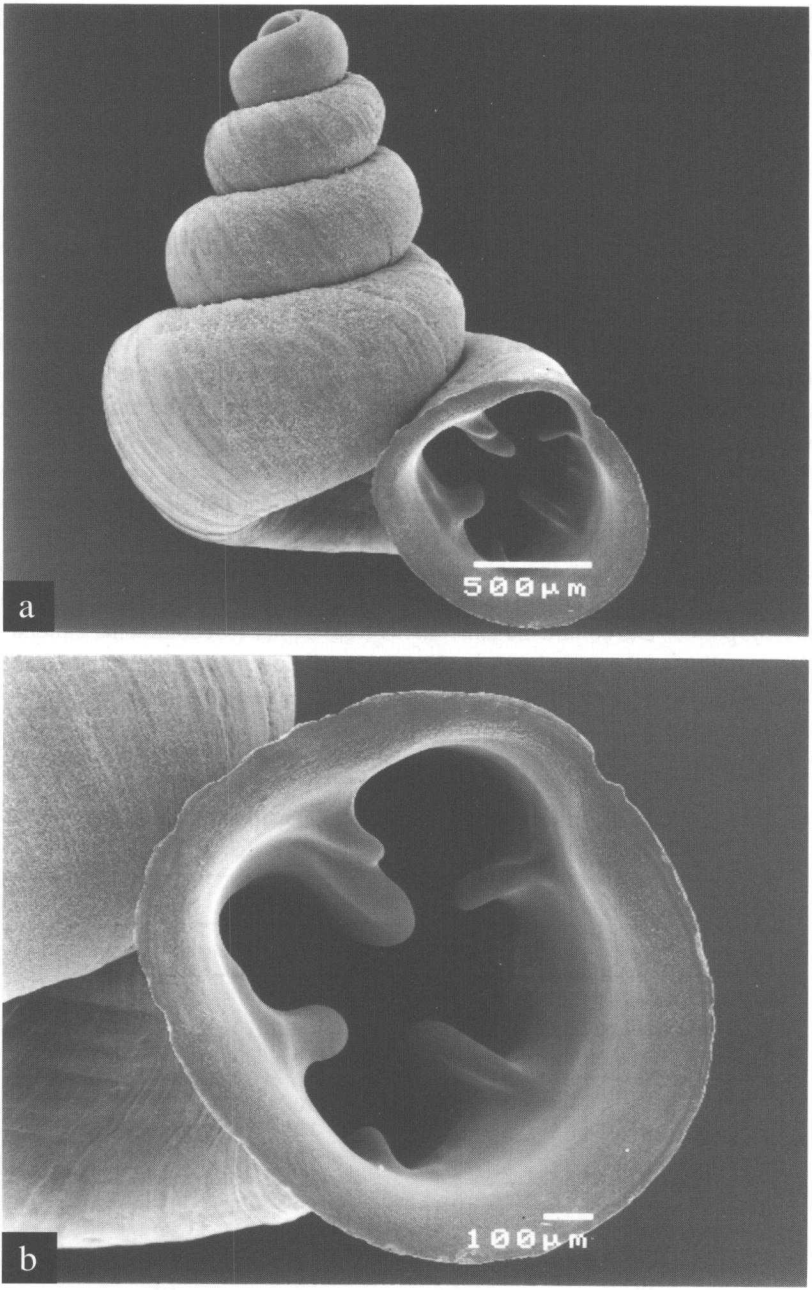

FIG. 3. *Anauchen utaithaniensis*, holotype. **a**, Apertural view; **b**, aperture enlarged.

whorl (Bavay & Dautzenberg, 1903, pl. 9, figs. 1-4; Pilsbry, 1917, pl. 33, fig. 4). We believe that this marked difference in whorl shape is a good species character.

Anauchen utaithaniensis Panha n. sp.

Description of holotype. Shell (Fig. 3) 2.4 mm high and 2.0 mm wide, with 4 ¾ whorls. (Shell measurements of a type series are given in Table 2). The last whorl is shouldered, and is about twice as high as the penultimate whorl. The spire is elongated, more or less straight-sided in peripheral view. The sutures are well impressed. The umbilicus is open, and deep. The peristome is complete, expanded, and separated from the last whorl. The teleoconch is sculptured with transverse growth lines; spiral striae are not evident, except on the shell in the umbilical area, which has prominent spiral indented striae. The main apertural barriers are five, well developed, set back in the aperture from the peristome. The parietal lamella, the most prominent of the barriers, is bifid, with the smaller part in front (*i.e.*, closest to the aperture). An angular lamella is absent. The columellar lamella enters the aperture perpendicularly (horizontally). There is a low-lying ridge between the columellar lamella and the bend (deflection) in the adjacent peristome. The two palatal plicae are well developed, but a bit thinner than the parietal and columellar lamellae. The basal plica (subcolumellar lamella?) is the smallest of the main barriers. Several small, low, nearly indistinguishable laminations occur between the palatal plicae, and between the lower palatal plica and the basal plica.

Type locality. Patavi Mountain, Utaithani Province, 15°28'20" N, 99°45'17"

TABLE 2. Holotype and paratype dimensions of *Anauchen utaithaniensis* n. sp.

Type	Dimensions (in mm)		
	Height	Width	Height of aperture
Holotype	2.4	2.0	1.2
Paratype number			
1	2.5	2.0	1.3
2	2.5	2.0	1.3
3	2.5	2.0	1.3
4	2.5	2.0	1.3
5	2.5	2.0	1.3
6	2.4	2.0	1.2
7	2.3	1.9	1.2
8	2.3	1.9	1.2
9	2.3	1.9	1.2
10	2.3	1.9	1.2
11	2.3	1.9	1.2

E, 70 meters elevation (CUIZM, Ver 040), Thailand 1997 (leg. S. Panha). (See Fig. 1.)

Etymology. The specific epithet *utaithaniensis* is from the name of Utaithani Province, where the species was found.

Type material. The holotype (CUIZM, Ver 040) is deposited in the Chulalongkorn University Zoological Museum together with six paratype specimens (CUIZM, Ver 041). Another five paratype specimens (CUIZM, Ver 042) will be deposited in the University of Michigan Museum of Zoology (UMMZ), Ann Arbor.

Geographic distribution and habitat. *Anauchen utaithaniensis,* known only from the type locality, may be limited to western Thailand. Our specimens were found on limestone walls in the same habitat as *Hypselostoma khaowongensis* Panha.

Diagnosis. Shell aperture with *five major barriers* (parietal, columellar, palatal (two), and basal), of which the parietal lamella is *bifid.* Additional low, lamellar ridges (plicae) occur deeper within the palatal aperture. The ultimate whorl is *moderately shouldered.*

Remarks. The parietal tooth is peculiarly bifid, but it is not concrescent. *Anauchen utaithaniensis* differs from both *A. massageri* and *A. huaykhakang* by its bifid parietal tooth and additional low interpalatal and infrapalatal plicae. The ultimate whorl of *A. utaithaniensis* is more anteriorly sloped than that of *A. massageri,* but less sloped than that of *A. huaykhakang. Anauchen utaithaniensis* has a shorter, less attenuate spire than that of *A. chedi.*

Anauchen angthongense Panha n. sp.

Description of holotype. Shell (Fig. 4) ovate-conic, 3.1 mm high and 2.1 mm wide, with 4 ½ inflated whorls. (Shell measurements of a type series are given in Table 3.) The spire is straight to slightly convex in silhouette. The peripheries of the whorls are round, the sutures between the whorls are well impressed. The umbilicus is very narrow. The peristome is complete, expanded, and weakly adnate. The teleoconch is sculptured with spiral striae (threads) and transverse growth striae. Some of the transverse striae are more pronounced than the rest, appearing almost like widely-spaced, low ribs. The aperture has five barriers, all prominent, although the basal plica is noticably smaller than the rest, *i.e.,* the parietal, columellar and two palatal barriers. The parietal lamella is the largest barrier in the aperture. Its distal half or more is curved slightly toward the columella. The upper and lower palatal plicae are of about equal prominence. At the base and in front of the upper palatal plica is a small protuberance. Additionally, there is a very low, obsolete, infraparietal swelling on the parietal wall.

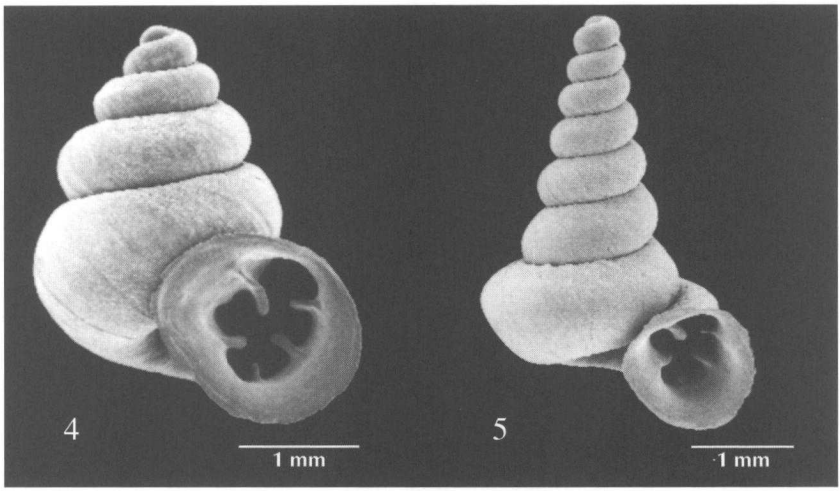

FIG. 4. *Anauchen angthongense,* holotype. Apertural view. FIG. 5. *Anauchen chedi* (Panha), paratype. Apertural view.

Type locality. Angthong National Park, Surathani Province, Thailand, 9°38'6" N, 99°41'16" E, 60 meters elevation (CUIZM, Ver 073), Thailand (leg. S. Panha). (See Fig. 1.)

Etymology. The specific epithet *angthongense* is from the name of Angthong National Park, Ko Angthong, the locality of the snail.

Type material. The holotype (CUIZM, Ver 073) is deposited in the Chulalongkorn University Zoological Museum together with nine specimens (CUIZM, Ver 074). Six other paratype specimens (CUIZM, Ver 075) will be deposited in the University of Michigan Museum of Zoology, Ann Arbor.

Geographic distribution and habitat. *Anauchen angthongense* is known only from its type locality in southern Thailand. The specimens were found on limestone walls. *Gyliotrachela khaochongensis* Panha was found at the same habitat.

Diagnosis. Shell *ovate-conic, narrowly umbilicate,* with a *slightly convex spire* and *rounded whorls*. The peristome is expanded, and *adnate*. Aperture with *five, well-developed barriers:* parietal, columellar, palatal (two), and basal.

DISCUSSION

The genus *Anauchen* was erected by Pilsbry (1917) for species that did not fit into his diagnostic scheme for the other genera of Asian Pupillidae *s. lat.* that had well-developed apertural barriers ("teeth"), *i.e.,* the genera *Boysidia, Gyliotrachela, Hypselostoma* and *Paraboysidia*. Whereas the other genera have

TABLE 3. Holotype and paratype dimensions of *Anauchen anthongense* n. sp.

Type	Dimensions (in mm)		
	Height	Width	Height of aperture
Holotype	3.1	2.1	1.5
Paratype number			
1	3.1	2.1	1.5
2	3.1	2.1	1.5
3	3.0	2.0	1.5
4	3.0	2.0	1.5
5	3.0	2.0	1.5
6	2.8	2.0	1.4
7	2.8	2.0	1.4
8	2.8	2.0	1.4

two lamellae on the parietal wall of the shell aperture (albeit concrescent in *Boysidia* and *Hypselostoma*), *Anauchen* has only one. In *Anauchen,* the angular lamella is absent. Pilsbry's (*loc. cit.,* p. 188) description of *Anauchen* follows.

> The shell is umbilicate, pyramidal, light-colored and spirally striate, the last whorl scarcely or not ascending and *not free*. The aperture is rounded, oblique, the peristome broadly expanded but thin, shortly adnate above. *No angular lamella*; parietal and columella lamellae developed, the latter horizontal; 0-3 plicae in the lip.
>
> Type *H. gereti* (B. & D.).
>
> This group is peculiar for having lost the angular lamella, leaving a simple parietal. Except in *H. messageri,* the other teeth are more less completely degenerate. I do not know whether *A. rochebruni* and *angulina* are spirally striate or not. All but the last are from Tonkin.
>
> This group is related to *Hypselostoma* by the spiral sculpture but differs by having no angular lamella, and the last whorl is adnate. This last is not a very important difference, and one which may perhaps disappear with future discoveries. I do not think it is closely related to *Boysidia.*

In Pilsbry's time there were only four known species for his new genus, three species in Vietnam and one in southern China. Pilsbry divided the four species into two groups of two, based on the shape of the last whorl – swollen but not angular for *Anauchen gereti* (Bavay & Dautzenberg 1903) and *A. massageri* (Bavay & Dautzenberg 1903), and "somewhat angular at periphery and umbilicus" for *A. angulinus* (Gredler 1885) and *A. rochebruni* (Mabille 1887). He separated the four species by their number of teeth, "five well-developed teeth" for *A. messageri,* "three small teeth" for *A. gereti,* "two teeth" for *A. rochebruni,* and "a parietal tooth only" for *A. angulinus.*

Based on apertural-tooth criteria for generic assignment of species, an additional species from Thailand should be added to the genus *Anauchen, i.e.,*

"Hypselostoma" chedi Panha, which has four apertural barriers "arranged opposite each other" (Panha, 1997) [indicating a parietal lamella, a columellar lamella, and two palatal plicae] (see Fig. 5). *Anauchen chedi* has an ultimate whorl periphery like that of *A. huaykhakang, i.e.,* strongly shouldered, with an anteriorly tapering I periphery. *Anauchen chedi* is easily distinguished from the other known Thai species of the genus by its long, narrow spire and many (7 ¾) whorls. *Anauchen chedi* was found at the Tebpratan Nature Reserve, Kampangpet Province (see Fig. 1).

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