LAND SNAILS

OF

THE UNIVERSITY OF MICHIGAN
BIOLOGICAL STATION AREA

J. B. Burch and Younghun Jung

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from

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LAND SNAILS OF THE UNIVERSITY OF MICHIGAN BIOLOGICAL STATION AREA, NORTHERN LOWER PENINSULA, MICHIGAN

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LAND SNAILS OF THE UNIVERSITY OF MICHIGAN BIOLOGICAL STATION AREA, NORTHERN LOWER PENINSULA, MICHIGAN

INTRODUCTION

The purpose of this publication is to describe the land Mollusca (snails and slugs) of The University of Michigan Biological Station (UMBS) area, i.e., the northern portion of the Lower Peninsula of Michigan. As considered here, this area comprises the three northern-most counties of the Lower Peninsula, i.e., Emmet, Cheboygan and Presque Isle counties (Fig. 1). This is an area of nearly 2,200 square miles, bordered on the west by Lake Michigan, on the north and east by the Straits of Mackinac and Lake Huron, and on the south by Charlevoix, Otsego, Montmorency and Alpena counties. The climax vegetation of the area consists mainly of Northern

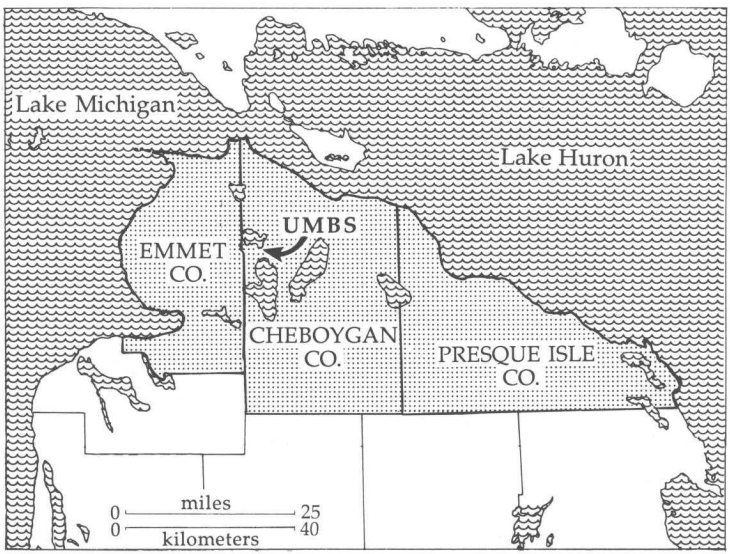

FIG. 1. Map of the northern end of the lower peninsula of Michigan.

Hardwoods, Pine, and Conifer Bog and Swamp communities. For land snails, the first, the Northern Hardwoods Community, is of particular significance. These communities provide mesic conditions and nutrient-adequate habitats.

In Pine communities, the soil is sandy, often dry, acid and poor in nutrients, all unfavorable circumstances for land snails. Conifer Bog and Swamp Communities are generally considered poor habitats for land snails, due to conifers and bog shrubs, the high water tables, and the acid and calcium-poor conditions. However, in this area some snails occur in such habitats, and a few species thrive there.

There are a few published records of land snails of the three counties under consideration. The records below come mostly from our own collecting in the area and the specimens housed in the Museum of Zoology, The University of Michigan.

OUTLINE OF CLASSIFICATION AND LIST OF SPECIES

Subclass Pulmonata Cuvier 1817
Order Acteophila Férussac [Basommatophora Keferstein, in part]
Superfamily Auriculoidea Férussac 1821
Family CARYCHIIDAE Jeffreys 1829
Genus ***Carychium*** Müller 1774[1] (*Carychium minimum* Müller)[2]
C. exiguum (Say 1822)
C. exile exile H.C. Lea 1842
C. exile canadense Clapp 1906
Order Geophila Férussac 1812 (= Stylommatophora Schmidt 1856)
Suborder Orthurethra Pilsbry 1900
Superfamily Cochlicopoidea Pilsbry 1900
Family COCHLICOPIDAE Pilsbry 1900 [Cionellidae Clessin 1879]
Genus ***Cochlicopa*** Férussac 1821 [= *Cionella* Jeffreys 1829] (*Helix lubricus* Müller)
C. lubrica (Müller 1774)
C. morseana (Doherty 1878)

---

[1]The genera in each family and subfamily, and subgenera and species in each genus, are listed in alphabetical order.

[2]Type species are placed in parentheses after each generic-group name.

Superfamily Pupilloidea Turton 1831
Family VALLONIIDAE Morse 1864
Genus ***Planogyra*** Morse 1864 (*Helix asteriscus* Morse)
P. asteriscus (Morse 1857)
Genus ***Vallonia*** Risso 1826 (*Vallonia rosalia* Risso = *Helix costata* Müller)
V. costata (Müller 1774)
V. excentrica Sterki 1893
V. pulchella (Müller 1774)
Genus ***Zoogenetes*** Morse 1864 (*Helix harpa* Say)
Z. harpa (Say 1824)
Family PUPILLIDAE Turton 1831
Subfamily PUPILLINAE *s.s.*
Genus ***Pupilla*** Leach (in Fleming) 1828 (*Pupa marginata* Draparnaud = *Turbo muscorum* Linnaeus)
P. muscorum (Linnaeus 1758)
Subfamily GASTROCOPTINAE Pilsbry 1918
Genus ***Gastrocopta*** Wollaston 1878 (*Pupa acarus* Benson)
Subgenus *Albinula* Sterki 1892 (*Pupa contracta* Say)
G. armifera (Say 1821)
G. contracta (Say 1822)
Subgenus *Vertigopsis* Sterki 1893 (*Pupa curvidens* Gould)
G. pentodon (Say 1821)
G. tappaniana ("Ward" C.B. Adams 1842)
Subfamily VERTIGININAE Pilsbry 1918
Genus ***Columella*** Westerlund 1878 (*Pupa inornata* Michaud)
C. edentula (Draparnaud 1805)
Genus ***Vertigo*** Müller 1774 (*Vertigo pusilla* Müller)
V. elatior Sterki 1894
V. gouldi gouldi (Binney 1843)
V. gouldi paradoxa Sterki (in Nylander) 1900
V. nylanderi Sterki 1909
V. ovata Say 1822
V. ventricosa (Morse 1865)
Family STROBILOPSIDAE Pilsbry 1918
Genus ***Strobilops*** Pilsbry 1893 (*Helix labyrinthica* Say)
S. affinis Pilsbry 1893
S. labyrinthica (Say 1817)

Suborder Heterurethra Pilsbry 1900
Superfamily Succinoidea Beck 1837
Family SUCCINEIDAE Beck 1837
Genus ***Catinella*** Pease 1871
C. avara (Say 1824)
Genus ***Oxyloma*** Westerlund 1885 (*Succinea hungarica* Hazay)
O. retusa (Lea 1834)
Genus ***Succinea*** Draparnaud 1801 (*Helix putris* Linnaeus)
S. ovalis Say 1817
Suborder Sigmurethra Pilsbry 1900
Infraorder Holopodopes H.B. Baker 1962
Superfamily Rhytidoidea Pilsbry 1895
Family HAPLOTREMATIDAE Baker 1925
Genus ***Haplotrema*** Ancey 1881 (*Selenites duranti* Newcomb)
H. concavum (Say 1821)
Infraorder Aulacopoda Pilsbry 1896
Superfamily Arionoidea Gray (in Turton) 1840
Family PUNCTIDAE Morse 1864 (Endodontidae auct.)
Subfamily PUNCTINAE Morse 1864
Genus ***Punctum*** Morse 1864 (*Helix minutissimum* Lea)
P. minutissimum (Lea 1841)
Subfamily DISCINAE Thiele 1931
Genus ***Anguispira*** Morse (*Helix alternata* Say)
A. alternata (Say 1817)
Genus ***Discus*** Fitzinger 1833 (*Helix ruderatus* Férussac)
D. cronkhitei (Newcomb 1865)
D. catskillensis (Pilsbry 1898)
Subfamily HELICODISCINAE "Pilsbry" Baker 1927
Genus ***Helicodiscus*** Morse (*Helix lineata* Say = *Planorbis parallellus* Say)
H. parallelus (Say 1821)
H. shimeki Hubricht 1962
Family PHILOMYCIDAE Gray 1847
Genus ***Pallifera*** Morse 1864 (*Philomycus dorsalis* Binney)
P. dorsalis (Binney 1842)
Genus ***Philomycus*** Rafinesque 1820 (*Philomycus flexuolaris* Rafinesque)
P. carolinianus flexuolaris Rafinesque 1820

Family ARIONIDAE Gray (in Turton) 1844
Genus ***Arion*** Férussac 1819 (*Limax ater* Linnaeus)
A. silvaticus Lohmander 1937
A. subfuscus (Draparnaud 1805)
Superfamily Limacoidea Rafinesque 1815
Family LIMACIDAE Rafinesque 1815
Genus ***Deroceras*** Rafinesque 1820 (*Limax gracilis* Rafinesque = *Limax laevus* Müller)
D. laeve (Müller 1774)
D. reticulatum (Müller 1774)
Family VITRINIDAE Fitzinger 1833 (Zonitidae Mörch 1864)
Subfamily VITRININAE *s.s.*
Genus ***Vitrina*** Draparnaud 1801 (*Helix pellucida* Müller)
V. limpida Gould 1850
Subfamily GASTRODONTINAE Tryon 1866
Genus ***Striatura*** Morse 1864 (*Helix milium* Morse)
Subgenus *Striatura s.s.*
S. milium (Morse 1859)
Subgenus *Striaturops* Baker 1928 (*Striatura ferrea* Morse)
S. ferrea Morse 1864
Subgenus *Pseudohyalina* Morse 1864 (*Helix exigua* Stimpson)
S. exigua (Stimpson 1850)
Genus ***Zonitoides*** Lehmann 1862 (*Helix nitidus* Müller)
Subgenus *Zonitellus* H.B. Baker (*Helix arboreus* Say)
Z. arboreus (Say 1817)
Subgenus *Zonitoides s.s.*
Z. nitidus (Müller 1774)
Subfamily ZONITINAE Mörch 1864
Genus ***Glyphyalinia*** Martens 1892 (*Helix indentata* Say)
Subgenus *Glyphyalinia s.s.*
G. indentata (Say 1823)
Subgenus *Glyphyalops* H.B. Baker 1928 (*Vitrea rhoadsi* Pilsbry)
G. rhoadsi (Pilsbry 1899)
Subgenus *Glyphyalus* H.B. Baker 1928 (*Glyphyalina burringtoni* Pilsbry)
G. wheatleyi (Bland 1883)

Subgenus *Perpolita* H.B. Baker 1928 (*Helix hammonis* Ström = *Helix electrina* Gould)
G. binneyana (Morse 1864)
G. electrina (Gould 1841)
Genus ***Hawaiia*** Gude 1911 (*Helix kawaiensis* Pfeiffer = *Helix minuscula* Binney)
H. minuscula (Binney 1840)
Genus ***Oxychilus*** Fitzinger 1833 (*Helix cellarius* Müller)
O. cellarius (Müller 1774)
Genus ***Paravitrea*** Pilsbry 1898 (*Helix capsella* Gould)
Subgenus *Paravitreops* Baker 1928 (*Helix multidentata* Binney)
P. multidentata (Binney 1840)
Family EUCONULIDAE Clessin 1879 (Helicarionidae Bourguignat 1883, emend.)
Genus ***Euconulus*** Reinhardt 1883 (*Helix fulva* Müller)
Subgenus *Euconulops* H.B. Baker 1928 (*Conulus chersinus polygyratus* Pilsbry)
E. chersinus (Say 1821)
Subgenus *Euconulus s.s.*
E. fulvus (Müller 1774)
Infraorder Holopoda Pilsbry 1896
Superfamily Mesodontoidea Tryon 1866
Family MESODONTIDAE Tryon 1866 (Polygyridae Pilsbry 1895)
Subfamily MESODONTINAE *s.s.*
Genus ***Mesodon*** Rafinesque (in Férussac) 1821 (*Helix thyroidus* Say)
Subgenus *Appalachina* Pilsbry 1940 (*Polygyra sayanus* (Pilsbry)
M. sayanus (Pilsbry 1906)
Subgenus *Mesodon s.s.*
M. thyroidus (Say 1817)
Genus ***Stenotrema*** Rafinesque 1819 (*Stenotrema convexa* Rafinesque = *Helix stenotrema* Pfeiffer)
Subgenus *Euchemotrema* Archer 1939 (*Helix monodon* Rackett 1821 = *Helix leai* Binney 1840)
S. fraternum (Say 1824)
S. leai (Binney 1840)

Subfamily TRIODOPSINAE Pilsbry 1940
Genus ***Triodopsis*** Rafinesque 1819 (*Triodopsis lunula* Rafinesque = *Helix tridentata* Say)
Subgenus *Neohelix* Ihering 1892 (*Helix albolabris* Say)
T. albolabris (Say 1817)
T. multilineata (Say 1821)

IDENTIFICATION KEY TO THE FAMILIES AND HIGHER TAXA IN THE UMBS AREA

1 Head of animal with one pair of contractile tentacles, with eyes at their bases (Fig. 2, a); shell very small to minute, less than 3 mm in length, elongate (but not pupa-shaped; see Fig. 4), translucent white; shell aperture with a reflected or expanded lip (Figs. 3, a; 108, b, c); entire columella inside shell with a lamella (Fig. 3, b). Order **Acteophila**.....CARYCHIIDAE (p. 17)

Head with two pairs of invaginable tentacles, with eyes at the tips of the upper pair (Fig. 2, b); shell, when present, of various shapes (see Fig. 4), but if elongate, then the shells are 5 mm or more in length, yellowish-corneous to brown in color, have unreflected lips and the internal columellae lack lamellae. Order **Geophila** 2

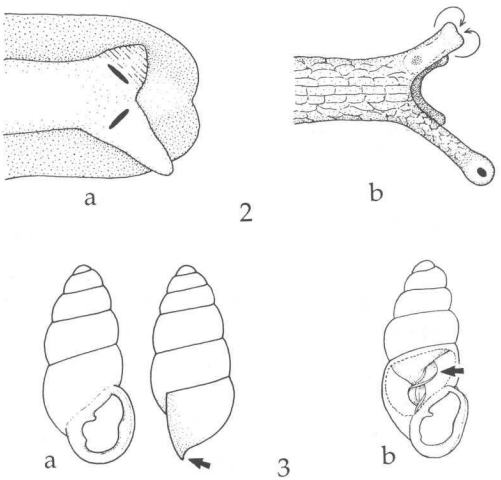

FIG. 2. **a**, Head with one pair of contractile tentacles, eyes at their bases; **b**, head with two pairs of invaginable tentacles, eyes at the tips of the upper pair. FIG. 3. **a**, Shell with an expanded lip; **b**, shell with a lamella on the columella (from Winslow, 1922, *Occ. Pap. Mus. Zool. Univ. Mich.*, (128): 1-17).

2(1) Shell elongate, succiniform (Fig. 4, a), very thin, with large aperture, its length more than half the shell length. Suborder **Heterurethra** ..... SUCCINEIDAE (p. 68)

Shell, when present, of various shapes (see Fig. 4, b-g), but not succiniform; aperture less than half the shell length 3

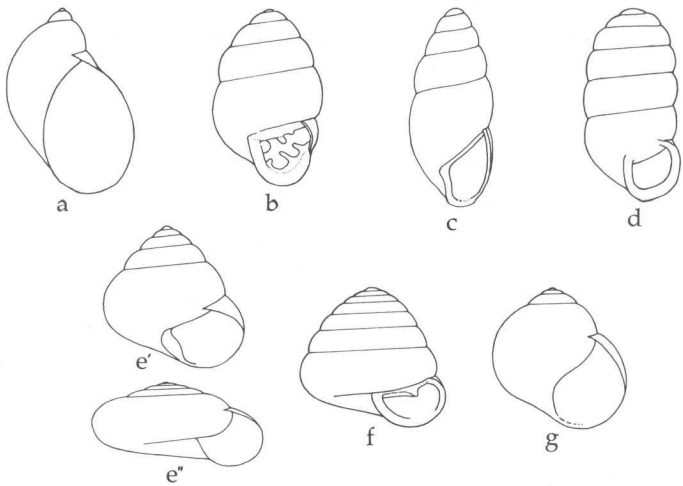

FIG. 4. Shell shapes. **a**, succiniform; **b**, pupa-shaped; **c**, spindle-shaped; **d**, cylindrical; **e'**, heliciform; **e"**, depressed heliciform; **f**, dome shaped; **g**, globose.

3(2) Shell rather small, less than 8 mm in length, elongate or depressed; pupa-shaped, spindle-shaped or cylindrical (Fig. 4, b-d), or, when heliciform (Fig. 4, e', e") or dome-shaped (Fig. 4, f), usually having either ribs (see Fig. 109) or a reflected lip (see Fig. 108, c). Suborder **Orthurethra** 4

Shell minute to large, wider than high, heliciform (Fig. 4, e', e") (not pupa-shaped, spindle-shaped or cylindrical); generally without ribbing, and if dome-shaped (Fig. 4, f), then without a reflected lip (see Fig. 108, c). Suborder **Sigmurethra** 7

4(3) Shell pupa-shaped (Fig. 4, b) or cylindrical (Fig. 4, d) with reflected lip (see Fig. 108, c)....PUPILLIDAE (p. 41)

Shell spindle-shaped, cylindrical (lip not reflected), dome-shaped, globose or heliciform (Fig. 4, c-g).....5

5(4) Shell spindle-shaped or cylindrical (Fig. 4, c, d), imperforate (see Fig. 107, a), very glossy ....COCHLICOPIDAE (p. 27)

Shell dome-shaped, globose or heliciform (Fig. 4, e-g), perforate or umbilicate (see Fig. 107, b-d), dull to moderately glossy.....6

6(5) Shell with one or more lamellae in the aperture; usually dome-shaped (Fig. 4, f), and with rather stout ribs; usually dark brown or reddish-brown .... STROBILOPSIDAE (p. 62)

Shell without lamellae in the aperture; usually depressed heliciform (Fig. 4, e"), but without ribs or with only very thin ribs when globose; usually olive-brown, olive-green, light brown, tan or white in color..... .....VALLONIIDAE (p. 31)

7(3) Pedal grooves of the foot conspicuous and well above the angle of the lateral and ventral foot margins (Fig. 5, a); with or without external shell; when the shell is present, its aperture lip is not reflected (see Fig. 108). Infraorder **Aulacopoda** 8

Pedal grooves of the foot inconspicuous and in or close to the angle of the lateral and ventral foot margins (Fig. 5, b); shell always present; aperture lip may or may not be reflected (see Fig. 108). Infraorders **Holopodopes** and **Holopoda**.....11

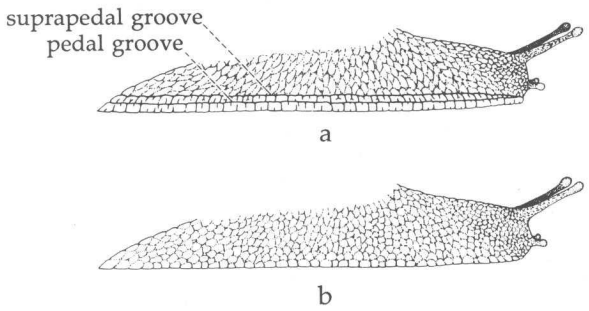

FIG. 5. **a**, Aulacopod foot; **b**, holopod foot.

8(7) Animals slug-like, external shells lacking (Fig. 6)..... . PHILOMYCIDAE, ARIONIDAE, LIMACIDAE (p. 142)

Animals with well developed external shells 9

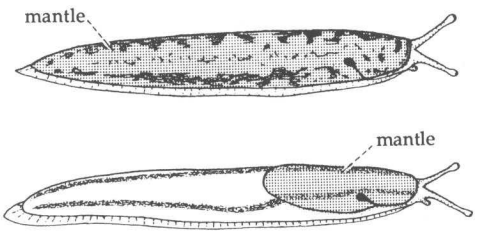

FIG. 6. Michigan slugs.

9(8) Shell usually opaque, generally dull and with prominent growth lines or low ribs, umbilicate to widely umbilicate (see Fig. 107), brown, reddish-brown, tan or almost white, one species with darker reddish color markings ..... PUNCTIDAE (p. 78)

Shell usually translucent, glossy, smooth or without prominent growth lines or ribs, narrowly umbilicate, perforate or occasionally imperforate (see Fig. 107), white or light tan-colored to dark olive-brown, often containing some tint of green, but without reddish patches or bands 10

10(9) Shell dome-shaped (Fig. 4, f).....
.....EUCONULIDAE (p. 124)

Shell depressed heliciform (Fig. 4, e") .....
..... VITRINIDAE (p. 92)

11(7) Shell widely umbilicate, greenish-yellow to white in color; aperture lip not reflected. Infraorder **Holopodopes**
..... HAPLOTREMATIDAE (p. 76)

Shell narrowly umbilicate or imperforate (see Fig. 107), tan to brown.....MESODONTIDAE (p. 128)

LAND SNAILS OF THE UNIVERSITY OF MICHIGAN BIOLOGICAL STATION AREA

SNAILS WITH EXTERNAL SHELLS

Family CARYCHIIDAE

The mainly aquatic pulmonate order Acteophila has one inland family in North America, the Carychiidae, a small, widely distributed group of snails with minute shells (1.2 - 2.7 mm in length), which are elongate, translucent or whitish and have reflected or expanded apertural lips. The columella has a lamella, which is visible through translucent juvenile and adult shells. The end of this lamella appears as a small tooth on the parietal wall of the shell aperture. Like the lymnophile snails, the eyes of carychiid snails are sessile at the bases of the single pair of contractile tentacles (Fig. 7). Only

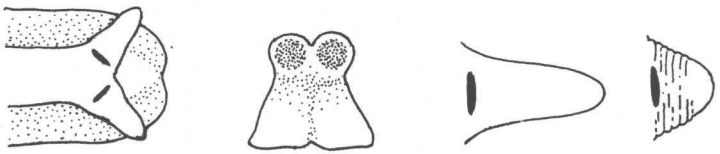

FIG. 7. *Carychium*, a, Dorsal view of head; b, frontal view of head; c, uncontracted and contracted tentacles.

one genus, *Carychium*, is found in the United States. The other genera in the family are *Coilostele* of the Pánuco River Valley in eastern Mexico, southern Europe, Abyssinia, India and Timor, *Zospeum* of the Balkan Peninsula, and *Carychiopsis* of the European Tertiary.

Genus *Carychium* Müller

The genus *Carychium* occurs in North America, the West Indies, Eurasia, Indonesia and the Philippines. In North America, *Carychium* has several or more species, but their

taxonomy is still somewhat confused. Several nominal species seem to be clearly distinct, yet others are difficult to distinguish, in spite of seemingly contrary statements in the literature. The various species usually frequent moist to wet places, often rotting logs or decaying leaves. In the UMBS area, three nominal forms have been recorded, *C. exile, C. exile canadense* and *C. exiguum.*

There is difficulty in separating *Carychium exiguum, C. exile exile* and *C. exile canadense,* a problem that has been considered in some detail by Harry (1951, p. 61, ff.)[3]. Harry (Table 1) found two extremes in shell characters of *Carychium* in Michigan, extremes that "are based on a combination of characters and fit rather closely the concepts of *C. exiguum* and *C. exile canadense* as now generally accepted; ... the characters which distinguish them are mostly relative. They do not seem to segregate independently. ... *C. exile* falls into this graded series somewhere near the *C. exile canadense* extreme. We may ... suppose that each colony has a gene pool which may differ from that of another colony in some respects. Possibly few, if any, colonies have a complete complement of genetic factors to be found in all colonies of the area. The variation of effective environmental factors may further complicate the situation by evoking different phenotypes from similar genotypic potentialities. ... Whether these species [and subspecies, i.e., *C. exiguum, C. exile exile* and *C. exile canadense*] are only nominal or represent valid genetic distinctions, and thus are biological, is the significant problem. Its ultimate solution seems to require an investigation of the dynamic aspects of *Carychium* biology beyond those touched upon in this and previous studies." Harry (1952, *Nautilus,* 66(1), p. 6) concluded "... that criteria previously used for distinguishing nominal species [of *Carychium*] in this area [Michigan] are not sufficient for recognizing more than one natural species." Further studies going more deeply into this problem have not been published. Accordingly, some authors (e.g., Burch, 1962, pp. 41, 188) have not treated *C. exile exile* and *C. exile canadense* as being distinct from *C. exiguum.* Nevertheless, in spite of some doubt

[3]Literature citations are given for authors cited in the text but not included in the References section (p. 173). Complete literature citations are not repeated in the text for those publications listed in the References.

TABLE 1. Extremes in variation in Michigan *Carychium* (from Harry, 1951, p. 63).

C. exiguum	*C. exile canadense*
Shell Form	
Ovate-conic, the diameter being broader in proportion to the height.	Cylindric, the diameter being narrower in proportion to the height.
Whorls	
Rounded.	Flattened.
Sculpture	
Transverse striae indefinite, weak, discontinuous, sparse.	Transverse striae strong, regular, closely spaced.
Upper Lamella [see Fig. 8]	
Upper lamella S-sinuate, curving first down (near the aperture) then up.	Upper lamella V-sinuate, which seems to be an overemphasis of the downward flexure of the S-sinuate lamella of the other extreme.
Sinuosity occurs about 3/4 whorl inward from the aperture.	Sinuosity occurs closer to 1 whorl inward from the aperture.
Lower Lamella [see Fig. 8]	
Slightly expanded at about the position of maximum flexure of the upper lamella; expansion tending to an equidimensional node.	Expanded also at the position of maximum flexure of the upper lamella, but distinctly quadrate, longer than broad.
Resorption	
Resorption of internal whorls begins about 1 3/4 whorls from the aperture.	Resorption of internal whorls begins about 2 1/4 whorls from the aperture.

Number of Whorls	
About 4 suture whorls.	About 4 1/2 to 5 suture whorls.
Size	
Smaller	Larger

as to the validity of certain nominal species, we are treating them individually in the key on *Carychium* which follows, since many of the reports on distribution of *Carychium* in the United States recognize the questionable forms as being distinct. Obviously, the genus *Carychium* in North America needs much more study.

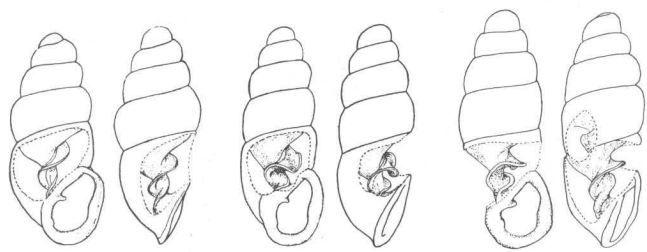

FIG. 8. Parietal lamellae of *Carychium*. **a**, *C. exiguum*; **b**, *C. exile exile*; **c**, *C. exile canadense*. (From M.L. Winslow, 1922, *Occ. Pap. Mus. Zool. Univ. Mich.*, (128); Harry, 1951).

Key to the Forms of *Carychium* in the UMBS Area

1 Shell without rib-striae, or striae weak and irregular; parietal lamella (also called upper lamella, superior lamella, principal internal lamella or upper columellar fold) within the last whorl not deflected sharply downward (Figs. 8, a; 9) ..... *C. exiguum* (p. 21)

Shell, especially the last several whorls, sculptured with relatively strong, evenly spaced transverse rib-striae; parietal lamella bent sharply downward.....2

2(1) Shell less elongate, averaging only 1.75 mm in length (Figs. 8, b; 12)..... *C. exile exile* (p. 25)

Shell more elongate, averaging 2.1 mm in length (Figs. 8, c; 13) ..... *C. exile canadense* (p. 26)

Carychium exiguum (Say)
(Figs. 8, a; 9-11)

Pupa exigua Say 1822, *J. Acad. nat. Sci. Philad.*, 2, p. 375 (Harrigate, Philadelphia)
Carychium exiguum (Say), Walker (1899, p. 25)[4]
Carychium exiguum Say, Walker (1906, p. 522, fig. 166).
Carychium exiguum (Say), Winslow (1926, p. 9, no. 102).
Carychium exiguum (Say), Goodrich (1932, p. 40, fig.)
Carychium exiguum (Say), Pilsbry (1948, p. 1052, figs. 561,a,b; 562).
Carychium exiguum (Say), in part, Burch (1962, pp. 41, 188, fig. 69).
Carychium exiguum (Say), Burch & Patterson (1966, p. 1, fig. 1).
Carychium exiguum (Say), Burch & Van Devender (1980, p. 68, figs. 66, 69, 76, 77, 85, 89, 99).
Carychium exiguum (Say), Hubricht (1985, p. 6, map 17).

Shell: The shell of *Carychium exiguum* is elongate, whitish, minute, measuring 1.5 - 2.5 mm with about 4 1/2 convex whorls. The aperture is generally relatively large, 1/3 or more of the

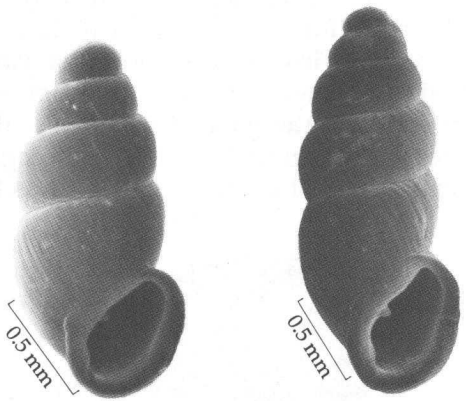

FIG. 9. Shell of *Carychium exiguum;* UMMZ 43761. (Scanning electron microscope [SEM] photographs).

[4]See footnote 3, p. 18.

total length of the shell. G.H. Clapp (cf. M.L. Winslow, 1922, *Occ. Pap. Mus. Zool. Univ. Mich.*, (128), p. 3) pointed out the swollen body whorl, which gives *C. exiguum* a 'bellied' appearance in side view, distinguishing it from *C. exile.* The first several whorls are essentially smooth. The last several whorls are weakly or faintly striate. The upper columellar lamella is S-sinuate, curving first down (near the aperture), then up (Harry, 1951). Winslow (1922, p. 3) described the upper lamella as "small in proportion to the diameter of the last whorl, somewhat sinuate, but never deflected sharply downward."

Remarks: The shell of *Carychium exiguum* is stouter than that of *C. exile exile,* and it is usually smoother, often having only faint growth wrinkles. There is some variation in sculpture, however, some specimens being nearly as strongly striate as *C. exile exile* (Pilsbry, 1948, p. 1054).

The relationship of the nominal species *Carychium exiguum* and *C. exile* to each other is poorly understood, and the two are frequently difficult to separate in spite of statements as to how they are "readily distinguishable," and in spite of a great many publications - mostly distribution lists - which include one or the other or both forms. The only in-depth study of the problem is that of Harry (1951; abstracted in Harry, 1952, *Nautilus,* 66(1), pp. 5-7), an excellently illustrated and unusually detailed (for North American land snails) and penetrating analysis. He concluded "from the variation of the form, size, sculpture, internal lamellae, number of whorls and extent of resorption of the internal lamellae ... that only one natural species [*C. exiguum*] is worthy of recognition in the [Michigan] material." Additionally, nothing was found in the

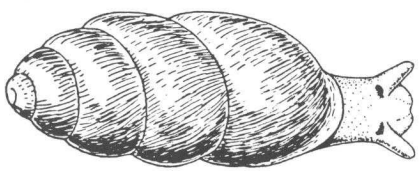

FIG. 10. Animal and shell of *Carychium exiguum.* (From F.C. Baker, 1939, *Handb. Ill. land snails,* Nat. Hist. Surv. Div., Urbana, Ill.)

soft anatomy that could be used to separate the nominal forms. Harry's specimens were from 60 localities and represented the conchological extremes from *C. exiguum (sensu stricto)* to *C. exile canadense.*

Animal: White, more or less transparent, digestive gland light golden in color. The sole of the foot is oval, about three times as long as broad, with parallel, straight sides. The posterior end of the foot is evenly rounded. The anterior end is truncated by a transverse groove separating the sole from the labial palps. The sole is without grooves. The labial palps are about as wide as the sole and one-third as long. The mouth is located in a mid-ventral cleft between the palps. Pedal grooves are absent. A reproductive groove on the right side of the body extends from the pedo-palpal groove to the pneumostome. Otherwise all dorsal parts of the head-foot are entirely smooth, without furrows, nodules or ridges. The single pair of tentacles are circular in cross-section. The body stalk and expanded mantle margin completely fill the shell aperture. The pneumostome is a circular opening at the right posterior part of the mantle close to the anus. A pneumostomal canal leads from the pneumostome to the mantle margin; the canal's anterior and posterior walls are formed by mantle lappets.

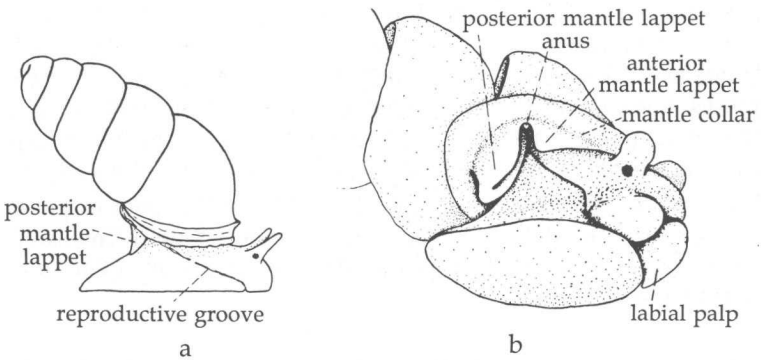

FIG. 11. **a**, Normal crawling position of *Carychium exiguum*; **b**, head-foot of *Carychium exiguum* (from Harry, 1951).

In crawling, the shell is carried with the columellar axis at an angle of about 45° and in a plane with the longitudinal axis of the foot (Fig. 11, a). The shell is continuously moved

forward, during which it is moved slightly from side to side. The anterior end of the foot moves uniformly, but the posterior part is advanced in jerks, possibly indicating the presence of pedal waves. (Harry, 1951, p. 75 ff.).

Habitats: *Carychium exiguum* "prefers very damp places and appears to be able to live for a long time in situations where almost all other land snails would be drowned" (Goodrich, 1932, p. 40). *Carychium exiguum* frequents moss, ferns and plant debris in bog woods (Archer, 1936, p. 14). Harry (1951, p. 17 ff.) found *Carychium* in Michigan to occur always in isolated microhabitats of a few feet maximum dimension, surrounded by unsuitable areas. These microhabitats contain decaying plant material which provides a source of food, shelter, and a constant high moisture content of the leaf mold. *Carychium* was not found in areas which undergo frequent flooding, e.g., floodplains of streams. The microhabitats supporting *Carychium* were found in three general types of associations: Thuja forests, grasslands and hardwood forests.

General Distribution: Eastern North America generally, except for the southern states.

Distribution in UMBS Area: Emmet Co.: Section 27, T39N, R4W, UMMZ 178086[5], 178087, 178088, 178102, 178118, 178125; **Cheboygan Co.**: Hook Point peninsula, North Fishtail Bay, Douglas Lake, Section 32, T3N, R3W, Munro Township, UMBS-86-22[6]; Reeses Swamp, southwest 1/4 of Section 3, Burt Township, T36N, R3W, UMBS-86-11; Reeses Swamp, UMMZ 178082, 178083, 178084, 178085, 178098, 178099, 178100, 178101, 178103; Section 5, T37N, R3W, UMMZ 178119; Section 6, T34N, R1E, UMMZ 178130; Section 10, T34N, R1E, UMMZ 178123; Section 12, T36N R1W, UMMZ 178092; Section 19, T38N, R3W, UMMZ 178131, 178132, 178133; woods pool at public access and park, Maple Bay, Burt Lake, Section 29, Burt Township, T36N, R3W, UMBS-87-1; **Presque Isle Co.**: Section 30, T35N, R5E, UMMZ 178094.

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[5]Lot catalogue number of the Mollusk Division, Museum of Zoology, The University of Michigan.

[6]Our own collecting localities are followed by their consecutive collection numbers, each prefaced by UMBS-86- or UMBS-87- .

Carychium exile exile Lea
(Figs. 8, b; 12)

Carychium exile H.C. Lea 1842, *Am. J. Sci. Arts*, 42, p. 109, pl. 1, fig. 5.
Carychium exile H.C. Lea, Walker (1899, p. 25).
Carychium exile H.C. Lea, Walker (1906, p. 523, fig. 167).
Carychium exile H.C. Lea, Winslow (1926, p. 9, no. 103).
Carychium exile H.C. Lea, Goodrich (1932, p. 40).
Carychium exile H.C. Lea, Archer (1936, p. 14).
Carychium exile H.C. Lea, Pilsbry (1948, p. 1058, figs. 561,c; 566,a).
Carychium exiguum (Say), in part, Burch (1962, pp. 41, 188).
Carychium exile Lea, Burch & Van Devender (1980, p. 75, figs. 81, 91, 100).
Carychium exile exile H.C. Lea, Hubricht (1985, p. 5, map 20).

Shell: The shell is minute, measuring 1.7 - 1.9 mm in length with 5 - 5 1/2 whorls. It is generally narrower than that of *Carychium exiguum*, has a smaller aperture and is usually more strongly and regularly striate. However, like *C. exiguum*, the shell may vary considerably.

Remarks: "A further difference [from *Carychium exiguum*] is that in *C. exile* the last whorl is built forward so that, in a profile view of the aperture, the lip is even with the ventral convexity of the last whorl. In *C. exiguum* the belly of the last whorl projects decidedly beyond the plane of the aperture. By this peculiarity the occasional striate specimens of *C. exiguum* may readily be distinguished from *C. exile*" (Pilsbry, 1948, p. 1058). According to Hubricht (1963, *Nautilus*, 76(3), p. 109), the best distinguishing character to separate *C. exile* and *C. exiguum* is in the outer lip. "In *C. exiguum* the outer lip is somewhat expanded, but in *C. exile* it is narrowly reflected. This appears to be a constant difference which will stand up when other characters fail." Winslow (1922, *Occ. Pap. Mus. Zool. Univ. Mich.*, (128), pp. 3-4) advocated using the upper columellar lamella to distinguish *exile* from *exiguum* in case other shell characters were not adequate to do so. "The deflection downward of the upper fold [in *C. exile*] is a very marked characteristic. ... The upper columellar fold is very large in proportion to the diameter of the last whorl, almost touching the wall of the last whorl at the upper angle of the aperture. Typically it is bent sharply downward at its widest part, the edge turning toward the columella." However, Harry (1951, p. 60) questions the ultimate value of the columellar

might occur after assessing Oughton's (1948, *U. Toronto Stud.*, biol. ser., 57, pp. 78, 79) and S.T. Brooks & G. M. Kutchka's (1937, *Ann. Carnegie Mus.*, (25), pp. 157-159) accounts of variation found in the columellar folds.

Animal: Identical to *Carychium exiguum* (see p. 17).

Habitats: See *Carychium exiguum* (p. 18).

General Distribution: Eastern North America generally, except for Florida and Texas.

Distribution in UMBS Area: **Emmet Co.**: Petoskey, UMMZ 116273; **Cheboygan Co.**: Reeses Swamp, southwest 1/4 of Section 3, Burt Township, T36N, R3W, UMBS-86-11; Douglas Lake, UMMZ 116291.

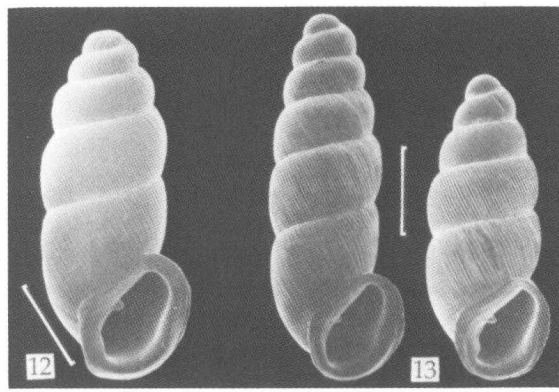


FIG. 12. Shell of *Carychium exile exile;* UMMZ specimen. FIG. 13. Shells of *C. exile canadense;* UMMZ 43767. (SEM Photographs). Measurement lines = 0.5 mm.

Carychium exile canadense Clapp
(Figs. 8, c; 13)

Carychium exile canadense Clapp 1906, *Nautilus*, 19, p. 139, pl. 8, figs. 1, 2, 6, 7.
Carychium exile canadense Clapp, Walker, (1906, p. 523, fig. 168).
Carychium exile canadense Clapp, Winslow (1926, p. 9, no. 104).
Carychium exile canadensis Clapp, Goodrich (1932, p. 40).
Carychium exile canadense Clapp, Pilsbry (1948, p. 1059, figs. 561,d, 566,b).
Carychium exiguum (Say), in part, Burch (1962, pp. 41, 188).
Carychium exile canadense Clapp, Burch & Van Devender (1980, p. 75, Figs. 82, 83, 103, 104).
Carychium exile canadense Clapp, Hubricht (1985, p. 5, map 21).

Shell: The shells of *Carychium exile canadense* are larger than those of *C. exile exile* (i.e., averaging 2.1 x 0.75 mm vs. 1.75 x 0.6 mm, according to G.H. Clapp 1906, *Nautilus*, 19, p. 139).

Animal: Identical to *Carychium exiguum* (see p. 23).

Habitat: See *Carychium exiguum* (p. 24).

General Distribution: Northern in distribution, Maine to Minnesota, Ontario and Manitoba.

Distribution in UMBS Area: Emmet Co.: beach drift behind sand dunes, shore of Lake Michigan, Wilderness State Park, Section 19, T39N, R5W, UMBS-86-19; **Cheboygan Co.**: woods pool at public access and park, Maple Bay, Burt Lake, Section 29, Burt Township, T36N, R3W, UMBS-87-1; Wolverine, UMMZ 213579.

Family COCHLICOPIDAE

This is a small, Palearctic family, containing the Holarctic genus *Cochlicopa* and two genera restricted to Europe, *Azeca* and *Spelaeoconcha*. The family is closely related to the Amastridae of the Hawaiian Islands, and somewhat more distantly to the Pupillidae. The Cochlicopidae differ from these two families mainly by characters of the shell. Cochlicopids have small shells (5 - 7.5 mm in length), which are elongate, very smooth and glossy, transparent or translucent, and are brown or yellow-brown in color.

Genus *Cochlicopa* Jeffreys

The generic name *Cionella* is often used instead of *Cochlicopa*. This nomenclatural problem has been discussed by A.S. Kennard (1942, *Proc. malacol. Soc. London*, 25, pp. 107, 113) and by Pilsbry (1948, p. 1047); both used *Cionella*, but most malacologists are currently using the older name *Cochlicopa*.

Several cochlicopid species occur in North America. The most common is *Cochlicopa lubrica* (Müller), which has been reported from nearly all of the United States. *Cochlicopa morseana* (Doherty) is also common in many regions. Both species occur in the UMBS area.

Key to Species of *Cochlicopa* in UMBS Area

1 Shell wider, spindle-shaped (Figs. 14, 15).....
.....*C. lubrica* (p. 28)

Shell narrower, more cylindrical in shape (Fig. 16).....
..... *C. morseana* (p. 30)

Cochlicopa lubrica (Müller)
(Figs. 14, 15)

Helix lubricus Müller 1774, *Verm. terr. fluv. ... succ. hist.*, 2, p. 104 (Denmark).
Cochlicopa lubrica (Müller), Walker (1899, p. 18).
Cochlicopa lubrica (Müller), Walker (1906, p. 519, figs. 154-157).
Cochlicopa lubrica (Müller), Winslow (1926, p. 7, no. 50).
Cochlicopa lubrica (Müller), Goodrich (1932, p. 24, fig.).
Cochlicopa lubrica (Müller), Pilsbry (1948, p. 1047, fig. 560,a,b).
Cionella lubrica (Müller), Burch (1962, pp. 43, 189, fig. 73).
Cionella lubrica (Müller), Burch & Patterson (1966, p. 4, fig. 10).
Cochlicopa lubrica (Müller), Hubricht (1985, p. 6, map 24).

Shell: The shells are elongate, spindle-shaped, with unreflected but thickened lips, and lack apertural teeth. Shells of adults are small, 5-7+ mm in length, and have 5 1/2 to 6 whorls. Especially noticeable is the smoothness and high gloss of the shell.

Animal: The foot is rather short, lacking pedal grooves and caudal pore, and the sole is distinctly tripartite. The lung has a reticulation of fine capillaries, but no visible branches on the main pulmonary vein. (Pilsbry, 1948, p. 1046).

Habitat: *Cochlicopa lubrica* lives in leaf mold and under rotting logs in shady hardwood stands (Archer, 1936). It "lives among the damp under-leaves in densely shaded places; under wood, such as old board sidewalks; in chinks of stone walls and under stones. ... They are sometimes found congregating in great numbers on stone or concrete walks. ... Possibly such gatherings are for mating" (Pilsbry, 1948, p. 1049).

General Distribution: United States, except the southern states, and California.

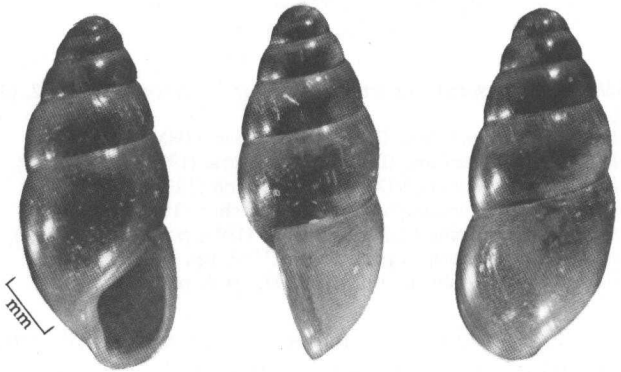


FIG. 14. Shell of *Cochlicopa lubrica*, apertural, side and top views; UMMZ 170597.

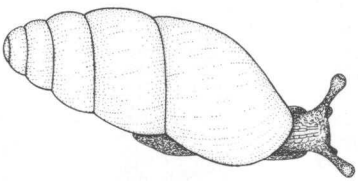


FIG. 15. Animal and shell of *Cochlicopa lubrica*, UMBS-87-19.

Distribution in UMBS Area: Emmet Co.: beside small tributary on the west side of the East Branch of the Maple River, southeastern corner of Section 25, T37N, R4W, McKinley Township, Emmet County, UMBS-86-4; beach drift behind sand dunes, shore of Lake Michigan, Wilderness State Park, Section 19, T39N, R5W, UMBS-86-19; northeast shore of Walloon Lake, Section 30, Bear Creek Township, UMMZ 170718; near Carp River, Section 29, Wawatam Township, UMMZ 170619; Wequetonsing, UMMZ 141633; **Cheboygan Co.**: Cheboygan, UMMZ 141642; east shore of Lancaster Lake, Munro Township, UMMZ 170597; around steps to front entrance, Lakeside Laboratory, UMBS grounds, Douglas Lake, northwest 1/4 of Section 33, T37N, R3W, Munro Township, UMBS-87-3; Milligan Creek, on Michigan Highway 68, UMMZ 170578; **Presque Isle Co.**: Michigan Highway 68a, Section 30, T35N, R5E, UMMZ 178275; Ocqueoc River, 3 miles northeast of Ocqueoc, UMMZ 249445.

Cochlicopa morseana (Doherty)
(Fig. 16)

Cionella (Zua) morseana Doherty 1878, *Quart. J. Conchol.*, 1, p. 342, pl. 4, fig. 2.
Cochlicopa lubrica morseana (Doherty), Walker (1906, p. 519).
Cochlicopa lubrica morseana (Doherty), Winslow (1926, p. 7, no. 51).
Cochlicopa lubrica morseana Doherty, Goodrich (1932, p. 24).
Cochlicopa lubrica appalachicola Pilsbry, Archer (1936, p. 12).
Cionella lubrica morseana Doherty, Pilsbry (1948, p. 1049, fig. 560,c).
Cionella lubrica (Müller), in part, Burch (1962, pp. 43, 189).
Cochlicopa lubrica (Müller), Hubricht (1985, p. 6, map 24).

Shell: The shell of *Cochlicopa morseana* differs from *C. lubrica* by being narrower, more cylindrical, having longer spire whorls and a shorter body whorl, and by the thinner and narrower callous rim of the outer apertural lip.

FIG. 16. Shell of *Cochlicopa morseana;* UMMZ 141515.

Animal: See *Cochlicopa lubrica* (p. 28).

Habitat: "*Cionella* [*Cochlicopa*] ... *morseana* occurs [in Alabama] only in shady and damp places among rocks, especially in clefts where the leaves are not exposed to the sun" (H.H. Smith, in Pilsbry, 1948, p. 1050).

General Distribution: Maine to Minnesota, south to Arkansas and Tennessee.

Distribution in UMBS Area: Emmet Co.: beech maple grove, 8 miles southeast of Bay View, UMMZ 132198; Carp Lake, UMMZ 141632; **Cheboygan Co.**: Grapevine Point, woods pool area, Douglas Lake, Section 28, T37N, R3W, Munro Township, UMBS-86-3; Douglas

Lake Biological Station, UMMZ 57629, 141669; Section 33, T37N, R3W, Grapevine Point, Douglas Lake, UMMZ 232367; hardwoods, 2 miles west of Wolverine, UMMZ 132215; **Presque Isle Co.**: Lake Huron, north edge of Rogers City, UMMZ 170567.

Family VALLONIIDAE

Members of this family are minute to very small snails (shells 1.7 - 3 mm in diameter) with depressed (in most species) or globose (in *Zoogenetes harpa*) shells, which are often sculptured with fine transverse costae. Of the three genera, *Planogyra* and *Zoogenetes* are monotypic. *Vallonia* has seven species in North America, two of which, *V. costata* and *V. parvula*, occur in the UMBS area. *Vallonia* and *Planogyra* are oviparous, *Zoogenetes* is ovoviviparus.

Key to Genera in the UMBS Area

1 Shell strongly depressed, with or without ribs 2

Shell globose, last several whorls with thin periostracal ribs .....*Zoogenetes* (p. 39)

2(1) Shell thin, brownish, sculptured with thin, periostracal ribs; aperture lip thin, not reflected.....*Planogyra* (p. 31)

Shell moderately calcified, rather sturdy, with or without ribs; aperture lip thickened and reflected .... *Vallonia* (p. 34)

Genus *Planogyra* Morse

Named for its planate shape, the shell of this genus superficially looks like *Vallonia*. However, its darker color and the nature of its periostracal ribs easily distinguish *Planogyra*. Two species comprise the genus, *P. asteriscus* of eastern North America, and *P. clappi* of British Columbia, Washington and Oregon.

Planogyra asteriscus (Morse)
(Figs. 17, 18)

Helix asteriscus Morse 1857, *Proc. Bost. Soc. nat. Hist.*, 6, p. 128.
Pyramidula asteriscus (Morse), Walker (1899, p. 22).
Pyramidula asteriscus (Morse), Walker (1906, p. 494, fig. 84).
Planogyra asteriscus (Morse), Winslow (1926; p. 9, no. 83).
Planogyra asteriscus (Morse), Goodrich (1932, p. 37, fig.).
Planogyra asteriscus (Morse), Archer (1936, p. 8).
Planogyra asteriscus (Morse), Pilsbry (1948, p. 1038, fig. 555, a-c).
Planogyra asteriscus (Morse), Burch (1962, pp. 44, 189, fig. 75).
Planogyra asteriscus (Morse), Burch & Patterson (1966, p. 6, fig. 13).
Planogyra asteriscus (Morse), Hubricht (1985, p. 7, map 32).

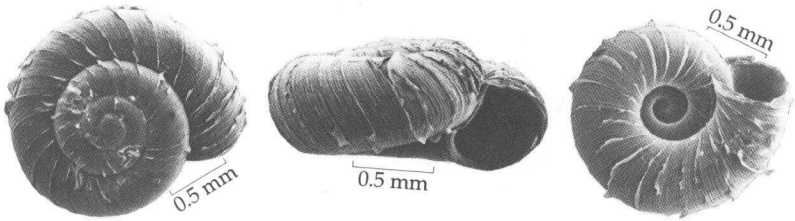


FIG. 17. Shell of *Planogyra asteriscus*, top, apertural and umbilical views of three different shells; UMMZ 57637, 208389. (SEM photographs).

Shell: Minute, shells with 3 1/2 whorls measure less than 2 mm in diameter. The shell is very depressed, rather widely umbilicate, translucent, pale brown in color and sculptured with thin periostracal ribs and fine spiral lines. The embryonic whorls have a granular sculpture. The aperture is round, the lip thin (a little thickened along the columellar and basal margins in old specimens) and entire.

Animal: "The animal is very translucent, body bluish white, head, neck and tentacles mottled with bluish black in streaks and dots; disk yellowish white" (E.S. Morse, 1864, *J. Portland Soc. nat. Hist.*, 1(1), p. 24). The animal is almost white and has short and stout, darkly pigmented ommatophores. The inferior tentacles are short, lighter in color. The foot is holopod, but it has a quite prominent serrate line formed by the upper edges of the lowest row of tesselloid bosses. The foot is short and broad. The sole is lanceolate with rounded tip, displaying coarse (3 to its length) pedal waves during locomotion. The mantle collar is

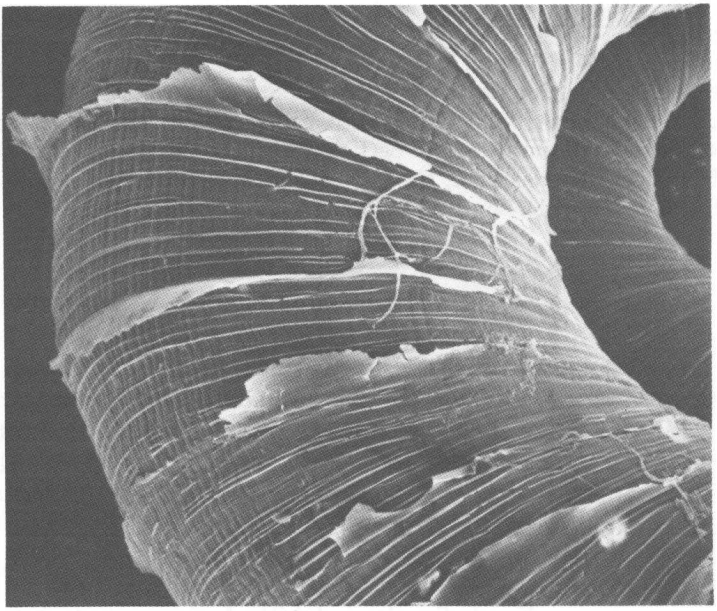


FIG. 18. Shell of *Planogyra asteriscus*, close-up of sculpture., x120. Note the thin periostracal "ribs" or flaps. (SEM photograph).

thick, swollen, white, and very noticeable, protruding beyond the peristome. The pneumostome is guarded by thickenings, but distinct shell-lappets are lacking. The anus is near the inner end of the pneumostome. (H.B. Baker, 1928a, p. 122).

Habitats: Found in very wet, boggy places, including swampy alder thickets (Pilsbry, 1948, p. 1039). "At Douglas Lake ... [found on] debris at the edge of a cedar swamp" (Goodrich, 1932, p. 37). At Douglas Lake, H.B. Baker (1928a) found *Planogyra asteriscus* "under dead leaves in the strand-line, between the water-soaked *Sphagnum* mats of the arbor-vitae-spruce bogs, and the fringe of low deciduous trees around their borders. At the Straits of Mackinac "it was quite common in the damp swales between the low, fixed sand dunes." It "seems to prefer the deeper layers of fallen leaves."

General Distribution: Southern Canada (Quebec and Ontario) and northern United States (Maine to Wisconsin).

Distribution in UMBS Area: Cheboygan Co.: Section 28, T37N, R3W, Grapevine Point forest floor, at south edge of Douglas Lake, UMMZ 208389; Grapevine Point, woods pool area, Douglas Lake,

Section 28, T37N, R3W, Munro Township, UMBS-86-3; Reeses Swamp, southwest 1/4 of Section 3, Burt Township, T36N, R3W, UMBS-86-11; Reeses Swamp, Douglas Lake Biological Station area, UMMZ 57637; Reeses Swamp at Carp Creek (also called Little Carp River) and Hogsback Road, north 1/4 of Section 4, Burt Township, T36N, R3W, UMBS-87-2; Douglas Lake, UMMZ 127749; southwest 1/4 of Section 12, T36N, R1W, near south end of Long Lake, UMMZ 178312.

Genus *Vallonia* Risso

This is a Holarctic genus, its various species occurring in North America (Canada and the United States), Eurasia and the Far East. The shells are minute, rather widely umbilicate, depressed, light colored, and either smooth or ribbed. The oblique aperture is round, lacks teeth, the lip is expanded or reflected, thickened, and more or less continuous.

Key to Species in UMBS Area

1 Shell surface smooth, except for growth lines.....2

Shell surface with costae in addition to growth lines (Figs. 19, 20).....*V. costata* (p. 34)

2(1) Umbilicus oval (Fig. 21).....*V. excentrica* (p. 36)

Umbilicus circular (Fig. 22).....*V. pulchella* (p. 37)

Vallonia costata (Müller)
(Figs. 19, 20)

Helix costata Müller 1774, *Verm. terr. fluv. ... succ. hist.*, 2, p. 31 (Fridrichsdal, Denmark).
Vallonia costata (Müller), Walker (1899, p. 11).
Vallonia costata (Müller), Walker (1906, p. 521, fig. 162).
Vallonia costata (Müller), Winslow (1926, p. 5, no. 2).
Vallonia pulchella mutant *costata* (Müller), Goodrich (1932, p. 10).
Vallonia costata (Müller), Pilsbry (1948, p. 1026, figs. 543,b,c,; 544; 546).
Vallonia costata (Müller), Burch (1962, pp. 45, 189, fig. 78).
Vallonia costata (Müller), Burch & Patterson (1966, p. 6, fig. 14, in part).

Shell: Minute, about 2.5 mm in diameter with 3 1/2 whorls, strongly depressed, gray or faintly yellowish-corneous in color, translucent, umbilicate. Sculptured with fine transverse ribs and very fine transverse striae. The embryonic whorls have fine spiral striae. The aperture is rather round, oblique, the lip expanded, thickened within.

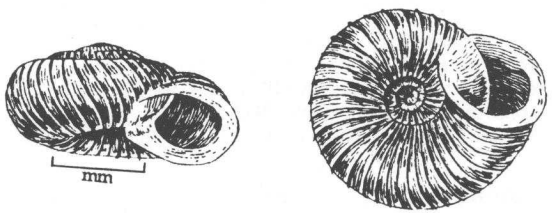


FIG. 19. Shells of *Vallonia costata*. (From F.C. Baker (1939, *Handb. Ill. land snails*, Nat. Hist. Surv. Div., Urbana, Ill.).

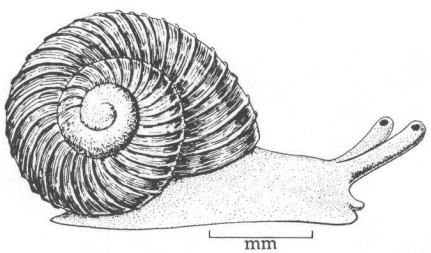


FIG. 20. Animal and shell of *Vallonia costata*. (From F.C. Baker, 1939, *Handb. Ill. land snails*, Nat. Hist. Surv. Div., Urbana, Ill.).

Habitat: "Its usual habitat [in Illinois] appears to be on floodplains in river valleys" (F.C. Baker, 1939, *Handb. Ill. land snails*, Nat. Hist. Surv. Div., Urbana, Ill., p. 119). J. Oughton (1948, *U. Toronto Stud.*, biol. ser., 57, p. 95) listed similar habitats for *Vallonia costata* in Ontario.

General Distribution: Massachusetts to South Dakota, south to Virginia and Kentucky.

Distribution in UMBS Area: Emmet Co.: beach drift behind sand dunes, shore of Lake Michigan, Wilderness State Park, Section 19, T39N, R5W, UMBS-86-19; drift next to boat ramp parking lot at western end of Park road, near shore of Lake Michigan, Wilderness State Park, Section 19, T39N, R5W, UMBS-86-21; Oak-maple grove at

Cross Village, UMMZ 170656; **Cheboygan Co.:** around steps to front entrance, Lakeside Laboratory, UMBS grounds, Douglas Lake, northwest 1/4 of Section 33, T37N, R3W, Munro Township, UMBS-87-3.

Vallonia excentrica Sterki
(Fig. 21)

Vallonia excentrica Sterki 1893, *Man. Conchol.*, 8, p. 249, pl. 32, figs. 6, 9.
Vallonia excentrica Sterki, Walker (1899, p. 11).
Vallonia excentrica Sterki, Walker (1906, p. 521, fig. 161).
Vallonia excentrica Sterki, Winslow (1926, p. 5, no. 3)
Vallonia excentrica Sterki, Goodrich (1932, p. 10).
Vallonia excentrica Sterki, Pilsbry (1948, p. 1025, fig. 545,b).

Shell: Minute, about 2.5 mm in diameter with 3 - 3 1/2 whorls, very depressed, pale corneous to white in color, transparent to almost opaque, glossy, and umbilicate. The embryonic whorls are smooth; the remaining whorls are irregularly sculptured with very fine striae. The umbilicus is elongate and is 1/4

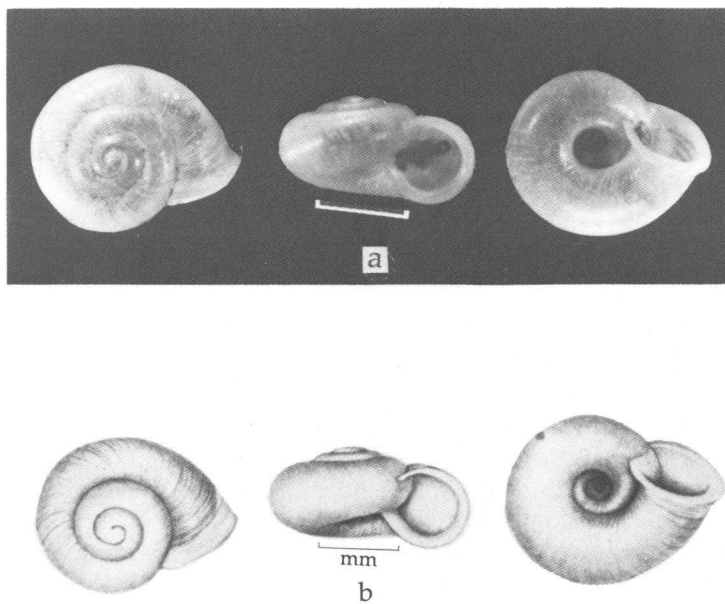


FIG. 21. Shells of *Vallonia excentrica*. **a**, UMMZ 109010; scale line = 1 mm; **b**, from Pilsbry (1948).

to 1/3 the diameter of the shell. The aperture is round, the lip expanded and thickened.

Habitats: Same as for *Vallonia pulchella* (see p. 38).

General Distribution: Maine to Wisconsin, south to northern Alabama.

Distribution in the UMBS Area: Emmet Co.: beach drift behind sand dunes, shore of Lake Michigan, Wilderness State Park, Section 19, T39N, R5W, UMBS-86-19; drift next to boat ramp parking lot at western end of Park road, near shore of Lake Michigan, Wilderness State Park, Section 19, T39N, R5W, UMBS-86-21; **Cheboygan Co.:** Cheboygan, UMMZ 108996; Douglas Lake, UMMZ 109010; Wolverine, UMMZ 208505; 2 miles southwest of Wolverine at Little Sturgeon River, UMMZ 208506.

Remarks: Oughton (1948, *U. Toronto Stud.*, biol. ser., 57, pp. 71-72) was not able to distinguish *Vallonia excentrica* from *V. pulchella* [as separate species] in collections from Ontario. Of the various criteria purported to distinguish *V. excentrica* - the more elongate umbilicus, the expanding body whorl, the pale horn color, the smaller size, the less open umbilicus and more impressed sutures within the umbilicus - only the more elongate umbilicus seemed of any significance. In Ontario, "the two characteristics of eccentricity of umbilicus and size of shell are not firmly enough linked together to warrant the maintenance of two species."

Vallonia pulchella (Müller)
(Fig. 22)

Helix pulchella Müller 1774, *Verm. terr. fluv. ... succ. hist.*, 2, p. 30 (Denmark).
Vallonia pulchella (Müller), Walker (1899, p. 11).
Vallonia pulchella (Müller), Walker (1906, p. 520, figs. 128 [sic, = 158], 160).
Vallonia pulchella (Müller), Winslow (1926, p. 5, no. 5).
Vallonia pulchella (Müller), Goodrich (1932, p. 10, fig.).
Vallonia pulchella (Müller), Pilsbry (1948, p. 1023, figs. 543,a; 545,a).
Vallonia pulchella (Müller), in part, Burch (1962, pp. 44, 189, fig. 76).
Vallonia pulchella (Müller), in part, Burch & Patterson (1966, p. 6, fig. 14, in part).

Shell: Minute, shells with 3 1/2 whorls measure about 2.5 mm in diameter, are very depressed, whitish or corneous, translucent, glossy and umbilicate. Sculptured with very fine

transverse striae; the embryonic whorls are smooth. The umbilicus is about 1/4 the diameter of the shell, and is round. The aperture is round, oblique, its lip reflected and heavily thickened.

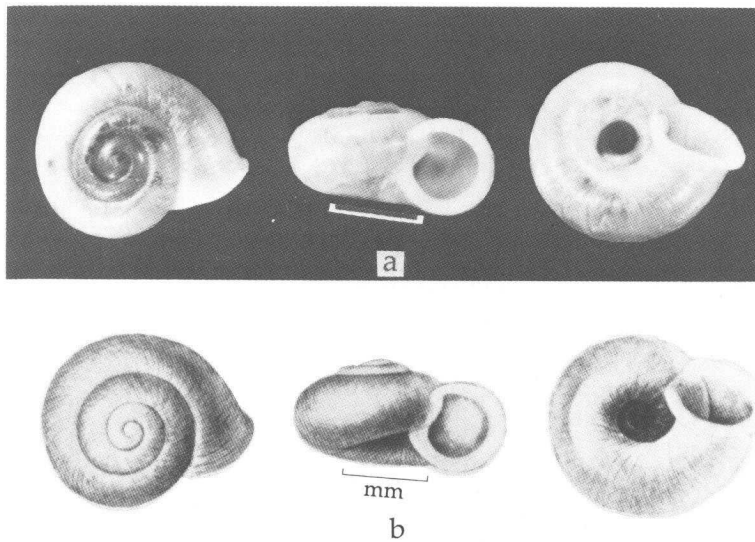


FIG. 22. Shells of *Vallonia pulchella*. **a**, UMMZ 208505; scale line = 1 mm; **b**, from Pilsbry (1948).

Habitats: "It is often found in abundance in lawns and gardens, where shrubbery, bricks, flower pots or the like afford protection from the summer sun and refuge during hibernation" (Pilsbry, 1948, p. 1024). J. Oughton (1948, *U. Toronto Stud.*, biol. ser., 57, p. 95) listed *Vallonia pulchella* in wetter habitats in Ontario: margins of ponds, streams and marshes; seeping hillsides; and sandy flats which receive water by percolation.

General Distribution: Eastern North-America from Maine south to North Carolina and Kentucky, west to Ontario, South Dakota and Missouri; introduced in Texas and California.

Distribution in UMBS Area: Emmet Co.: alive in beach drift behind sand dunes, shore of Lake Michigan, Wilderness State Park, Section 19, T39N, R5W, UMBS-86-19; drift next to boat ramp parking lot at western end of Park road, near shore of Lake Michigan, Wilderness State Park, Section 19, T39N, R5W, UMBS-86-21; **Cheboygan Co.:** Wolverine, UMMZ 208505.

Genus *Zoogenetes* Morse

Zoogenetes is a monotypic genus in North America with a northern distribution. It ventures south only in the Rocky Mountains. The ovate-globose shell with thin, oblique, periostracal ribs is diagnostic. The animal is ovoviviparus.

Zoogenetes harpa (Say)
(Figs. 23, 24)

Helix harpa Say 1824, in *Narr. Expedit. St. Peter's River, ...* 2, appendix, p. 256, pl. 15, fig. 1.
Acanthinula harpa (Say), Walker (1899, p. 11).
Acanthinula harpa (Say), Walker (1906, p. 508, figs. 122-125).
Zoogenetes harpa (Say), Winslow (1926, p. 5, no. 1).
Zoogenetes harpa (Say), Pilsbry (1948, p. 1043, fig. 559).
Zoogenetes harpa (Say), Goodrich (1932, p. 9, fig.).
Acanthinula harpa (Say), Archer (1936, p. 13).
Zoogenetes harpa (Say), Burch (1962, pp. 43, 189).
Zoogenetes harpa (Say), Burch & Patterson (1966, p. 5, fig. 12).
Zoogenetes harpa (Say), Hubricht (1985, p. 7, map 34).

Shell: Very small, just over 3 mm in length and about 2.5 mm in width with about four whorls, thin, nearly globose, translucent, some-what glossy, olive-green in color, narrowly ovate. Embryonic whorls sculptured with minute pits and granules. Later whorls with widely spaced periostracal ribs, between which are transverse striae. Aperture ovate, the lip is thin and sharp, reflected at the columellar margin.

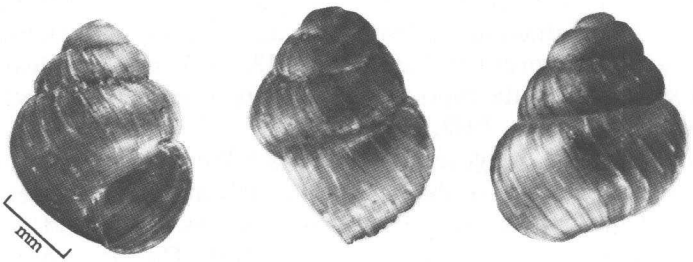


FIG. 23. Shell of *Zoogenetes harpa*, apertural, side and top views; UMMZ 170777.

Animal: "Animal small compared to the size of the shell, body and head slate color; superior tentacles darker, short, thick,

bulbous; eyes large, distinct. ... The foot is ... as long as the shell. ... The body, disk and mantle, are marked with white

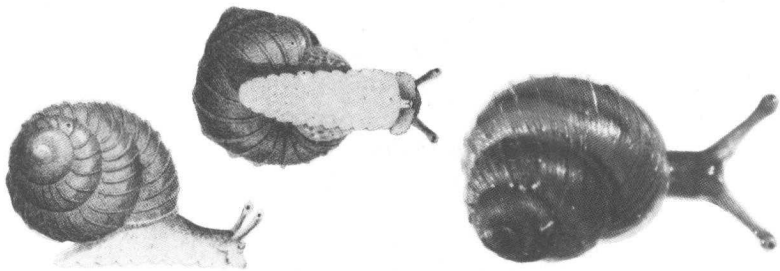


FIG. 24. Animal and shell of *Zoogenetes harpa*. **a**, Side and bottom views (from E.S. Morse, 1864, *J. Portland Soc. nat. Hist.*); **b**, top view (UMBS-86-10).

dots, the edge of the mantle is of the same color as the head and tentacles. The disk is rounded posteriorly, broad and truncated anteriorly, the lateral borders of which are deeply crenulated. The head is separate from the disk as in the Pupadae [Pupillidae], bearing two minutely crenulated lappets, which hang down on either side of the mouth like a visor. ... A longitudinal furrow extends from the mouth downward. The body is so translucent that when extended the ganglionic centres can be plainly seen." (E.S. Morse, 1864, *J. Portland Soc. nat. Hist.*, 1(1), p. 33).

Habitat: This species seems to prefer habitats near lake shores: in leaf mold in hardwood stands and deep in thick grass on open lake shores (Archer, 1936, p. 13). It lives under leaves and sticks and in the moss on the borders of the smaller bodies of water (Goodrich, 1932, p. 9).

Life History: *Zoogenetes harpa* "has a life cycle of a year or there-abouts, is born in the summer or early autumn, matures in summer of the following year, then produces young and dies" (Charles Oldham, in Pilsbry, 1948, p. 1045). During winter, it hibernates on leaves "just below the surface, or secreted in acorn cups or nut shells," not deeply buried like [*Cochlicopa lubrica*] (E.S.Morse, 1864, *J. Portland Soc. nat. Hist.*, 1(1), p. 33).

General Distribution: Holarctic; in Canada from Prince Edward Island to Yukon Territory; in the United States, Maine,

New Hampshire, New York, Michigan, Minnesota, Wyoming, Colorado and Alaska.

Distribution in UMBS Area: **Emmet Co.**: alive in beach drift behind sand dunes, shore of Lake Michigan, Wilderness State Park, Section 19, T39N, R5W, UMBS-86-19; birch-poplar grove, Section 7, Bliss Township, UMMZ 170777; **Cheboygan Co.**: woods pool at public access and park, Maple Bay, Burt Lake, Section 29, Burt Township, T36N, R3W, UMBS-86-10, UMBS-87-1; Section 28, T37N, R3W, Douglas Lake, UMMZ 166965; around steps to front entrance, Lakeside Laboratory, UMBS grounds, Douglas Lake, northwest 1/4 of Section 33, T37N, R3W, Munro Township, UMBS-87-3; Grapevine Point, UMMZ 232361; **Presque Isle Co.**: Lake Huron, north edge of Rogers City, UMMZ 170577; Lake Huron, Section 15, Bearinger Township, UMMZ 170765.

Family PUPILLIDAE

This is a large family of small to minute snails, which are generally pupa-shaped and frequently possess apertural lamellae and folds (Fig. 25). These apertural "teeth" are important in taxonomy and in species recognition. Also useful in identifying species are the sizes and general shapes of the adult shells (Fig. 27). The family, nearly world-wide in its distribution, has nine genera and many species and subspecies in the United States. *Gastrocopta* and *Vertigo* are both large genera (i.e., each contains numerous species); the other seven genera have few species. Four genera occur in the UMBS area, *Columella, Gastrocopta, Pupilla* and *Vertigo.* These are placed in three subfamilies, Pupillinae *s.s.* (*Pupilla*), Gastrocoptinae (*Gastrocopta*) and Vertigininae (*Columella* and *Vertigo*).

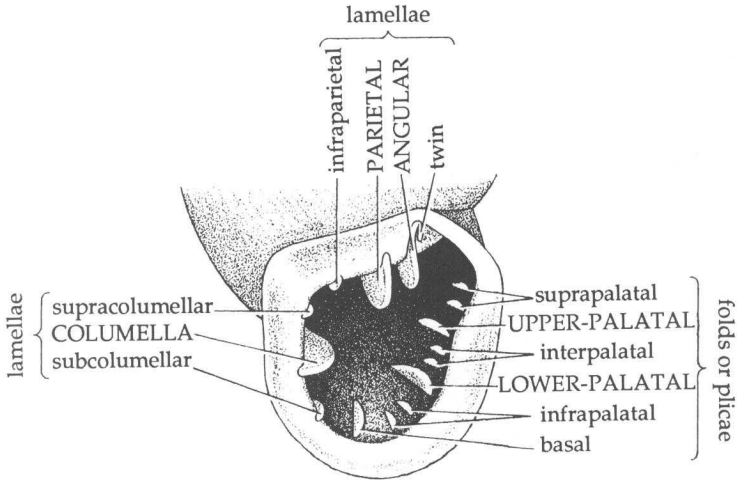


FIG. 25. Terminology of pupillid apertural teeth (after Pilsbry, 1948).

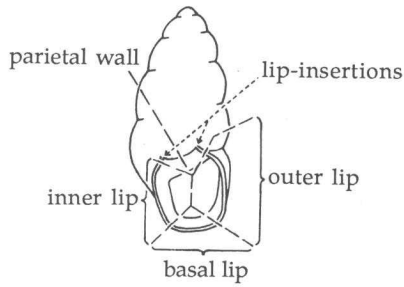


FIG. 26. Terminology of pupillid aperture and lip.

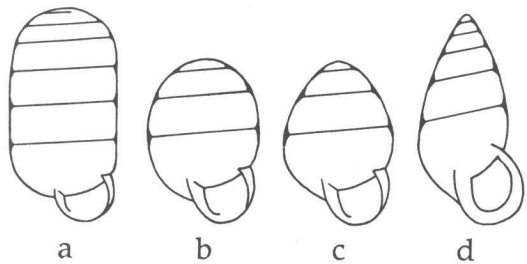


FIG. 27. Shapes of pupillid shells. **a**, cylindrical; **b**, oval; **c**, ovate-conic; **d**, elongately conic.

Key to Pupillid Genera in the UMBS Area

1 Shell aperture without "teeth" (lamellae, folds or plicae) 2

Aperture with "teeth" (see Fig. 25) 3

2(1) Shell minute, 1.5-3.0 mm in length, sutures deeply impressed ..... *Columella* (p. 53)

Shell small, 3.2-4.0 mm in length, sutures moderately impressed ..... *Pupilla* (p. 43)

3(1) Shell white; parietal and angular lamellae converging inward and more or less unite..... *Gastrocopta* (p. 45)

Shell brown; parietal and angular lamellae separate and distinct when present; either or both may be lacking ..... *Vertigo* (p. 54)

Subfamily PUPILLINAE

The subfamilies Pupillinae, Gastrocoptinae and Vertigininae are distinguished by anatomical characters. The Pupillinae and Gastrocoptinae have both pairs of tentacles present, and their lateral radular teeth are bicuspid (in contrast to the Vertigininae, which have lost the lower (inferior) tentacles and have tricuspid lateral teeth). The Pupillinae differ from the Gastrocoptinae by having a branched penis bearing an appendix, and a forked penial retractor muscle. In the UMBS area, only one pupilline species has been found, *Pupilla muscorum.*

Genus *Pupilla* Leach

Pupilla is a genus of temperate and cold regions. Six species occur in North America (north of Mexico). Other species are

found in Eurasia, Africa and Australia. The species have small, cylindrical, perforate, brownish shells. Depending on the species, there are 0 to 5 teeth in the aperture.

Pupilla muscorum (Linnaeus)
(Figs. 28, 29)

Turbo muscorum Linnaeus 1758, *Systema naturae* ..., 10th ed., p. 767.
Pupa muscorum (Linnaeus), Walker (1899, p. 17).
Pupilla muscorum (Linnaeus), Walker (1906, p. 513, figs. 137-142).
Pupilla muscorum (Linné), Winslow (1926, p. 7, no. 41).
Pupilla muscorum (Linnaeus), Goodrich (1932, p. 25, fig.).
Pupilla muscorum (Linné), Burch (1962, pp. 48, 55, 189, figs. 87, 108).
Pupilla muscorum (Linnaeus), Burch & Patterson (1966, p. 3, fig. 7).
Pupilla muscorum muscorum (Linné), Hubricht (1985, p. 7, map 35).

Shell: Very small, 3.0 - 3.9 mm in length with 6 - 6 1/2 whorls, ovately cylindrical, rimate, brownish in color. Sculptured with uneven growth lines; embryonic whorls smooth. Behind the outer and basal lip, there is a light-colored crest. The aperture is semicircular, its lip reflected, and bordered on the inside with a strong callus.

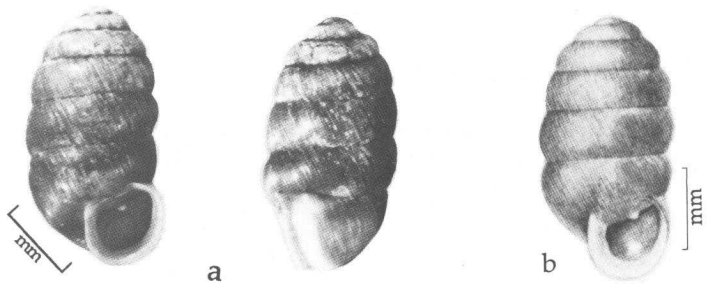


FIG. 28. Shell of *Pupilla muscorum*. **a**, UMMZ 170110; **b**, from Pilsbry (1948).

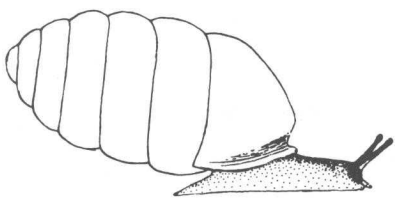


FIG. 29. Animal and shell of *Pupilla muscorum*. (From Pilsbry, 1948).

Animal: "The foot is about half as long as the shell, skin nearly smooth. Inferior tentacles short but distinct. Shell carried with the spire slanting upward a little." Ovoviviparous. (Pilsbry, 1948, p. 926).

Habitats: Grassy roadsides and meadows (Hubricht, 1985, p. 7).

General Distribution: Maine to northern Virginia, west to Oregon, south to Arizona and Texas.

Distribution in UMBS Area: Emmet County (Hubricht, 1985; no specific locality given).

Subfamily GASTROCOPTINAE

The Gastrocoptinae have retained both pairs of tentacles, and have bicuspid lateral radular teeth (both characters shared with the subfamily Pupillinae). The subfamily differs from the Pupillinae in having a simple penis without an appendix, and a simple, unforked penial retractor muscle. One genus, *Gastrocopta,* is found in the UMBS area. Here it is represented by four species, *G. armifera, G. contracta, G. pentodon* and *G. tappaniana.*

Genus *Gastrocopta* Wollaston

The shells of *Gastrocopta* are minute to small, cylindrical to ovate-conic in shape, perforate or rimate, generally whitish, sometimes corneous or light brown. The aperture contains teeth, and the diagnostic character of the genus is the union of the angular and parietal lamellae into a single lamella, which is bifid, biramose, lobed or sinuous in shape.

The genus has many species and is nearly world-wide in distribution, although absent from Europe (however it occurs in Europe as fossils).

Key to Species in UMBS Area

1 Angulo-parietal tooth sinuous or bilobed 2

Angulo-parietal tooth simple 3

2(1) Adult shell small, 3.0 - 4.8 mm in length (Fig. 30.....
.....*G. armifera* (p. 46)

Adult shell minute, 2.2 - 2.5 mm in length (Figs. 31, 32)....
.....*G. contracta* (p. 48)

3(1) Shell elongate-conic (Figs. 33, 34).....*G. pentodon* (p. 50)

Shell ovate-conic (Fig. 35) ..... *G. tappaniana* (p. 51)

Gastrocopta armifera (Say)
(Fig. 30)

Pupa armifera Say 1821, *J. Acad. nat. Sci. Philad.*, 2, p. 162.
Bifidaria armifera (Say), Walker (1899, p. 17).
Bifidaria armifera (Say), Walker (1906, p. 510, fig. 132).
Gastrocopta armifera (Say), Winslow (1926, p. 6, no. 33).
Gastrocopta armifera similis (Sterki), Winslow (1926, p. 6, no. 35).
Gastrocopta armifera (Say), Goodrich (1932, p. 21, fig.).
Gastrocopta armifera (Say), Pilsbry (1948, p. 874, fig. 472,1-4).
Gastrocopta armifera form similis Sterki, Pilsbry (1948, p. 877, fig. 472,6).
Gastrocopta armifera (Say), Burch (1962, pp. 50, 189, fig. 93).
Gastrocopta armifera (Say), Burch & Patterson (1966, p. 3, fig. 8, in part).

Shell: Small, 4.0 - 4.6 mm in length with about 6 1/2 whorls, ovate-conic, white, glossy, perforate, sculptured with irregular

FIG. 30. Shell of *Gastrocopta armifera*, apertural, side and top views; UMMZ 128546.

growth lines. The last part of the last whorl is compressed. The lip is thin, expanded. The angular and parietal lamellae are united into a bifid projection. The columellar lamella is well developed, and is deep-set. The basal lamella is usually low and inconspicuous. The three palatal folds are on a white callus.

Animal: Body spotted or mottled. Eyes on long tapering stalks. (Goodrich, 1932, p. 23, for Michigan species of *Gastrocopta*).

Habitats: "Under logs, sticks, chips, and bits of discarded harness leather, sometimes under stones and bricks" (Goodrich, 1932, p. 22). Inhabiting sunny places, "roadsides, along railroads, in cedar glades. Sometimes found in open woods." (Hubricht, 1985, p. 8).

General Distribution: Maine to Florida, west to North Dakota, Colorado and New Mexico.

Distribution in UMBS Area: Cheboygan County (Hubricht, 1985, p. 70, map 43; no definite locality given).

***Gastrocopta armifera similis* (Sterki).** *Bifidaria armifera similis* Sterki 1909, *Nautilus*, 23, p. 53; *Gastrocopta armifera similis* (Sterki), Winslow (1926, p. 6, no. 35); *Gastrocopta armifera* form *similis* Sterki, Pilsbry (1948, p. 877, fig. 472,6); *Gastrocopta similis* (Sterki), Hubricht (1948, p. 8, map 43).

Shell: "Averaging somewhat smaller, more cylindric; striae lighter; more milky-whitish; peristome never continuous" (Sterki, 1909, *loc. cit.*). The shell of this form differs from typical *Gastrocopta armifera* mainly by the less developed lip and the lip margin not being complete, i.e., the lip is interrupted in the parietal area.

Habitat: "Found in the same habitat as *G. armifera*, with which it is sometimes found" (Hubricht, 1985, p. 8).

General Distribution: New York to North Dakota, south to Kansas and Illinois (Hubricht, 1985, *loc. cit.*).

Distribution in UMBS Area: Cheboygan County (Hubricht, 1985, p. 70, map 43; no definite locality given).

Remarks: Pilsbry (1948, pp. 875, 877) considered several of Sterki's varieties of *Gastrocopta armifera*, including *similis*, to be too minor "to be named as races."

Gastrocopta contracta (Say)
(Figs. 31, 32)

Pupa contracta Say 1822, *J. Acad. nat. Sci. Philad.*, 2, p. 374.
Bifidaria contracta (Say), Walker (1899, p. 17).
Bifidaria contracta (Say), Walker (1906, p. 510, fig. 133).
Gastrocopta contracta (Say), Winslow (1926, p. 6, no. 37).
Gastrocopta contracta (Say), Goodrich (1932, p. 22).
Gastrocopta contracta (Say), Archer (1936, p. 13).
Gastrocopta contracta (Say), Pilsbry (1948, p. 880, fig. 474,9-12).
Gastrocopta contracta (Say), Burch (1962, pp. 50, 189, fig. 94).
Gastrocopta contracta (Say), Burch & Patterson (1966, p. 3, fig. 8, in part).

Shell: The shell of *Gastrocopta contracta* is very small, adults with about 5 1/2 whorls ranging in size from 2.2 to 2.5 mm in length. The shell is ovate-conic, with tapering spire, rimate, translucent, and is white or bluish white in color. It is sculptured with fine transverse striae. The last 1/2 whorl is pinched, giving the aperture a rather triangular appearance. The lip is expanded, continuous and contains angulo-parietal, columellar and palatal lamellae. "Angulo-parietal lamella joining the lip, angularly bent to the right near the middle, then abruptly becoming much lower and bent inward ... . Columellar lamella large, thin, very deeply placed, subvertical, the upper end curving forward ... . A subvertical callus stands in front of it, near the margin ... . Palatal folds two, connected by a low callus, the lower one obtuse, transverse, more deeply placed and larger than the tuberculiform upper fold." (Pilsbry, 1948, p. 881).

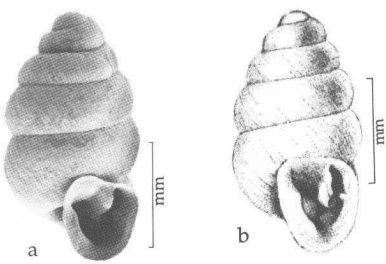


FIG. 31. Shells of *Gastrocopta contracta*. **a**, UMMZ 105860, SEM photograph; **b**, from Pilsbry (1948).

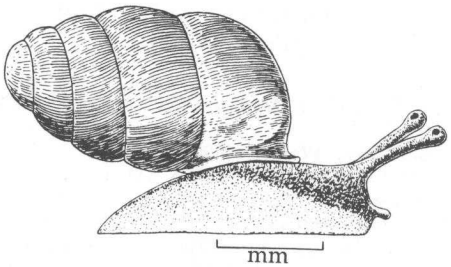


FIG. 32. Animal and shell of *Gastrocopta contracta*. (From F.C. Baker, 1939, *Handb. Ill. land snails*, Nat. Hist. Surv. Div., Urbana, Ill.).

Animal: See *Gastrocopta armifera* (p. 47).

Habitats: *Gastrocopta contracta* was found in a dense mat of rushes on the open lake shore at Sedge Point, Douglas Lake by Archer (1936, p. 13). In Illinois, this species lives under a variety of conditions: on river and creek floodplains where there is plenty of moisture, in forests of sycamore, oak and elm; on hillsides in forests of oak, elm, hickory, basswood and pine; on bluffs of limestone. ... It is common in isolated woodlands of oak, elm and hickory." (F.C. Baker, 1939, *Handb. Ill. land snails*, Nat. Hist. Surv. Div., Urbana, Ill., p. 97).

General Distribution: Maine to Florida, west to Minnesota and Mexico.

Distribution in UMBS Area: **Emmet Co.**: beach drift behind sand dunes, shore of Lake Michigan, Wilderness State Park, Section 19, T39N, R5W, UMBS-86-19; drift beside boat ramp at western end of Park road, near shore of Lake Michigan, Wilderness State Park, Section 19, T39N, R5W, UMBS-86-21; Crooked Lake, UMMZ 105860; **Cheboygan Co.**: Black River at Tower, UMMZ 170558; Douglas Lake, UMMZ 105893; around steps to front entrance, Lakeside Laboratory, UMBS grounds, Douglas Lake, northwest 1/4 of Section 33, T37N, R3W, Munro Township, UMBS-87-3; Milligan Creek on Michigan Highway 68, UMMZ 170580; **Presque Isle Co.**: Lake Huron, north edge of Rogers City, UMMZ 170569; south end of Grand Lake along highway US 23, UMMZ 171626; Ocqueoc River, 3 miles northeast of Ocqueoc, UMMZ 249450.

Gastrocopta pentodon (Say)
(Figs. 33, 34)

Vertigo pentodon Say 1821, *J. Acad. nat. Sci. Philad.*, 2, p. 376 (Pennsylvania).
Bifidaria pentodon (Say), Walker (1899, p. 17).
Bifidaria pentodon (Say), Walker (1906, p. 511, fig. 135).
Gastrocopta pentodon (Say), Winslow (1926, p. 7, no. 39).
Gastrocopta pentodon (Say), Goodrich (1932, p. 22).
Gastrocopta pentodon (Say), Pilsbry (1948, p. 886, figs. 470; 477,2,3,5-8).
Gastrocopta pentodon (Say), Burch (1962, pp. 54, 189, fig. 105).

Shell: The shell of *Gastrocopta pentodon* is minute, adults with about five whorls measuring 1.5 to 1.8 mm in length. The shell is elongate-conic, tapering to the apex, rimate, transparent, white or corneous in color. The shell is smooth, sculptured only with very fine growth lines. The aperture is nearly semi-circular, typically with five teeth (hence the specific name "*pentodon*"). The angulo-parietal lamella is simple, almost straight, the "columellar lamella thin, horizontal; the palatal folds stand upon a low callus ridge, the lower fold compressed and entering a little more deeply than the smaller, tuberculiform upper one. Accessory denticles are usually developed in the subcolumellar, basal and interpalatal positions. The peristome is thin, narrowly expanded, with a thin, straight, parietal callus between the widely separated ends." (Pilsbry, 1948, p. 888).

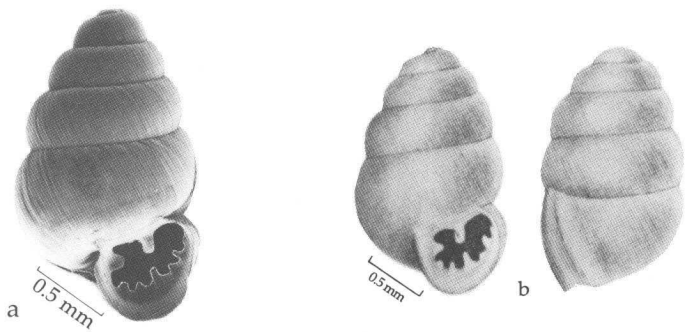


FIG. 33. Shells of *Gastrocopta pentodon*. **a**, UMMZ 170621, SEM photograph; **b**, from Pilsbry (1948).

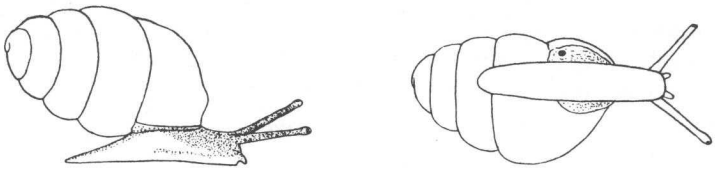


FIG. 34. Animal and shell of *Gastrocopta pentodon*. (From Pilsbry, 1948).

Animal: See *Gastrocopta armifera* (p. 47).

Habitat: *Gastrocopta pentodon* "lives on wooded hillsides or in well-drained groves, among leaves in the underbrush; also 'is common among moss and grass in forest and on open slopes.' ... It is most easily obtained by dirt or leaf sifting" (Pilsbry, 1946, p. 888).

General Distribution: Maine to Florida, west to Nebraska and Arizona.

Distribution in UMBS Area: Emmet Co.: beach drift behind sand dunes, shore of Lake Michigan, Wilderness State Park, Section 19, T39N, R5W, UMBS-86-19; near Carp River, Section 29, Wawatam Township, UMMZ 170621; northwest 1/4 of section 27, Wawatam Township, UMMZ 178397; **Cheboygan Co.**: Black River at Tower, UMMZ 170559; Douglas Lake, UMMZ 106845.

Gastrocopta tappaniana (C.B. Adams)
(Fig. 35)

Pupa tappaniana 'Ward' C.B. Adams 1842, in Thompson's *History of Vermont.*
Bifidaria tappaniana (C.B. Adams), Walker (1906, p. 512, fig. 136).
Gastrocopta tappaniana (C.B. Adams), Winslow (1926, p. 7, no. 40).
Gastrocopta tappaniana (C.B. Adams), Goodrich (1932, p. 22).
Gastrocopta tappaniana (C.B. Adams), Pilsbry (1948, p. 889, fig. 477,9).
Gastrocopta tappaniana (Adams), Burch (1962, pp. 54, 189, fig. 104).
Gastrocopta tappaniana (C.B. Adams), Hubricht, 1985, p. 9, map 57).

Shell: Minute, 1.7 to 2.0 mm in length with about five whorls, ovate conic in shape, translucent, whitish or corneous, smooth, except for fine growth lines. The aperture is semi-circular, and has one tooth on the parietal wall, and generally one on the columellar margin and five teeth on the basal/palatal margin.

Remarks: "The shell is larger than *pentodon,* markedly conic through obtuse. ... Lower-palatal fold usually not so long and entering as in *G. pentodon.*" (Pilsbry, 1948, p. 889).

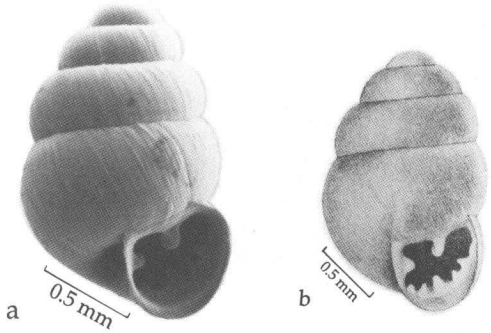


FIG. 35. Shells of *Gastrocopta tappaniana.* **a,** UMMZ 107263, SEM photograph; **b,** from Pilsbry (1948).

Animal: See *Gastrocopta armifera* (p. 47).

Habitats: "Low, moist places, under wood, often with *Vertigo ovata"* (Pilsbry, 1948, p. 889). In wet places, such as margins of ponds, streams and marshes, seeping hillsides, and sandy flats which receive water by percolation (J. Oughton, 1948, *U. Toronto Stud.,* biol. ser., 57, p. 95).

General Distribution: Maine to Florida and Texas, west to South Dakota, Kansas and Arizona.

Distribution in UMBS Area: Emmet Co.: Crooked Lake, UMMZ 107263.

Subfamily VERTIGININAE

The Vertigininae have lost the lower (inferior) tentacles, thereby differing from the other two pupillid subfamilies (Pupillinae and Gastrocoptinae) represented in the UMBS area. Other differences exhibited by the vertiginine snails are in their radular teeth, including the possession of tricuspid (rather than bicuspid) laterals. Two genera of Vertigininae are found in the UMBS area, *Columella* and *Vertigo.*

Genus *Columella* Westerlund

The shell of *Columella* is cylindrical, tapering at the apex, perforate, brown in color, and smooth except for growth striae. The aperture lacks lamellae, is semicircular to nearly round, and is bordered by a thin, sharp, unexpanded lip, except where it is reflected on the umbilical side of the aperture.

The genus has about 10 species, four of which occur in North America, one as far south as Central America. Three species are found in Eurasia, and another three in Hawaii.

Columella edentula (Draparnaud)
(Fig. 36)

Pupa edentula Draparnaud 1805, *Hist. nat. Moll. Terr. Fluv. France*, p. 59, pl. 3, figs. 28, 29.
Pupa simplex Gould 1841, *Boston J. nat. Hist.*, 3, p. 403, pl. 3, fig. 21 (Cambridge, Mass.).
Sphyradium edentulum (Draparnaud), Walker (1899, p. 22).
Sphyradium edentula (Draparnaud), Walker (1906, p. 496, fig. 93).
Columella edentula Draparnaud), Winslow (1926, p. 9, no. 90).
Columella edentula (Draparnaud), Goodrich (1932, p. 37, fig.).
Columella edentula (Draparnaud), Archer (1936, p. 13).
Columella edentula (Draparnaud), Pilsbry (1948, p. 1002, fig. 535,12-17)
Columella edentula (Draparnaud), Burch (1962, pp. 48, 190, fig. 88).
Columella edentula (Draparnaud), Burch & Patterson (1966, p. 2, fig. 5).
Columella simplex (Gould), Hubricht (1985, p. 12, map 97).

Shell: The shell of *Columella edentula* is minute to very small, adults with 5 1/2 to 6 1/2 whorls ranging in size from 1.75

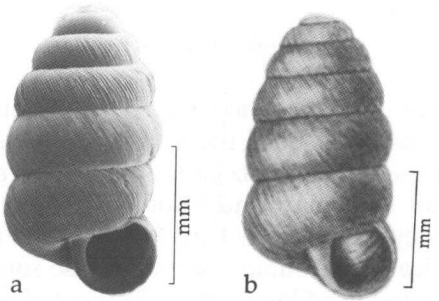


FIG. 36. Shell of *Columella edentula*. **a**, UMMZ 57626, SEM photograph; **b**, from Pilsbry (1948).

to 2.5 mm in length. The shell is cylindrical in shape, but tapers at the apex. It is cinnamon in color, sometimes darker, and occasionally having lighter transverse streaks. There is little sculpture other than irregular growth wrinkles. At the base, there is a small umbilical perforation. The lip is short, its outer and basal margins neither reflected or expanded, but the columellar margin is reflected. The aperture is without teeth.

Animal: The foot is short, oval, and lacks pedal grooves. The lower tentacles, which are characteristically present on nearly all other geophile snails, are lacking.

Habitat: "This species lives in the hardwoods on shady banks above Douglas Lake, and inhabits leaf débris and the under sides of birch and maple logs" (Archer, 1936, p. 13). "Under leaves in damp woods of floodplain areas. ... Usually only a single specimen is found in a place" (F.C. Baker, 1939, *Handb. Ill. land snails,* Nat. Hist. Surv. Div., Urbana, Ill. p. 109).

General Distribution: Southern Canada; Maine to Oregon, south to Alabama and Mississippi.

Distribution in UMBS Area: Emmet Co.: northwest 1/4 of Section 27, Wawatam Township, UMMZ 178408; Petoskey, UMMZ 110440; **Cheboygan Co.**: Douglas Lake Biological Station, UMMZ 57626; southwest 1/4 of Section 12, T36N, R1W, near the south end of Long Lake, UMMZ 178313; Reeses Swamp, north end of Burt Lake, UMMZ 178420; **Presque Isle Co.:** Michigan Highway 68a, Section 30, T35N, R5E, UMMZ 178285; Ocqueoc River, 3 miles northeast of Ocqueoc, UMMZ 249446.

Genus *Vertigo* Müller

The genus *Vertigo* was named by Müller in 1774, and originally included only the species *V. pusilla* Müller 1774. Since then the group has been found to have a broad Holarctic distribution and many additional species have now been named. "They are generally to be found on and under dead wood and fallen leaves in humid places, but also some species live on grass stems and dead leaves at the borders of ponds or marshes" (Pilsbry, 1948, p. 943). The shells of *Vertigo* are oval to ovate-

conic, some approaching a depressed-cylindrical shape. The angular lamella may be present or absent; if present, it is either short or not near the lip insertion. According to Pilsbry (1948, p. 943), the apertural teeth are among the best specific characters, even though they are rather variable, especially when small. When the teeth are well developed, they are usually constant features.

Key to Species of *Vertigo* in the UMBS Area

1 Aperture with four teeth or less 2

Aperture with five teeth or more 3

2(1) Shell with well developed striae (Fig. 39) .... *V. gouldi paradoxa* (p. 58)

Shell with indistinct striae, or smooth (Fig. 42)..... .....*V. ventricosa* (p. 61)

3(1) Lower-palatal lamella located deep within the aperture (Fig. 40).....*V. nylanderi* (p. 59)

Lower-palatal lamella located nearer the aperture lip.. 4

4(1) Shell distinctly striate (Fig. 38)..... ..... *V. gouldi gouldi* (p. 57)

Shell weakly striate or almost smooth 5

5(4) Shell aperture usually with 5-6 teeth 6

Shell aperture usually with 7-9 teeth (Fig. 41) ....*V. ovata* (p. 60)

6(5) Body whorl near lip noticeably indented; outer lip with a distinct angle (Fig. 37) ..... *V. elatior* (p. 56)

Body whorl near lip weakly indented or smooth; outer lip without a lip angle, or with only a weak one (Fig. 42) ..... *V. ventricosa* (p. 61)

Vertigo elatior Sterki
(Fig. 37)

Vertigo ventricosa elatior Sterki 1894, *Land and f. w. Moll. vic. New Philad.*, ... Ohio, p. 5.
Vertigo ventricosa elatior Sterki, Walker (1899, p. 18).
Vertigo ventricosa elatior Sterki, Walker (1906, p. 517).
Vertigo ventricosa elatior Sterki, Winslow (1926, p. 7, no. 49).
Vertigo ventricosa elatior Sterki, Goodrich (1932, p. 24).
Vertigo elatior Sterki, Pilsbry (1948, p. 956, figs. 514; 515,6).
Vertigo elatior Sterki, Burch (1962, pp. 60, 190, fig. 121).

Shell: Minute, a little over 2 mm in length with five whorls, ovate-conic in shape, nearly smooth except for weak growth lines. The outer lip and adjoining body whorl are rather strongly indented. The aperture usually has five teeth, a parietal lamella, a columellar lamella, a basal lamella, and two palatal folds on a strong palatal callus. Sometimes there is a suprapalatal fold, and rarely an angular lamella.

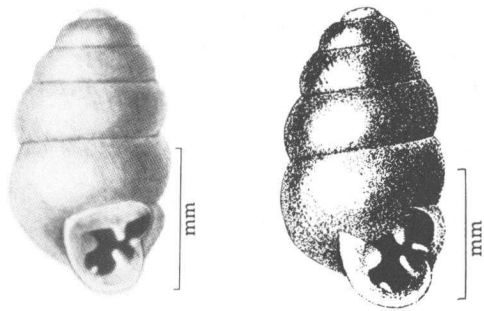


FIG. 37. Shells of *Vertigo elatior*. (From Pilsbry, 1948).

Habitats: Presumably the same [in Ontario] as listed for *Vertigo ventricosa* above (see J. Oughton, 1948, *U. Toronto Stud.*,

biol. ser., 57, pp. 64, 65, 95). H.B. Baker (1922, *Occ. Pap. Mus. Zool. Univ. Mich.*, 111, p. 29) recorded it from the floodplain of a creek in Dickinson Co., Mich., in both grassy swales (with grasses and sedges, mixed with sensitive ferns, meadow-rue, swamp milkweed and Joe-pye weed) and wooded flats (carpeted with leaves and shaded by tag-alders, red dogwoods and white maples).

General Distribution: Canada: Alberta, British Columbia, and Ontario from the Great Lakes to James and Hudson bays; United States: Maine west to Montana, south to New Mexico.

Distribution in UMBS Area: **Emmet Co.**: beach drift behind sand dunes, shore of Lake Michigan, Wilderness State Park, Section 19, T39N, R5W, UMBS-86-19; **Cheboygan Co.:** woods pool at public access and park, Maple Bay, Burt Lake, Section 29, Burt Township, T36N, R3W, UMBS-86-10, UMBS-87-1.

Vertigo gouldi gouldi (Binney)
(Fig. 38)

Pupa gouldii Binney 1843, *Proc. Bost. Soc. nat. Hist.*, 1, p. 105.
Vertigo gouldii Binney, Walker (1899, p. 18).
Vertigo gouldii (Binney), Walker (1906, p. 517, fig. 151).
Vertigo gouldii (Binney), Winslow (1926, p. 7, no. 43).
Vertigo gouldi (Binney), Goodrich (1932, p. 24).
Vertigo gouldi (Binney), Pilsbry (1948, p. 971, fig. 515,4,5,8).
Vertigo gouldi (Binney), Burch (1962, pp. 63, 190, fig. 128).
Vertigo gouldi (Binney), Burch & Patterson (1966, p. 4, fig. 9, in part).

Shell: Minute, 1.5 - 1.75 mm in length with 4 1/2 to 5 whorls, elongately ovate in shape, pale chestnut in color, sculptured with distinct, well developed transverse striae.

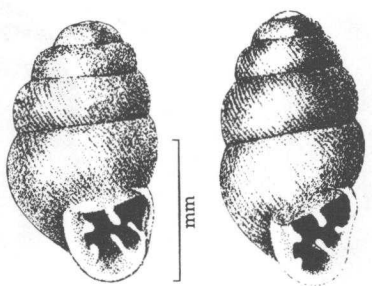


FIG. 38. Shells of *Vertigo gouldi gouldi.* (From Pilsbry, 1948).

The outer lip is flattened, without a deep indentation, only slightly depressed. The aperture usually has five teeth: a long, strong parietal lamella, two columellar lamellae and two palatal folds. Rarely an angular lamella is present.

Habitats: Listed by J. Oughton (1948, *U. Toronto Stud.*, biol. ser., 57, p. 95) as inhabiting [in Ontario] margins of ponds, streams and marshes, and seeping hillsides and sandy flats which receive water by percolation. "Found in leaflitter in upland woods" (Hubricht, 1985, p. 11).

General Distribution: Maine to Montana, south to Tennessee, Colorado and Arizona.

Distribution in UMBS Area: Emmet Co.: alive in beach drift behind sand dunes, shore of Lake Michigan, Wilderness State Park, Section 19, T39N, R5W, UMBS-86-19; drift beside boat ramp at western end of Park road, near shore of Lake Michigan, Wilderness State Park, Section 19, T39N, R5W, UMBS-86-21; Petoskey, UMMZ 111518; **Cheboygan Co.**: east shore of Lancaster Lake, Munro Township, UMMZ 170597.

Vertigo gouldi paradoxa Sterki
(Fig. 39)

Vertigo gouldi paradoxa Sterki (in Nylander) 1900, *Nautilus*, 13, p. 103.
Vertigo gouldi paradoxa Sterki, Pilsbry (1948, p. 972, figs. 518,6,8; 520).
Vertigo paradoxa Sterki, Hubricht (1985, p. 11, map 80).

Shell: Very similar to *Vertigo gouldi s.s.*, except that the basal (or subcolumellar) fold is absent, the lower palatal tooth is further back in the aperture, and the outer lip is straighter.

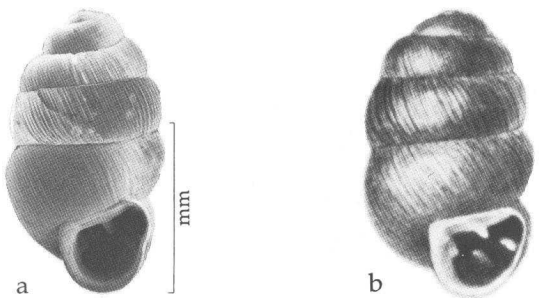


FIG. 39. Shells of *Vertigo gouldi paradoxa*. **a**, UMMZ 111538, SEM photograph; **b**, from Pilsbry, 1948.

Habitat: "Similar to that of *V. gouldi* and sometimes found with it" (Hubricht, 1985, p. 11).

General Distribution: Newfoundland and Maine west to Ontario and Michigan.

Distribution in UMBS Area: Emmet Co.: beach drift behind sand dunes, shore of Lake Michigan, Wilderness State Park, Section 19, T39N, R5W, UMBS-86-19; **Cheboygan Co.:** Douglas Lake, UMMZ 111538.

Vertigo nylanderi Sterki
(Fig. 40)

Vertigo nylanderi Sterki 1909, *Nautilus*, 22: 107.
Vertigo nylanderi Sterki, Pilsbry, (1948, p. 970, fig. 515, 13-15).
Vertigo nylanderi Sterki, Burch (1962, pp. 61, 190, fig. 123).

Shell: The shell of *Vertigo nylanderi* is minute (1.6 - 1.7 mm in length with 4 1/2 - 5 whorls), elongately oval to ovately subcylindrical in shape, rimate, cinnamon colored, with distinct, well developed transverse striae. The aperture has six teeth: a well developed parietal lamella next to a thin lamelliform angular lamella, a substantial columellar lamella above a tiny subcolumellar basal fold, and two elongate palatal folds. The lower palatal fold is deep within the aperture, its distal end terminating near the proximal end of the upper palatal fold.

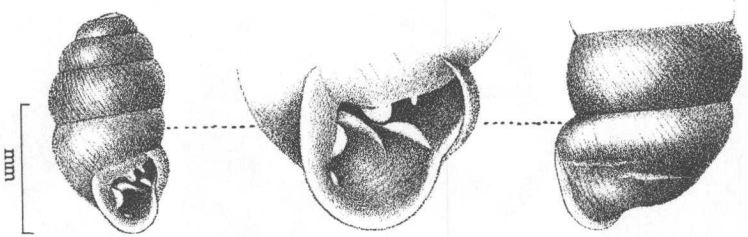


Fig. 40. *Vertigo nylanderi.* (From Pilsbry, 1948).

General Distribution: Maine to Ontario and Michigan.

Distribution in UMBS Area: Emmet Co.: beach drift behind sand dunes, shore of Lake Michigan, Wilderness State Park,

Section 19, T39N, R5W, UMBS-86-19.

Vertigo ovata Say
(Fig. 41)

Vertigo ovata Say 1822, *J. Acad. nat. Sci. Philad.*, 2, p. 375.
Vertigo ovata (Say), Walker (1899, p. 18).
Vertigo ovata Say, Walker (1906, p. 516, fig. 148).
Vertigo ovata Say, Winslow (1926, p. 7, no. 46).
Vertigo ovata (Say), Goodrich (1932, p. 23, fig.)
Vertigo ovata Say, Pilsbry (1948, p. 952, fig. 513,1-4,7).
Vertigo ovata Say, Burch (1962, pp. 59, 190, fig. 119).
Vertigo ovata Say, Burch & Patterson (1966, p. 4, fig. 9, in part).

Shell: Minute, about 2.2 - 2.6 mm in length with 5 whorls, ovate to ovate-conic, auburn colored, smooth except for fine growth lines. The aperture, outer lip and terminal portion of the body whorl have a strong indention. "The parietal lamella is strong and rather long; angular lamella small; a minute infraparietal tubercle usually present. Columellar lamella strong. Basal fold well developed but small and thin, in a subcolumellar position; below it there is usually a minute infrapalatal fold in the basal margin. Upper and lower palatal folds are strong and stand on a tinted callous ridge, a minute suprapalatal tubercle usually above them." (Pilsbry, 1948, p. 953).

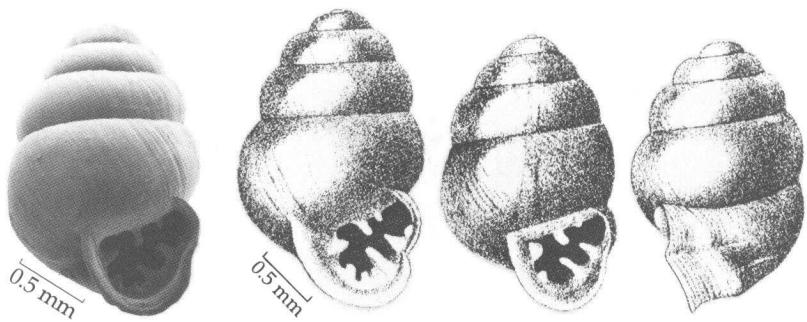


FIG. 41. Shells of *Vertigo ovata*. **a**, UMMZ 112101, SEM photograph; **b**, from Pilsbry (1948).

Habitat: "In moist places under sticks and debris. It is most abundant on stream floodplains, but it has been found also in forests on the bluffs that border rivers." (F.C. Baker, 1939, *Handb. Ill. land snails*, Nat. Hist. Surv. Div., Urbana, Ill., p. 105).

General Distribution: Maine to Florida, west to Oregon and California. This is the most widely distributed species of the genus.

Distribution in UMBS Area: Emmet Co.: beach drift behind sand dunes, shore of Lake Michigan, Wilderness State Park, Section 19, T39N, R5W, UMBS-86-19; Crooked Lake, UMMZ 112085; northwest 1/4 of Section 27, Wawatam Township, UMMZ 178403; **Cheboygan Co.**: Douglas Lake, UMMZ 112101; woods pool at public access and park, Maple Bay, Burt Lake, Section 29, Burt Township, T36N, R3W, UMBS-87-1; **Presque Isle Co.**: Ocqueoc River, 3 miles northeast of Ocqueoc, UMMZ 249439.

Vertigo ventricosa (Morse)
(Fig. 42)

Isthmia ventricosa Morse 1865, *Ann. Lyc. nat. Hist. N.Y.*, 8, p. 207.
Vertigo ventricosa (Morse), Walker (1899, p. 18).
Vertigo ventricosa (Morse), Walker (1906, p. 517, fig. 150).
Vertigo ventricosa (Morse), Winslow (1926, p. 7, no. 48).
Vertigo ventricosa (Morse), Goodrich (1932, p. 24).
Vertigo ventricosa (Morse), Archer (1936, p. 13).
Vertigo ventricosa (Morse), Pilsbry (1948, p. 957, fig. 515,1-3).
Vertigo ventricosa (Morse), Burch (1962, pp. 60, 190, fig. 120).
Vertigo ventricosa (Morse), Burch & Patterson (1966, p. 4, fig. 9, in part).

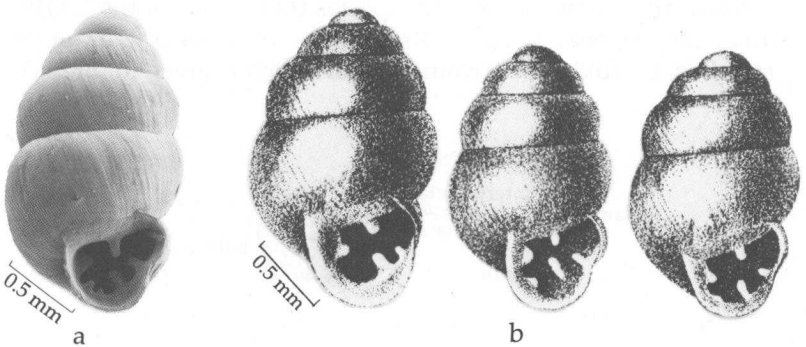


FIG. 42. Shells of *Vertigo ventricosa*. **a**, UMMZ 249440, SEM photograph; **b**, from Pilsbry (1948).

Shell: Minute, 1.7 - 2.0 mm in length with 4 1/2 whorls, ovate to ovate-conic in shape, auburn colored, umbilicate, sculptured with very faint growth lines and microscopic punctations and granulations. The outer lip varies from being deeply indented to having hardly any indentation at all. The aperture usually has five teeth, but may occasionally have six or only four. The teeth usually present are a prominent one on the parietal wall, two on the columellar margin, and two deeper within the aperture on the palatal side.

Habitats: Listed by J. Oughton (1948, *U. Toronto Stud.*, biol. ser., 57, p. 95) as inhabiting margins of ponds, streams and marshes in Ontario, as well as seeping hillsides and sandy flats which receive water by percolation.

General Distribution: Maine to Michigan, south to Virginia and Tennessee.

Distribution in UMBS Area: Emmet Co.: beach drift behind sand dunes, shore of Lake Michigan, Wilderness State Park, Section 19, T39N, R5W, UMBS-86-19; Petoskey, UMMZ 112196; near Carp River, Section 29, Wawatam Township, UMMZ 170451; northwest 1/4 of Section 27, Wawatam Township, UMMZ 178403; **Cheboygan Co.:** Reeses Swamp, north end of Burt Lake, UMMZ 178424; **Presque Isle Co.:** Lake Huron, Section 15, Bearinger Township, UMMZ 170763; Ocqueoc River, 3 miles northeast of Ocqueoc, UMMZ 249440.

Family STROBILOPSIDAE

The snails of this family are characterized by their dome-shaped, ribbed shells. Several species (not found in the UMBS area) are depressed. The shell aperture contains one or more lamellae or folds, the terminology of which is given in Fig. 43.

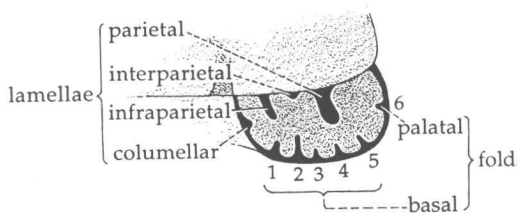


FIG. 43. Terminology of strobilopsid teeth (after Pilsbry). Only the parietal lamellae are usually seen in frontal view in mature shells.

These snails are usually found on decaying or dead leaves or wood in moderately humid forests. The single genus in the United States, *Strobilops* contains five species, two of which (*S. affinis* and *S. labyrinthica*) are found in the UMBS area.

Genus *Strobilops* Pilsbry

Strobilops has a rather wide though somewhat discontinuous distribution, occurring from Quebec to Guatemala, on several of the Caribbean islands, and in South America from Venezuela to Brazil. It is also found in Europe, the Far East, and the Philippines.

Key to Species in the UMBS Area[7]

1 Shell diameter 2.7 - 2.9 mm; basal folds short, subequal, disposed in a regular curve (Fig. 44) ..... *S. affinis* (p. 63)

Shell diameter 2.3 - 2.5 mm; basal folds strongly unequal (Figs. 45-47) ..... *S. labyrinthica* (p. 64)

Strobilops affinis Pilsbry
(Fig. 44)

Strobilops affinis Pilsbry 1893, *Nautilus*, 7, p. 57.
Strobilops affinis Pilsbry, Walker (1899, p. 16).
Strobilopes [*sic*] *affinis* Pilsbry, Walker (1906, p. 507, fig. 121).
Strobilops affinis Pilsbry, Winslow (1926, p. 6, no. 29).
Strobilops affinis Pilsbry, Goodrich (1932, p. 20).
Strobilops affinis Pilsbry, Pilsbry (1948, p. 860, fig. 465,1-5).
Strobilops affinis Pilsbry, Burch (1962, pp. 66, 191, fig. 135).

Shell: Minute, 2.7 - 2.9 mm in diameter with 6 whorls, dome-shaped, brown with pale apex, glossy, narrowly umbilicate, sculptured with radial ribs which become weaker on the base of the shell (except within the umbilicus). The aperture is lunate, its lip expanded, thickened within, brown in color. Pilsbry (1948, p. 860) described the lamellae and folds as follows:

[7]Adapted from Pilsbry (1948, p. 854).

Parietal callus moderately strong. The parietal lamella emerges to the edge of the callus and penetrates inward about two-thirds of a whorl. The infra-parietal lamella is low and weak, deeply immersed, not visible in a front or basal view. Interparietal lamella short and very weak. A third of a whorl within, there is an obliquely radial series of about eight folds: a short low lamella on the columellar axis, followed by two folds larger and higher than the rest, and an oblique series running to the suture, composed of four to seven subequal folds.

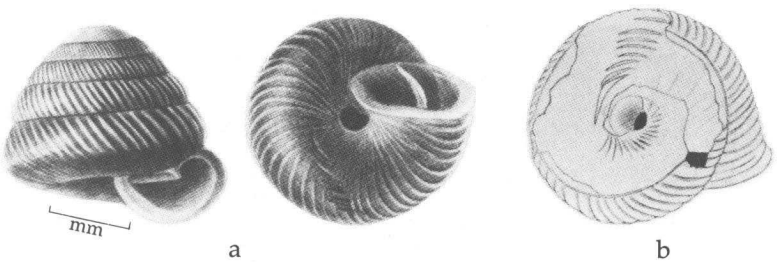


FIG. 44. Shell of *Strobilops affinis*. **a**, Apertural and umbilical views; **b**, top of shell cut away to show lamellae. (From Pilsbry, 1948).

Habitat: "These small shells can be found under logs near the edges of woodlots and under the debris around old woodpiles" (Goodrich, 1932, p. 20).

General Distribution: Massachusetts to Minnesota and Kansas, south to Alabama and Oklahoma.

Distribution in UMBS Area: Emmet Co.: (Hubricht, 1985; no specific locality given).

Strobilops labyrinthica (Say)
(Figs. 45-47)

Helix labyrinthica Say 1817, *J. Acad. nat. Sci. Philad.*, *1*, p. 124.
Strobilops labyrinthica (Say), Walker (1899, p. 16).
Strobilops labyrinthica (Say), Walker (1906, p. 506, fig. 119).
Strobilops labyrinthica (Say), Winslow (1926, p. 6, no. 30).
Strobilops labyrinthica (Say), Goodrich (1932, p. 20, fig.).
Strobilops labyrinthica (Say), Archer (1936, p. 13).
Strobilops labyrinthica (Say), Pilsbry (1948, p. 854, figs. 459, 463).
Strobilops labyrinthica (Say), Burch (1962, pp. 66, 191, fig. 137).
Strobilops labyrinthica (Say), Burch & Patterson (1966, p. 5, fig. 11, in part).

Shell: Minute, 2.3-2.5 mm in diameter with 5 1/2 whorls, dome-shaped, chestnut-brown in color, narrowly umbilicate, sculptured with radial ribs which become weaker on the base of the shell. The aperture is lunate, the lip thick, expanded, and brown in color. The parietal lamella comes to the edge of the parietal callus; it goes inward about half a whorl. "The infraparietal lamella is much smaller, only shortly emerging, the end visible in a basal view; inside it penetrates as far as the parietal lamella. There is a low and slender intraparietal lamella between these lamellae deep within; all three are strongly nodose at the edge, the nodes armed with minute prickles directed towards the aperture. Within the basal and outer walls, at the last third of the base, there is a low, rather blunt columellar lamella and a forward curving series of five (or six) unequal basopalatal folds; first and second folds are large and high, the second longer; two or three following folds are low and thin, the one immediately above the periphery usually longer, and there is sometimes another fold above it." (Pilsbry, 1948, p. 854).

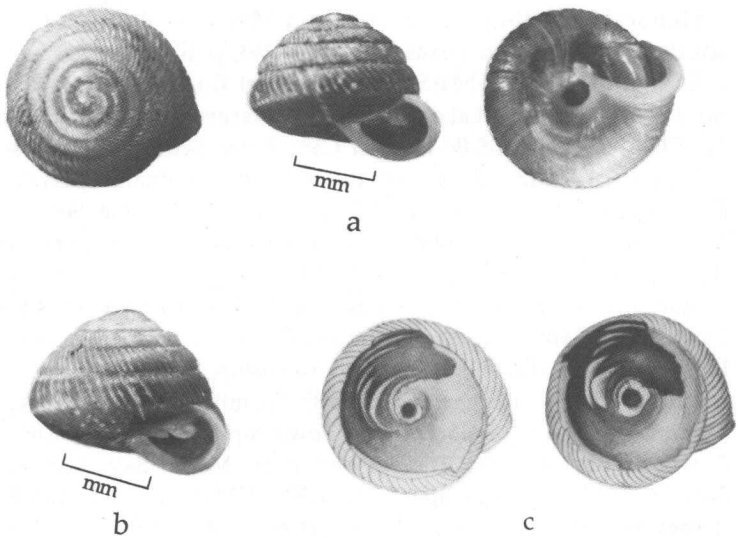
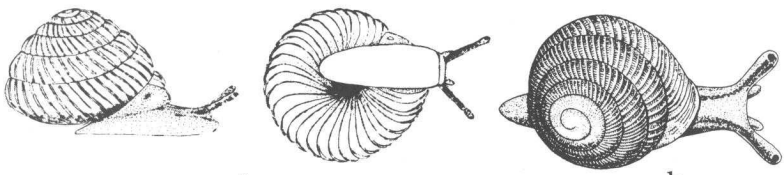


FIG. 45. Shells of *Strobilops labyrinthica*. **a**, UMMZ 170711; **b**, UMMZ 170733; **c**, shells with tops cut away to show lamellae (from Pilsbry, 1948).

Animal: The sole of the foot is broad and short. Pedal grooves are lacking. The tentacles are short and somewhat swollen distally. "The back, eye-stalks and tentacles are blackish gray, darker streaks running from the collar to the eye-stalks; sides of the foot and the tail are clear whitish gray" (Pilsbry, 1948, p. 855).



a b

FIG. 46. Animal and shell of *Strobilops labyrinthica*, side, bottom and top views. **a**, From Pilsbry (1948); **b**, from F.C. Baker (1939, *Handb. Ill. land snails*, Nat. Hist. Surv. Div., Urbana, Ill.).

Habitat: This species lives in hardwoods, aspens and shrubby areas, under rotting logs and fallen bark, at the bases of stumps, and in leaf mold (Archer, 1936, p. 13; Pilsbry, 1948, p. 854).

General Distribution: Quebec and Maine west to Minnesota, south to Georgia and Texas (Pilsbry, 1948, p. 854).

Distribution in UMBS Area: Emmet Co.: beach drift behind sand dunes, shore of Lake Michigan, Wilderness State Park, Section 19, T39N, R5W, UMBS-86-19; near Carp River, Section 29, Wawatam Township, UMMZ 170447; shore of Lake Michigan, Section 30, Friendship Township, UMMZ 170711; near Walloon Lake, Section 30, Bear Creek Township, UMMZ 170732; birch-poplar grove, Section 7, Bliss Township, UMMZ 170773; **Cheboygan Co.**: woods near southcentral shore of Douglas Lake, Section 28, T37N, R3W, Munro Township, UMBS-86-1; Grapevine Point, woods pool area, Douglas Lake, Section 28, T37N, R3W, Munro Township, UMBS-86-3; woods at roadside rest stop on highway I-75 north, 5.2 miles south of highway C-64, northeast 1/4 of Section 24, Burt Township, T36N, R3W, UMBS-86-7; woods pool at public access and park, Maple Bay, Burt Lake, Section 29, Burt Township, T36N, R3W, UMBS-86-10, UMBS-87-1; Reeses Swamp, southwest 1/4 of Section 3, Burt Township, T36N, R3W, UMBS-86-11; Milligan Creek, on Michigan Highway 68, UMMZ 170588; east shore of Lancaster Lake, Munro Township, UMMZ 170606; southwest 1/4 of Section 12, T36N, R1W, near south end of

Long Lake, UMMZ 178321; **Presque Isle Co.**: along US Highway 23, UMMZ 170618; Lake Huron, Section 14, Ocqueoc Township, UMMZ 170661; Lake Huron, Section 15, Bearinger Township, UMMZ 170760; oak-pine grove, Section 17, Ocqueoc Township, UMMZ 170556; Michigan Highway 68a, Section 30, T35N, R5E, UMMZ 178281; Ocqueoc River, 3 miles northeast of Ocqueoc, UMMZ 249457.

Strobilops labyrinthica virgo (Pilsbry) (Fig. 47). *Strobila labyrinthica virgo* Pilsbry 1892, *Nautilus*, 6, p. 94; *Strobilops virgo* (Pilsbry), Walker (1899, p. 16); *Strobilops virgo* (Pilsbry), Walker (1906, p. 506, fig. 120); *Strobilops virgo* (Pilsbry), Winslow (1926, p. 6, no. 31); *Strobilops labyrinthica virgo* (Pilsbry), Goodrich (1932, p. 20); *Strobilops labyrinthica virgo* (Pilsbry); Archer (1936, p. 13);*Strobilops labyrinthica virgo* Pilsbry, Pilsbry (1948, p. 855, fig. 462).

Shell (as described by Pilsbry): Whitish with a faint green or yellow tint (or pale brown), the lip and lamellae white. Umbilicus small, contained 10 times in the shell diameter. The infraparietal lamella emerges somewhat more strongly than usual in *S. labyrinthica;* otherwise the lamellae and folds are the same. Height 2 mm, diameter 2.5 mm.

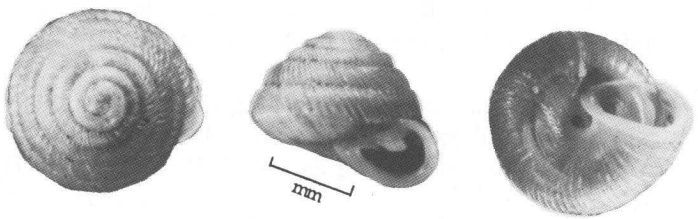


FIG. 47. Shell of *Strobilops labyrinthica virgo;* UMMZ 108364.

Remarks: "As a color variety [*Strobilops labyrinthica virgo*] is noticeable, but I believe of little or no significance racially." (Pilsbry, 1948, p. 856).

General Distribution: Maine to Minnesota and Iowa, south to Arkansas.

Distribution in UMBS Area: Emmet Co.: Carp Lake, UMMZ 108380; Petoskey, UMMZ 108364; Round Lake, Petoskey, UMMZ 108381; Sturgeon Bay, UMMZ 198390; **Cheboygan Co.**: banks of Carp Creek, 3 miles from the Biological Station, near Pelston, UMMZ 173617; Cheboygan, UMMZ 108390; Douglas Lake, Biological Station, UMMZ 57648; drift of Douglas Lake, UMMZ 48670; Mackinaw City, UMMZ 208603; 1/2 mile southeast of Freedom, UMMZ 208604.

Family SUCCINEIDAE

The shells of snails belonging to this primitive family of land pulmonates are very thin, with unusually large apertures, and are often amber-colored (giving them the common name, "amber snails"). Succineids are most commonly found close to bodies of water, along stream banks, at the edges of ponds or lakes, and in or near marshes. About thirty species have been recorded in the eastern United States and another ten in the west. Identification is difficult and future much-needed revisions will rest mainly on anatomical characters, such as genitalia. Three genera are recognized in the United States: *Succinea, Oxyloma* and *Catinella.* One species of each genus is found in the UMBS area.

Key to Genera in the UMBS Area

1 Penis with an enveloping penial sheath (Fig. 50, b, c); shell larger, generally 12 mm or more in length, glossy, spire noticeably shorter than the shell aperture 2

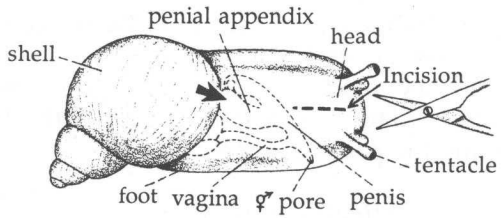
Penis lacking a penial sheath (Fig. 50, a); adult shell relatively small, generally 11 mm or less in length, dull, spire long, almost as long as the shell aperture. (Fig. 51)..... *Catinella* (p. 68)

2(1) Penis with an appendix, epiphallus small and within the penial sheath (Fig. 50, c); shell generally elongate (Fig. 53, a).....*Oxyloma* (p. 72)

Penis without an appendix, epiphallus large and external to the penial sheath (Fig. 50, b); shell generally oval (Fig. 54, a) ..... *Succinea* (p. 74)

Genus *Catinella* Pease

In addition to being common throughout much of North America, the distribution of *Catinella* includes islands of the Pacific. Its species are peculiar in having the lowest chromosome



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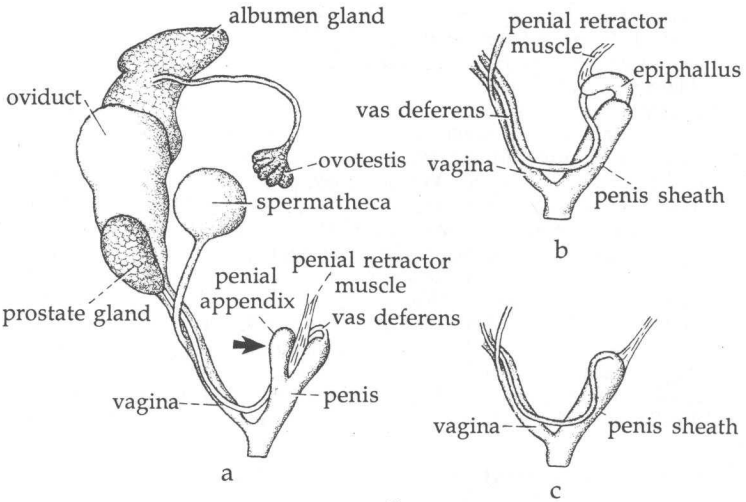

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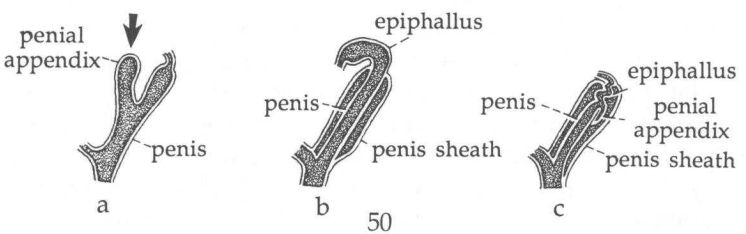

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FIGS. 48-50. Generic characters of the terminal male genitalia of North American succineid snails. FIG. 48. Dorsal view of *Catinella* showing the natural position of the terminal genitalia (in outline) and the place for incision (heavy dashed line) to open the dorsal head-foot to observe the lower reproductive system. FIG. 49. **a**, Complete reproductive system of *Catinella vermeta*; **b**, lower genitalia of *Succinea ovalis*; **c**, lower genitalia of *Oxyloma retusa*. FIG. 50. Sagittal sections through the lower genitalia of **a**, *C. avara*; **b**, *S. ovalis*; **c**, *O. retusa*.

numbers in the Mollusca (n=5 and n=6; 2n=10 and 2n=12). Characteristic of the genus in North America is the elongate shell spire, and the mud-covered shell. The anatomical character which is diagnostic for the genus is the lack of a sheath enveloping the penis (Fig. 48).

Catinella avara (Say)

(Figs. 48; 49, a; 50, a; 51; 52)

Succinea avara Say 1824, In: *Narrative ... expedit. ... St. Peter's R.*, 2, p. 260, pl. 15, fig. 6 (Northwest Territory).
Succinea vermeta Say 1829, *New Harmony Dissem.*, 2, p. 230 (New Harmony, Indiana).
Succinea avara Say, Walker (1899, p. 24).
Succinea avara alba Cockerell, Walker (1899, p. 24).
Succinea avara major Binney, Walker (1899, p. 25).
Succinea avara vermeta Say, Walker (1899, p. 25).
Succinea avara vermeta Say, Walker (1906, p. 503, fig. 114).
Succinea avara vermeta Say, Winslow (1926, p. 9, no. 94).
Succinea avara Say, Goodrich (1932, p. 39, fig.)
Succinea avara vermeta Say, Goodrich (1832, p. 40).
Succinea avara Say, Archer (1936, p. 14)
Succinea avara Say, Pilsbry (1948, p. 837, fig. 455,a-k).
Quickella vermeta (Say), Hubricht (1958, Nautilus, 72(2). p. 60).
Catinella avara (Say), Burch (1962, pp. 67, 191, fig. 139).
Catinella vermeta (Say), Burch & Patterson (1966, p. 1, fig. 2).
Catinella avara (Say), Hubricht (1985, p. 16, map 134).

Shell: Small to medium-sized, 7 - 13$^+$ mm in length with 3$^+$ whorls, very thin, fragile, imperforate, translucent, color pale yellowish with a greenish or pinkish tint, or bright yellow to corneous. Whorls well rounded, sutures impressed. Sculpture of irregular wrinkles, generally covered with dirt or mud. Aperture large, oval, lip thin, sharp, not expanded.

Animal: "There is a distinct 'locomotive disc,' half to two-thirds the width of the sole. In rapid movement it shows forwardly moving waves with oscillatory backward movement between them. The mantle under the shell is beautifully spotted with opaque white and black on a pale gray background; tentacles black. The sole is either of uniform pale tint or peppered with black." (Pilsbry, 1948, p. 837).

Habitat: "The habitat is usually the under side of logs, sticks, chips, or on the damp stones of dark places" (Goodrich, 1932, p. 39). Archer (1936, p. 14) found it in a broad range of habitats, and at Douglas Lake in leaf mold in hardwoods, on

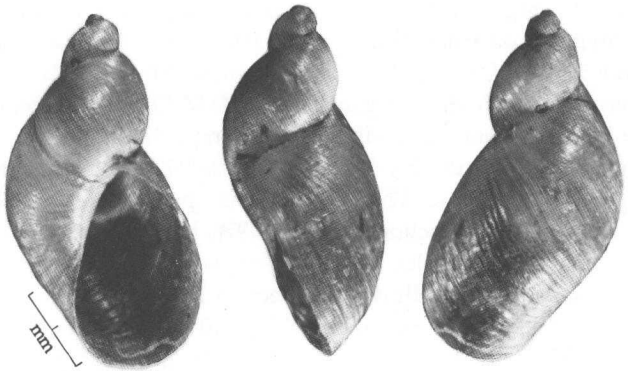


FIG. 51. Shell of *Catinella avara*, apertural (ventral), side (right lateral) and top (dorsal) views; UMMZ 121435.

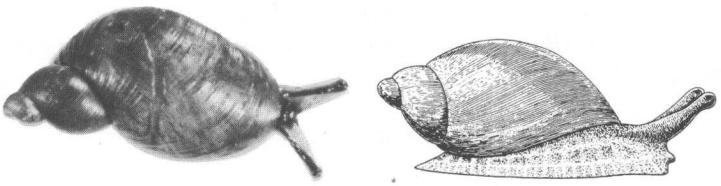


FIG. 52. Animal and shell of *Catinella avara*. **a**, Dorsal view, from UMBS area; **b**, side view, from F.C. Baker (1939, *Handb. Ill. land snails*, Nat. Hist. Surv. Div., Urbana, Ill.).

sandy beaches, and at the bases of grasses on open lake shores. "Usually found on vegetable debris thrown up on muddy shores, or crawling on the muddy banks of ditches, often exposed to the sun; also in swampy places in pastures (Pilsbry, 1948, p. 839).

General Distribution: North America generally, from Newfoundland west to British Columbia, south to Florida and northern Mexico.

Distribution in UMBS Area: Emmet Co.: beach drift behind sand dunes, shore of Lake Michigan, Wilderness State Park, Section 19, T39N, R5W, UMBS-86-19; beech-maple grove, Section 30, Bear Creek Township, UMMZ 170645; Crooked Lake, UMMZ 121413; Little Sucker Creek, UMMZ 198391; northwest 1/4 of Section 27, Wawatam Township, UMMZ 178414; northeast shore of Walloon Lake, Section 30, Bear Creek Township, UMMZ 170733; near Carp River, Section 29, Wawatam Township, UMMZ 170448; Petoskey, UMMZ 121435; shore

of Lake Michigan, Section 30, Friendship Township, UMMZ 170712; **Cheboygan Co.:** Hook Point bay, North Fishtail Bay, Douglas Lake, Section 32, T37N, R3W, Munro Township, UMBS-86-2; Black River, at Tower, UMMZ 170563; Douglas Lake, UMMZ 121458, 121486; Douglas Lake Biological Station, UMMZ 57650; Grapevine Point beach pools, Douglas Lake, Section 28, T37N, R3W, UMMZ 232339; north side of Douglas Lake, UMMZ 42983; Hook Point peninsula, North Fishtail Bay, Douglas Lake, Section 32, T3N, R3W, Munro Township, UMBS-86-22; near Douglas Lake, UMMZ 42984; woods pool at public access and park, Maple Bay, Burt Lake, Section 29, Burt Township, T36N, R3W, UMBS-87-1; drift of Lake Michigan 10 miles south of Mackinaw, UMMZ 63850; hotel at Mullet Lake, UMMZ 121414; Mackinaw City, UMMZ 211883; 2 miles southwest of Wolverine at Little Sturgeon River, UMMZ 212048. **Presque Isle Co.:** Lake Huron, north edge of Rogers City, UMMZ 170575; Lake Huron, Section 15, Bearinger Township, UMMZ 170761; Lake Huron, Section 14, Ocqueoc Township, UMMZ 170662; Ocqueoc River, 3 miles northeast of Ocqueoc, UMMZ 249458.

Genus *Oxyloma* Westerlund

Oxyloma is a Holarctic genus; further geographic distribution can only be ascertained by future anatomical studies. The shells generally have flattered whorls and short spires. The diagnostic character for determining the genus is in the terminal male genitalia, in which there is a sheath covering the retracted penis and an appendix at the apical end of the penis (Fig. 49, c, d).

Oxyloma retusa (Lea)

(Figs. 49, c; 50, c; 53)

Succinea retusa Lea 1834, *Trans. Am. philos. Soc.*, 5, p. 117, pl. 19, fig. 86.
Succinea retusa Lea, Walker (1899, p. 22).
Succinea retusa Lea, Walker (1906, p. 500, figs. 103, 106, 107, 109).
Succinea retusa Lea, Winslow (1926, p. 9, no. 98).
Succinea retusa Lea, Goodrich (1932, p. 38, fig.).
Succinea retusa Lea, Archer (1936, p. 14).
Oxyloma retusa (Lea), Pilsbry (1948, p. 785, fig. 421).
Oxyloma retusa (Lea), Burch (1962, pp. 68, 191, fig. 141).
Oxyloma retusa (Lea), Burch & Patterson (1966, p. 2, fig. 3).

Shell: Medium in size, about 15 - 16 mm in length with three

whorls, very thin, fragile, imperforate, transparent, glossy, color pale horn to buff, sculptured with faint growth lines. Whorls flattened, spire much shorter than the aperture length. Aperture relatively very large, elongately oval, the lip thin, sharp, unexpanded.

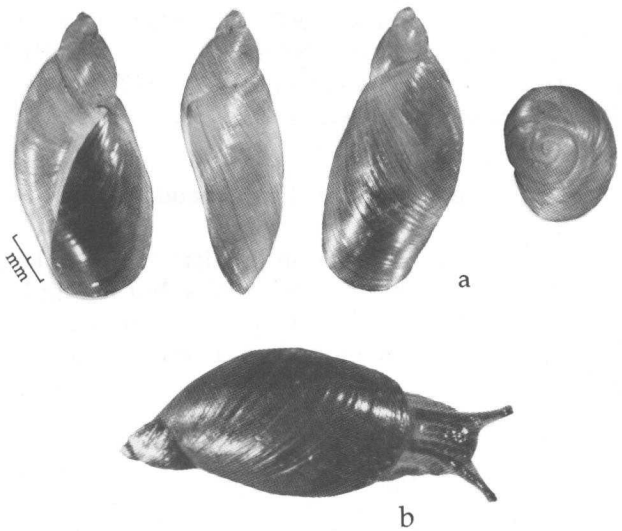


FIG. 53. *Oxyloma retusa*. **a**, shell: apertural (ventral), side (right lateral), top (dorsal) and apical views, UMMZ 122562; **b**, shell and animal, dorsal view, UMBS-86-2.

Animal: "The mantle over the lung is gray, being finely peppered with microscopic dark points. These pigment dots are sparse on the collar, and there is some gray marking on the foot. The genital orifice is a short, oblique slit." (Pilsbry, 1948, p. 786 [for form *higginsi*]).

Habitat: "Marshes and other wet places. It can be found upon partly submerged sticks, on rotting water weeds, and often high on the stems of cat-tails" (Goodrich, 1932, p. 38). At Douglas Lake, Archer (1936, p. 14) found *Oxyloma retusa* among rushes along the shore of the lake.

General Distribution: United States generally.

Distribution in UMBS Area: **Emmet Co.**: roadside ditch and swamp along Levering Road, 0.35 mile east of crossroads (highways

US-31 and C-66) at Levering, northeast corner of Section 3, T37N, R4W, McKinley Township, UMBS-86-6; beach drift behind sand dunes, shore of Lake Michigan, Wilderness State Park, Section 19, T39N, R5W, UMBS-86-19; Crooked Lake, UMMZ 122524; Island in Crooked Lake, UMMZ 122495; Petoskey, UMMZ 122516; **Cheboygan Co.**: Hook Point bay, North Fishtail Bay, Douglas Lake, Section 32, T37N, R3W, Munro Township, UMBS-86-2; head of Mullet Lake, UMMZ 122496; Burt Lake, UMMZ 39714; woods pool at public access and park, Maple Bay, Burt Lake, Section 29, Burt Township, T36N, R3W, UMBS-87-1; Douglas Lake, UMMZ 122562.

Genus *Succinea* Draparnaud

Succinea is nearly world-wide in its distribution. The shells differ in shape among the various species, but the only really reliable diagnostic character for the genus is the terminal male genitalia: the penis is enveloped in a sheath, but lacks an appendix (Fig. 49, a, b).

Succinea ovalis Say
(Figs. 49, b; 50, b; 54)

Succinea ovalis Say 1817, *J. Acad. nat. Sci. Philad.*, 1, p. 15.
Succinea obliqua Say, Walker (1899, p. 24, ? = *Succinea ovalis* Say).
Succinea ovalis Say, Walker (1906, p. 502, fig. 113).
Succinea ovalis Say, Winslow (1926, p. 9, no. 96).
Succinea ovalis Say, Goodrich (1932, p. 39).
Succinea ovalis Say, Archer (1936, p. 14).
Succinea ovalis Say, Pilsbry (1948, p. 801, figs. 430-433).
Succinea ovalis Say, Burch (1962, pp. 68, 191, fig. 140).
Succinea ovalis Say, Burch & Patterson (1966, p. 2, fig. 4).

Shell: Medium in size, 14.0 - 16.5 mm in length with about 2 1/2 whorls, thin, fragile, imperforate, translucent, greenish-yellow in color, sculptured with transverse growth wrinkles. Whorls rounded, spire short. Aperture large, oval, its lip sharp, thin, not expanded.

Animal: "The sides of the living animal are more or less suffused with orange, deeper towards the edges of the foot (but sometimes diluted, or replaced by light yellow); the orange color under the lens appearing in minute flecks. The back is gray or blackish with pale venation. Usually short black or gray stripes adorn the sides, and a dark patch is on the top of

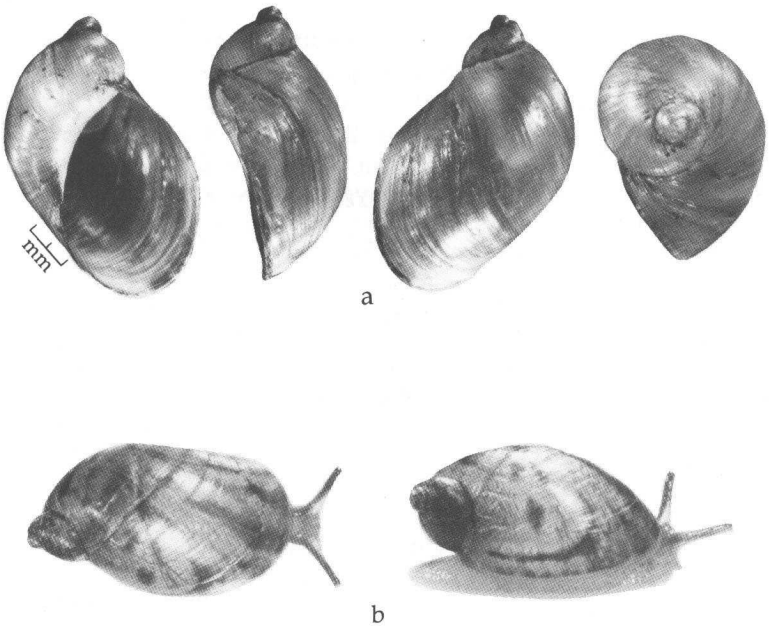


FIG. 54. *Succinea ovalis.* **a**, Shell: apertural (ventral), side (right lateral), top (dorsal) and apical views, UMMZ 212047; **b**, shell and animal dorsal and right lateral views (UMBS, Grapevine Point).

the tail. Sole bluish-gray, shading to orange at the edges. In progression it shows five or six moderately distinct waves across the sole. Tentacles dark gray. Mantle edge closely flecked with orange. The mantle over the lung, when the shell is removed, is variable in color among individuals of one colony. It is rarely almost black, more often blackish marbled with a pale tint, or it may be pale yellow with scattered gray or black spots in a tracery of gray. Usually there are some black dashes bordering and at right angles to the mantle-edge." (Pilsbry, 1948, p. 804).

Habitat: "This snail prefers drier localities than those frequented by [*Oxyloma*] *retusa* and often is to be found among the weeds of the edges of upland woods" (Goodrich, 1932, p. 39). In hardwoods, *Succinea ovalis* lives in leaf mold; in open fields, it can be found in grasses and weeds, and has been found under boards and rubbish along roadsides (Archer, 1936, p. 14). According to Pilsbry (1948, p. 804) it is "usually found on low

ground near streams, in summer often upon the weedy herbage of such places, a foot or two from the ground".

General Distribution: United States generally.

Distribution in UMBS Area: Emmet Co.: beach drift behind sand dunes, shore of Lake Michigan, Wilderness State Park, Section 19, T39N, R5W, UMBS-86-19; **Cheboygan Co.**: woods at roadside rest stop on highway I-75 north, 5.2 miles south of highway C-64, northeast 1/4 of Section 24, Burt Township, T36N, R3W, UMBS-86-7; University of Michigan Biological Station grounds, near shore, South Fishtail Bay, northwest 1/4 of Section 34, Munro Township, T37N, R3W, UMBS-86-8; around steps to front entrance, Lakeside Laboratory, UMBS grounds, Douglas Lake, northwest 1/4 of Section 33, T37N, R3W, Munro Township, UMBS-87-3; Petoskey, UMMZ 122516; Mackinaw City, UMMZ 212047; 2 miles southwest of Wolverine at Little Sturgeon River, UMMZ 212048.

Family HAPLOTREMATIDAE

This is mainly a family of North American north of Mexico, but a few members inhabit Middle America, the West Indies, and northern South America. The species are carnivorous, feeding on other land snails. Some species are oviparous and others are ovoviviparous. The family contains but one genus, *Haplotrema*, which is best represented in the western United States. In the east there is only one species, *H. concavum*, but it has a wide distribution.

Genus *Haplotrema* Ancey

The shells of *Haplotrema* are very depressed (planispiral or nearly so), generally light-colored (often light greenish-yellow), and are umbilicate or widely umbilicate. The shells are generally sturdy and opaque, in contrast to the thinner and often translucent shells of the Vitrinidae.

Haplotrema concavum (Say)
(Figs. 55, 56)

Helix concava Say 1821, *J. Acad. nat. Sci. Philad.*, 2, p. 159.
Circinaria concava (Say), Walker (1899, p. 18).
Circinaria concava (Say), Walker (1906, p. 472, figs. 25-28).
Circinaria concava (Say), Winslow (1926, p. 7, no. 52).
Circinaria concava (Say), Goodrich (1932, p. 26, fig.).
Haplotrema concavum (Say), Archer (1936, p. 8).
Haplotrema concavum (Say), Pilsbry (1946, p. 208, fig. 100).
Haplotrema concavum (Say), Burch (1962, pp. 120, 196, fig. 295).
Haplotrema concavum (Say), Burch & Patterson (1966, p. 13, fig. 35).

Shell: Medium in size, 11 - 21 mm in diameter with 4 1/2 - 5 1/2 whorls, very depressed to discoidal in shape, widely umbilicate, whitish to yellowish in color (often with a greenish tint), rather glossy, smooth, sculptured with irregular growth lines and often fine spiral lines. The aperture is ovate-lunate, bounded on the parietal side by a callus. The lip is a little thickened and somewhat expanded basally and at its outer margin.

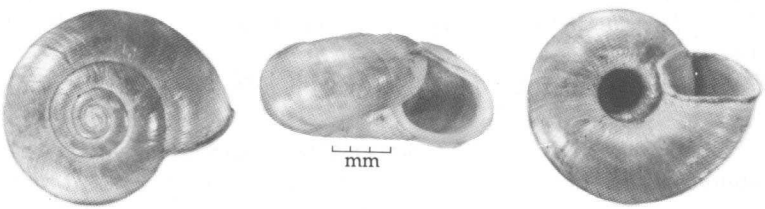


FIG. 55. Shell of *Haplotrema concavum*, UMMZ 57652.

Animal: "Foot with thick epidermis and coarse tessellation; head especially elongate; pedal grooves absent although ventral row of tessellae may present a fairly even dorsal edge; sole undivided. ... Mantle collar broad and heavy; right neck lappet large and prominent; left and left accessory lappets very small and subequal." (H.B. Baker, 1930, *Proc. Acad. nat. Sci. Philad.*, 82, pp. 406, 411).

Habitats: "*Haplotrema concavum* is a forest snail found [in Illinois] in river valleys which are well wooded with oak, elm, hickory, basswood, walnut and pine. It is a rather solitary snail, and few individuals are found together, possibly because

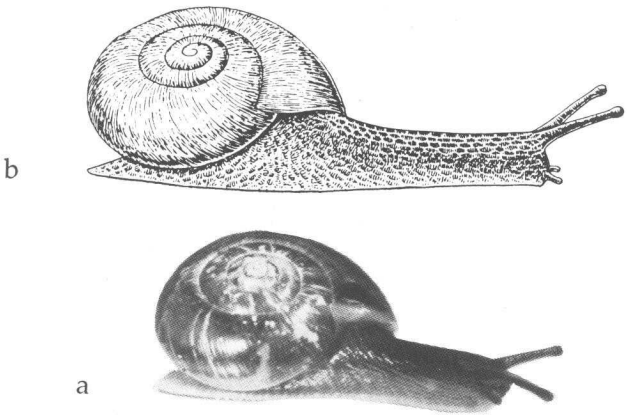


FIG. 56. Animal and shell of *Haplotrema concavum*. **a**, UMBS area; **b**, from F.C. Baker (1939, *Handb. Ill. land snails*, Nat. Hist. Surv. Div., Urbana, Ill.).

of its carnivorous habits. It lives under forest debris, old logs, leaves or any other material which affords concealment and shelter from the sun's rays. It is most abundant in moist woods and is common on floodplains of river valleys." (F.C. Baker, 1939, *Handb. Ill. land snails*, Nat. Hist. Surv. Div., Urbana. Ill., p. 92).

General Distribution: Maine to Florida, west to Iowa and Texas.

Distribution in UMBS Area: Cheboygan Co.: woods near southcentral shore of Douglas Lake, Section 28, T37N, R3W, Munro Township, UMBS-86-1; Grapevine Point, woods pool area, Douglas Lake, Section 28, T37N, R3W, Munro Township, UMBS-86-3; Douglas Lake, UMMZ 113878, 113892; Biological Station, Douglas Lake, UMMZ 57625; Grapevine Point forest floor, Douglas Lake, Section 28, T37N, R3W, UMMZ 232360; south shore of Black Lake near Black Lake Ranch, UMMZ 171621; Reeses Swamp, north end of Burt Lake, UMMZ 178422; **Presque Isle Co.**: Lake Huron, Section 15, Bearinger Township, UMMZ 170753; Ocqueoc River, 3 miles northeast of Ocqueoc, UMMZ 249451.

Family PUNCTIDAE

The snails included below in the Punctidae Morse 1864 were generally previously referred to the Endodontidae Pilsbry 1895.

The "endodontoid" snails currently are undergoing significant revision (Solem, 1976, 1983, *Endodontoid land snails from Pacific islands*, pts. 1, 2, Field Mus. nat. Hist., Chicago), and several of the subfamilies used in the past have been raised one level in the taxonomic hierarchy to the status of full families. Thus, the Endodontidae in the more restricted sense, are inhabitants of the Pacific islands, and do not occur in North America. In our publication, for practical reasons, we are following a conservative path, using one family, the Punctidae, for the North America "endodontoid" land snails, retaining a conservative subfamilial classification. Thus, the four genera of the UMBS area are placed in three subfamilies: *Punctum* in the Punctinae, *Helicodiscus* in the Helicodiscinae, and *Discus* and *Anguispira* in the Discinae.

Key to the Genera in the UMBS Area

1 Shell lirate.....*Helicodiscus* (p. 88)

Shell ribbed or with well-developed (generally coarse) growth lines.....2

2(1) Adult shell small to medium, 5 mm or more in diameter... 3

Adult shell minute (less than 2 mm in diameter with about four whorls), surface sculptured with major and minor riblets.....*Punctum* (p. 80)

3(2) Adult shells of medium size, adults 9 mm and generally 15 mm or more in diameter .....*Anguispira* (p. 82)

Adult shells small, 8 mm or less in diameter..... .....*Discus* (p. 84)

Subfamily PUNCTINAE

This is a subfamily of minute snails having depressed or obtusely conical, umbilicate (mainly) or perforate shells, with lunate apertures and thin, unexpanded lips. Especially diagnostic is the intricate shell sculpture, which may include major and minor riblets, and spiral and transverse striae.

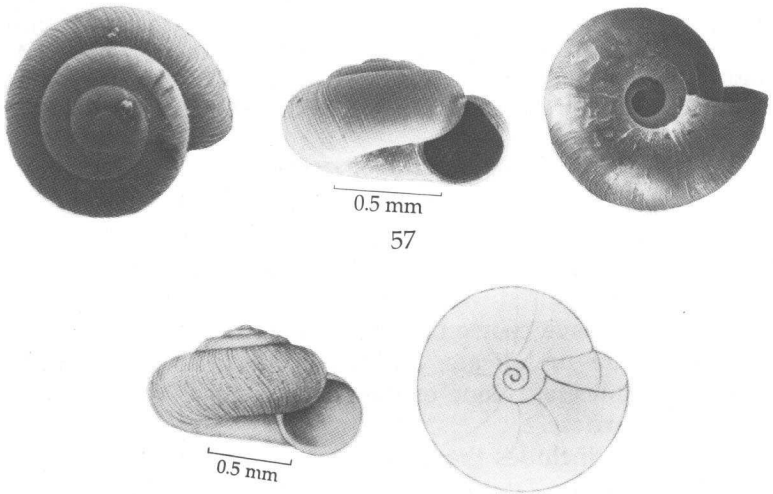
Genus *Punctum* Morse

Punctum gets its name from the minute size of its species. Adult shells of *Punctum* usually measure less than 2 mm in diameter, rarely exceeding 2 mm, and are sculptured with delicate riblets and well-developed spiral striae (see Fig. 57). The shells are umbilicate, and vary in shape from subdiscoidal to low helicoid, depending on the species. The jaw is composed of numerous separate plates, which are connected loosely by a thin membrane.

Punctum minutissimum (Lea)
(Figs. 57, 58)

Helix minutissima I. Lea 1841, *Trans Am. philos. Soc.*, 9, p. 17.
Punctum pygmaeum (Draparnaud), Walker (1899, p. 22).
Punctum pygmaeum (Draparnaud), Walker (1906, p. 496, fig. 91).
Punctum pygmaeum (Draparnaud), Winslow (1926, p. 9, no. 89).
Punctum pygmaeum (Draparnaud), Goodrich (1932, p. 36, fig.)
Punctum minutissimum (Lea), Pilsbry (1948, p. 644, fig. 350).
Punctum minutissimum (Lea), Burch (1962, pp. 80, 192, fig. 179).
Punctum minutissimum (Lea), Burch & Patterson (1966, p. 8, fig. 21).

Shell: Minute, 1.1 - 1.5 mm in diameter with 4 1/4 whorls, thin, rather depressed-helicoid in shape, umbilicate, corneous to light brown in color, translucent, somewhat glossy. "The periostraca is raised in coarse ridges running parallel with the incremental striae [growth lines]; these ridges become more prominent as they approach the umbilical region; they frequently coalesce at, or near, the suture; the faintest perceptible revolving lines are also present, which become more prominent near the umbilicus and seem to be arranged in pairs." (E.S. Morse, 1864, *J. Portland Soc. nat. Hist.*, 1(1), p. 28). The embryonic whorls are smooth. The aperture is round, except for the parietal incursion, the lip is sharp and unexpanded.



FIGS. 57, 58. Shells of *Punctum minutissimum*, top, apertural and umbilical views. FIG. 57, UMMZ 178280, SEM photographs; FIG. 58, from Pilsbry (1948).

Habitat: "Under sticks, chips, and decaying tree branches" (Goodrich, 1932, p. 36). "This dwarf among pygmies lives on damp leaves, around decaying logs, and is chiefly to be obtained by sifting leaves. "Dense, hard wood growths appear to be their favorite position. They prefer the rotten bark of beech trees, and frequently are found in the large forms of fungi, such as *Polyporus and Boletus."* (E.S. Morse, 1864, *J. Portland Soc. nat. Hist.*, 1(1), p. 28).

General Distribution: Maine to Florida, west to Oregon and New Mexico.

Distribution in UMBS Area: Emmet Co.: alive in beach drift behind sand dunes, shore of Lake Michigan, Wilderness State Park, Section 19, T39N, R5W, UMBS-86-19; drift next to boat ramp parking lot at western end of Park road, near shore of Lake Michigan, Wilderness State Park, Section 19, T39N, R5W, UMBS-86-21; shore of Lake Michigan, Section 30, Friendship Township, UMMZ 170710; **Cheboygan Co.**: Grapevine Point, woods pool area, Douglas Lake, Section 28, T37N, R3W, Munro Township, UMBS-86-3; woods at roadside rest stop on highway I-75 north, 5.2 miles south of highway C-64, northeast 1/4 of Section 24, Burt Township, T36N, R3W, UMBS-86-

7; Douglas Lake, UMMZ 214275; Milligan Creek on Michigan Highway 68, UMMZ 170585; east shore of Lancaster Lake, Munro Township, UMMZ 170602; southwest 1/4 of Section 12, T36N, R1W, near south end of Long Lake, UMMZ 178320; **Presque Isle Co.**: Michigan Highway 68a, Section 30, T35N, R5E, UMMZ 178280.

Subfamily DISCINAE

The subfamily Discinae has small to medium shells. The shells of some species have distinctive color markings and some species are sculptured with rather coarse ribs. Species without ribbed shells have coarse or well-developed transverse striae. All shells are umbilicate, and most species of *Discus* are widely umbilicate. None of the shells have reflected lips or apertural barriers.

This group includes the larger North American "endodontoids," the genera *Discus* and *Anguispira*. *Discus* has a Holarctic distribution, while *Anguispira* is found only in North America. *Discus* has about 10 species in the United States and Canada, *Anguispira* has four (as well as a number of named races).

Genus *Anguispira* Morse

The genus *Anguispira* contains species of substantial size and their shells are marked with reddish-brown color bands or patches on a lighter horn, yellow or tan background. The genus is mostly eastern in distribution, but several species occur in the West.

Anguispira alternata (Say)
(Figs. 59, 60)

Helix alternata Say 1817, Conchology, in *Nicholson, W., Am. ed. Brit. encyclop. ...*, sp. 4, pl. 1, fig. 2 (middle states).
Pyramidula alternata (Say), Walker (1899, p. 21).
Pyramidula alternata alba (Tryon), Walker (1899, p. 21).
Pyramidula alternata (Say), Walker (1906, p. 491, figs. 78, 79).
Anguispira alternata (Say), Winslow (1926, p. 8, no. 80).
Anguispira alternata (Say), Goodrich (1932, p. 34, fig.).
Anguispira alternata alba (Tryon), Goodrich (1932, p. 35).
Anguispira alternata (Say), Archer (1936, p. 9).
Anguispira alternata Say), Pilsbry (1948, p. 568, figs. 304,a-d; 305).
Anguispira alternata (Say), Burch (1962, pp. 75, 192, fig. 159).

Anguispira alternata (Say), Burch & Patterson (1966, p. 8, fig. 20, in part).

Shell: Medium in size, 17 - 25 mm in diameter with 5 1/2 - 6 whorls, helicoid to depressed, umbilicate, periphery round or angular, pale yellow to horn in color, marked on the upper surface and just below the periphery with irregular reddish-brown

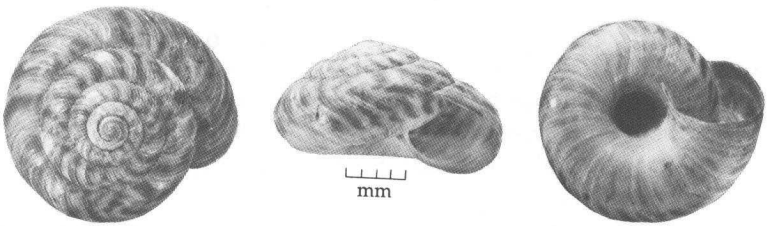


FIG. 59. Shell of *Anguispira alternata*, top, apertural and umbilical views; UMMZ 210827.

brown color blotches, and usually with reddish-brown streaks on the lower surface. Sculptured with rib-like striae, which become weaker on the base, and with transverse wrinkles and weak spiral lines. The embryonic whorls are smooth. The aperture is roundly or ovately lunate, its lip unexpanded.

Animal: "The upper surface of the foot is dull scarlet, becoming dusky on the back; tentacles pale slate; mantle-margin bright red, almost Indian red. The sole is light blue, becoming purplish towards the tail. Often, especially late in the season, all the colors are duller, and at all times there is some individual variation in hue. The mucus of the living animal is saffron colored." (Pilsbry, 1948, pp. 570-571).

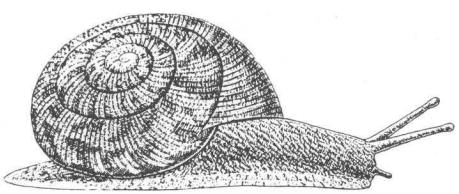


FIG. 60. Animal and shell of *Anguispira alternata*. (From F.C. Baker, 1939, *Handb. Ill. land snails*, Nat. Hist. Surv. Div., Urbana, Ill.)

Habitat: "Found in small to large colonies under sticks and boards, rotting leaves, and the loosened bark of tree stumps" (Goodrich, 1932, p. 34). Archer (1936, p. 9) found it in hardwoods and aspens (leaf mold, the undersides of rotten logs, fallen bark, rotten stumps, ferns and poison ivy), pines (under rotten wood frequently covered with lichens), on reindeer moss, in bog woods (at the bases of arbor vitae and spruce), in open country (in grass and under planks and rotten logs) and in abandoned fields (in old furrow lines). "One of our commonest and most widely spread land snails. It is found under loose bark, dead wood, and in stone-piles. Several observers have found it climbing trees" (Pilsbry, 1948, p. 570).

General Distribution: Maine to Alabama, west to South Dakota and Texas.

Distribution in UMBS Area: Emmet Co.: beach drift behind sand dunes, shore of Lake Michigan, Wilderness State Park, Section 19, T39N, R5W, UMBS-86-19; **Cheboygan Co.:** woods near southcentral shore of Douglas Lake, Section 28, T37N, R3W, Munro Township, UMBS-86-1; Grapevine Point, woods pool area, Douglas Lake, Section 28, T37N, R3W, Munro Township, UMBS-86-3; Douglas Lake, Old Camp, Section 34, T37N, R3W, UMMZ 232355; Reeses swamp at Carp Creek (also called Little Carp River) and Hogsback Road, north 1/4 of Section 4, Burt Township, T36N, R3W, UMBS-87-2; 2 miles west of Wolverine, UMMZ 210824; near Little Sturgeon River, 2 miles southwest of Wolverine, UMMZ 210825; Mackinaw City, UMMZ 210827.

Remarks: *Anguispira alternata* from Virginia was figured by Martin Lister in 1685, making it one of the first North American land snails appearing in a scientific publication (Pilsbry, 1948, p. 570).

Genus *Discus* Fitzinger

The genus *Discus* is widely distributed and has nine naturally occurring species in North America north of Mexico. Five of these species are found only in the east, three are western in distribution, and one species, *D. cronkhitei,* occurs from the Atlantic Ocean to the Pacific. A tenth species, the European and North African *D. rotundatus* (Müller), has been introduced into the eastern states, and into California. Two nominal

species (perhaps only forms), *D. cronkhitei* and *D. catskillensis*, are found in the UMBS area.

Key to Species of *Discus* in the UMBS Area

1 Periphery of last whorl angular, aperture trapezoidal (Figs. 61) ..... *D. catskillensis* (p. 85)

Periphery of last whorl rounded, aperture round (Fig. 62)..... *D. cronkhitei* (p. 87)

Discus catskillensis (Pilsbry)
(Fig. 61)

Pyramidula striatella catskillensis Pilsbry 1898, *Nautilus*, 12, p. 86.
Pyramidula cronkhitei catskillensis (Pilsbry), Walker (1906, p. 493).
Gonyodiscus cronkhitei catskillensis (Pilsbry), Winslow (1926, p. 9, no. 86).
Gonyodiscus cronkhitei catskillensis (Pilsbry), Goodrich (1932, p. 37).
Gonyodiscus cronkhitei catskillensis (Pilsbry), Archer (1936, p. 9).
Discus cronkhitei catskillensis (Pilsbry), Pilsbry (1948, p. 605, fig. 328,e,f).
Discus cronkhitei catskillensis (Pilsbry), Burch (1962, p. 77, fig. 166).
Discus cronkhitei catskillensis (Pilsbry), Burch & Patterson (1966, p. 9, fig. 22, in part).

Shell: Small, about 5 mm in diameter with 4 whorls, very depressed, rather widely umbilicate, pale brown in color, sculptured with low riblets and, on the upper surface, irregular granulation between the riblets. Embryonic whorls smooth. Whorls angular, shouldered above and flattened at the peri-

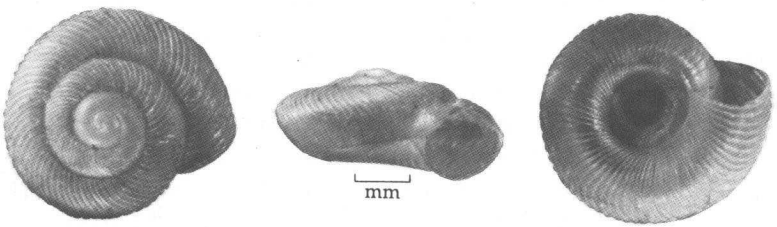


FIG. 61. Shell of *Discus catskillensis*, top, apertural and side views. UMMZ 170570.

phery. The aperture is trapezoidal in shape. The lip is sharp, not expanded.

Habitat: This species lives in leaf mold, under and around rotting logs and stumps, under loose bark, and in open country under debris (Archer, 1936, p. 9). "Found on rotton [sic] logs and among dead leaves in dryer situations than eastern *Discus cronkhitei* generally, often at higher elevations and in hilly or mountainous country" (Pilsbry, 1948, p. 606).

General Distribution: Maine to West Virginia, west to Minnesota and South Dakota.

Distribution in UMBS Area: Emmet Co.: alive in beach drift behind sand dunes, shore of Lake Michigan, Wilderness State Park, Section 19, T39N, R5W, UMBS-86-19; beech-maple grove, 8 miles southeast of Bay View, UMMZ 132197; beech-maple grove, Section 30, Bear Creek Township, UMMZ 170639; Carp Lake, UMMZ 126996; near Carp River, Section 29, Wawatam Township, UMMZ 170622; west shore of Larks Lake, Section 17, Genter Township, UMMZ 170526; northeast shore of Walloon Lake, Section 30, Bear Creek Township, UMMZ 170721; west of Tower, Milligan Creek, UMMZ 36796; **Cheboygan Co.**: woods near southcentral shore of Douglas Lake, Section 28, T37N, R3W, Munro Township, UMBS-86-1; Hook Point bay, North Fishtail Bay, Douglas Lake, Section 32, T37N, R3W, Munro Township, UMBS-86-2; Grapevine Point, woods pool area, Douglas Lake, Section 28, T37N, R3W, Munro Township, UMBS-86-3; around steps to front entrance, Lakeside Laboratory, UMBS grounds, Douglas Lake, north-west 1/4 of Section 33, T37N, R3W, Munro Township, UMBS-87-3; woods at roadside rest stop on highway I-75 north, 5.2 miles south of highway C-64, northeast 1/4 of Section 24, Burt Township, T36N, R3W, UMBS-86-7; Colonial Point Forest, Section 28, Burt Township, T36N, R3W, UMBS-86-9; Reeses Swamp, southwest 1/4 of Section 3, Burt Township, T36N, R3W, UMBS-86-11; Cheboygan, UMMZ 126706; Colonial Point, Burt Lake, UMMZ 57633; Douglas Lake, Biological Station, UMMZ 57632; east shore of Lancaster Lake, Munro Township, UMMZ 170600; Milligan Creek, on Michigan Highway 68, UMMZ 170581; Wequetonsing, 126998; **Presque Isle Co.**: Lake Huron, Section 14, Ocqueoc Township, UMMZ 170659; Lake Huron, Section 15, Bearinger Township, UMMZ 170752; Lake Huron, north edge of Rogers City, UMMZ 170570; oak-pine grove, Section 17, Ocqueoc Township, UMMZ 170555; on US Highway 23, extreme northwest Section [*sic*], UMMZ 170615.

Discus cronkhitei (Newcomb)
(Fig. 62)

Helix cronkhitei Newcomb 1865, Proc. Calif. Acad. Sci., 3, p. 180 (Klamath Valley, Oregon).
Pyramidula striatella (Anthony), Walker (1899, p. 22).
Pyramidula striatella alba Walker, Walker (1899, p. 22).
Pyramidula cronkhitei albina 'Morse' Cockerell, Walker (1906, p. 493).
Pyramidula cronkhitei anthonyi Pilsbry, Walker (1906, p. 493, fig. 83).
Gonyodiscus cronkhitei anthonyi (Pilsbry), Winslow (1926, p. 9, no. 85.).
Gonyodiscus cronkhitei anthonyi Pilsbry, Goodrich (1932, p. 37).
Discus cronkhitei (Newcomb), Pilsbry (1948, p. 600, fig. 328,a-d).
Discus cronkhitei (Newcomb), Burch (1962, pp. 76, 192, fig. 164).
Discus cronkhitei (Newcomb), Burch & Patterson (1966, p. 9, fig. 22, in part).

Shell: Small, 5.0 - 6.7 mm in diameter with 3 2/3 - 4 2/3 whorls, depressed, widely umbilicate, yellowish-horn to brown in color (often with an olive tint), sculptured on both upper and lower sides with low riblets, and with irregular granulation between riblets on the upper surface. Whorls round, not shouldered. Embryonic whorls smooth. The aperture is round, its lip sharp, not expanded.

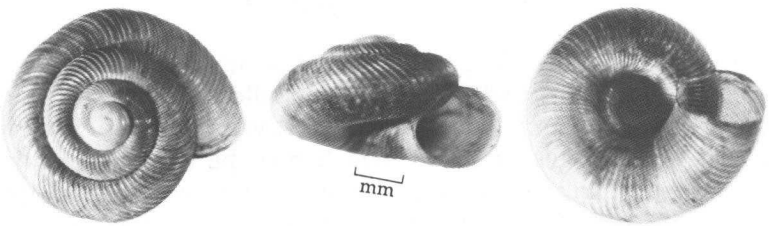


FIG. 62. Shell of *Discus cronkhitei*, top, apertural and umbilical views. **a**, UMMZ 126685; **b**, from Pilsbry (1948).

Animal: "The back and tentacles are blackish; the sides toward the edges of the foot and the tail are translucent pale gray. Sole pale gray, lighter posteriorly, narrow, its width, when the animal is moving, about one-sixth the length; length about 1 1/4 times the diameter of the shell. The surface is copiously lubricated, and no muscular waves are seen on the sole in movement." (Pilsbry, 1948, p. 604).

Habitat: "In humid forest, under dead wood, and among rotting leaves or grass in rather wet situations" (Pilsbry, 1948, p. 604).

General Distribution: Labrador south to North Carolina and Texas, west to Alaska and California.

Distribution in UMBS Area: Emmet Co.: drift next to boat ramp parking lot at western end of Park road, near shore of Lake Michigan, Wilderness State Park, Section 19, T39N, R5W, UMBS-86-21; Crooked Lake, UMMZ 126685; near Carp River, Section 29, Wawatam Township, UMMZ 170622; northeast shore of Walloon Lake, Section 30, Bear Creek Township, UMMZ 170721; **Cheboygan Co.**: Cheboygan, UMMZ 126706; **Presque Isle Co.**: Lake Huron, north edge of Rogers City, UMMZ 170570; Lake Huron, Section 15, Bearinger Township, UMMZ 170752.

Subfamily HELICODISCINAE

The subfamily Helicodiscinae is represented in this area by the single genus *Helicodiscus*, whose peculiar planate and lirate shells are readily diagnostic for the group.

Genus *Helicodiscus* Morse

The shells of *Helicodiscus* are discoidal, have slowly increasing whorls, and are widely umbilicate. Shells of the subgenus *Helicodiscus s. str.* are distinctively sculptured with spiral lirae, ridges or striae, which may be enhanced with periostracal fringes, and the shells have wide, shallow umbilicuses and contain barriers ("teeth") in the last whorl.

Key to Species in the UMBS Area

1 Shell with broader whorls and a narrower, deeper umbilicus (Fig. 63).....*H. parallelus* (p. 89)

Shell with more slender whorls and a broader, shallower umbilicus (Fig. 65).....*H. shimeki* (p. 91)

Helicodiscus parallelus (Say)
(Figs. 63, 64)

Helix parallellus Say 1821, *J. Acad. nat. Sci. Philad.*, 2, pp. 164, 407 (Upper Missouri).
Helicodiscus lineatus (Say), Walker (1899, p. 22).
Helicodiscus parallelus (Say), Walker (1906, p. 495, fig. 88).
Helicodiscus parallelus (Say), Winslow (1926, p. 9, no. 88).
Helicodiscus parallelus (Say), Goodrich (1932, p. 30, fig.)
Helicodiscus parallelus (Say), Archer (1936, p. 8)
Helicodiscus parallelus (Say), Pilsbry (1948, p. 625, figs. 338,c; 339).
Helicodiscus parallelus (Say), Burch (1962, pp. 78, 192, fig. 171).
Helicodiscus parallelus (Say), Burch & Patterson (1966, p. 9, fig. 23).

Shell: Small, diameter about 3.5 mm with about 4 1/2 whorls, discoidal, rather widely umbilicate, pale yellow in color with a greenish tint, and with very little gloss. The apical surface is nearly flat or slightly convex. Sculpture consisting of numerous spiral cords (lirae); the embryonic whorls are spirally striate. The aperture is narrowly lunate, its lip thin, not expanded. Pairs (usually two) of teeth occur in the body whorl. One tooth of each pair is on the outer wall, the other tooth is on the basal wall. One pair of teeth can usually be seen in the aperture.

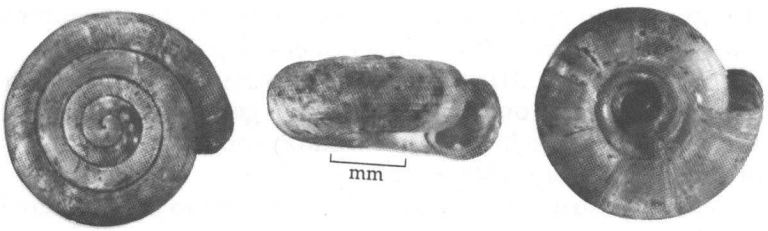
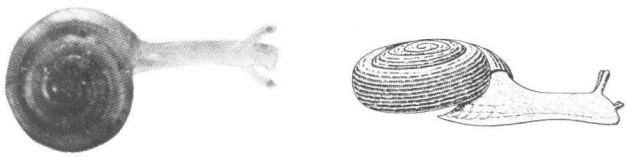


FIG. 63. Shell of *Helicodiscus parallelus*, top, apertural and umbilical views; UMMZ 170722.

Animal: The animal is nearly white or rather translucent, and is mottled with small white blotches. The body is long and narrow. The upper posterior portion of the foot is conspicuously furrowed. In motion, the shell lies perfectly flat on the extreme posterior portion of the body, the superior tentacles stand nearly perpendicular, and the head with the inferior tentacles is thrust out some way beyond the base of the larger tentacles. The eyes are scarcely visible. (E.S. Morse, 1864, *J. Portland Soc.*



a b

FIG. 64. Animal and shell of *Helicodiscus parallelus*. **a**, top view, UMBS area; **b**, from F.C. Baker (1939, *Handb. Ill. land snails*, Nat. Hist. Surv. Div., Urbana, Ill.).

nat. Hist., 1(1), p. 25). "The sole shows no division, and no waves in progression; pedal furrows distinct. Eye stalks rather stout, not swollen at the ends, and without pigmented eyes; tentacles short. Mantle-edge orange tinted, but the animal is otherwise translucent whitish throughout." (Pilsbry, 1948, p. 622). The mantle collar is quite narrow, except around the pneumostome, where it is extensive. The anus is under the mantle flap on the right side of the pneumostome. (H.B. Baker, 1927, *Proc. Acad. nat. Sci. Philad.*, 79: 234).

Habitat: *Helicodiscus parallelus* lives in hardwoods in leaf litter and ferns, under loose bark and at the bases of rotting stumps, and in open country under boards and in old stumps (Archer, 1936, pp. 8, 9). "Under sticks, logs, and stones ..." (Goodrich, 1932, p. 31). "It lives on decaying wood in shady or humid places, also on damp leaves. It is generally distributed, and may usually be found in leaf siftings and in the drift debris of streams" (Pilsbry, 1948, p. 627).

General Distribution: Maine to Florida, west to South Dakota and Texas.

Distribution in UMBS Area: Emmet Co.: near Carp River, Section 29, Wawatam Township, UMMZ 170623; beech-maple grove, Section 30, Bear Creek Township, UMMZ 170640; northeast shore of Walloon Lake, Section 30, Bear Creek Township, UMMZ 170722; **Cheboygan Co.**: Grapevine Point, woods pool area, Douglas Lake, Section 28, T37N, R3W, Munro Township, UMBS-86-3; around steps to front entrance, Lakeside Laboratory, UMBS grounds, Douglas Lake, northwest 1/4 of Section 33, T37N, R3W, Munro Township, UMBS-87-3; Colonial Point Forest, Section 28, Burt Township, T36N, R3W, UMBS-86-9; Reeses Swamp, southwest 1/4 of Section 3, Burt

Township, T36N, R3W, UMBS-86-11; vacant lot, Cheboygan, UMMZ 170611; Douglas Lake, UMMZ 127303; east shore of Lancaster Lake, Munro Township, UMMZ 170601; 2 miles southwest of Wolverine at Little Sturgeon River, UMMZ 211464.

Helicodiscus shimeki Hubricht
(Fig. 65)

Helicodiscus shimeki Hubricht 1962, *Nautilus*, 75(3), p. 103, pl. 7,A-C, map 1.
Helicodiscus shimeki Hubricht, Hubricht (1985, p. 21, map 186).

Shell: "Discoidal, pale yellow, somewhat shining, translucent, spire flat or slightly convex. Umbilicus wide, shallow, showing all the whorls, occupying about 50% of the diameter of the shell. Whorls 5 to 6, well rounded, very narrow and slowly increasing; nuclear whorls with faint spiral striae; later whorls with numerous spiral threads. Aperture lunate, peristome thin. Within the last whorl there are usually three pairs of small conical teeth; on the outer and basal walls, the earlier teeth are absorbed. Height, 1.7 mm. Diameter, 4.2 mm. Umbilicus diameter, 2.1 mm. Aperture height, 1.7 mm. 5.2 whorls. Holotype." (Hubricht, 1962, p. 103).

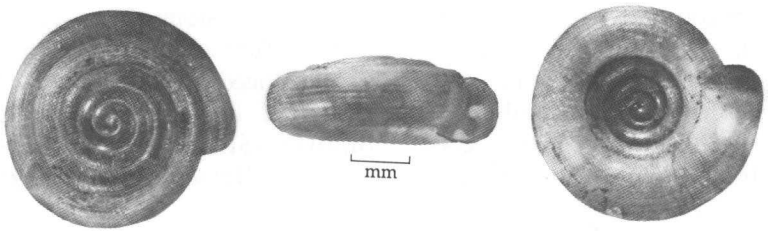


FIG. 65. Shell of *Helicodiscus shimeki*, top, apertural and umbilical views; UMMZ 207796.

Remarks: "*Helicodiscus shimeki* may be readily distinguished from *H. parallelus* (Say) by its more slender whorls and its broader, shallower umbilicus" (Hubricht, 1962, *loc. cit.*).

Habitat: Leaf litter in upland woods, often on very acid soil. (Hubricht, 1985, p. 21).

General Distribution: Maine west to Minnesota, south to Iowa, Illinois and West Virginia (Hubricht, *op. cit.*)

Distribution in UMBS Area: Emmet and Cheboygan counties. (Hubricht, 1962; specific localities not given). [A few specimens seemingly fitting Hubricht's description of *Helicodiscus shimeki* occur in lot UMMZ 127303 (Douglas Lake area) with many typical *H. parallelus* shells. We are not convinced that "*H. shimeki*" is specifically distinct from *H. parallelus*.]

Family VITRINIDAE (Zonitidae)

This family of medium to small snails is almost world-wide in its distribution, and in North America it is one of the dominant land snail families. The shell of its species is usually perforate or umbilicate, and generally is smooth and glossy and has a depressed spire. The apertural lip is thin and not reflected. The animal has the margin of the foot defined by pedal and suprapedal grooves, like other aulacopod snails. Several of the North American genera are rather large ones, e.g., *Glyphyalinia* and *Paravitrea*, each containing a number of species. *Paravitrea* is restricted to eastern North America. *Glyphyalinia* is also found only in the east, except for *G. indentata paucilirata*, which extends into Arizona, New Mexico and Utah. *Hawaiia, Striatura, Vitrina* and *Zonitoides* are found in both the eastern and western divisions. Members of the genus *Oxychilus*, usually found in gardens and in and around greenhouses and cellars, have been introduced from Europe.

Three vitrinid subfamilies are found in the UMBS area, Vitrininae (*Vitrina*), Gastrodontinae (*Striatura* and *Zonitoides*) and Zonitidae (*Glyphyalinia, Hawaiia, Oxychilus* and *Paravitrea*).

Key to the Genera in the UMBS Area

1 Shell with few (3 or less) rapidly enlarging whorls, imperforate, very thin; aperture unusually large, larger than the rest of the shell when seen in side view .... *Vitrina* (p. 94)

Shell with 3 or more whorls which increase slowly in size; shell thicker; aperture smaller than rest of shell when seen in side view.....2

2(1) Shell with barriers ("teeth" or lamellae) in the aperture or body whorl.....*Paravitrea* (p. 122)

Shell without "teeth" in the aperture and body whorl.... 3

3(2) Shell sculptured with either riblets or a reticulate pattern.....*Striatura* (p. 97)

Shell without either riblets or a reticulate pattern.....4

4(3) Whorls increase regularly in size, the last whorl much wider (Fig. 65, a) 5

Whorls narrow, tightly coiled, increasing very slowly in size (Fig. 65, b).....6

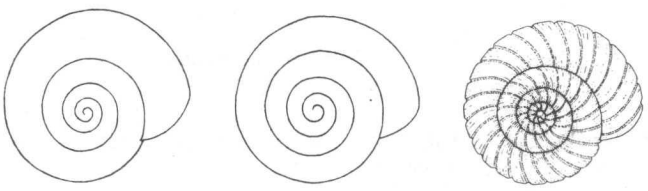


FIG. 66. Shell with **a**, regularly increasing whorls; **b**, slowly increasing whorls; **c**, radiating indented lines.

5(4) Adult shell 8 mm or more in diameter, without radiating indented lines.....*Oxychilus* (p. 121)

Adult shell usually less than 6 mm in diameter, or if larger, with radiating indented lines (Fig. 65, c)..... .....*Glyphyalinia* (p. 108)

6(5) Shell white, opaque ..... *Hawaiia* (p. 119)

Shell corneous, translucent ..... *Zonitoides* (p. 104)

Subfamily VITRININAE

The Vitrininae have thin, fragile, imperforate, glassy, transparent shells with only several whorls. The last (body) whorl is relatively quite large, with a correspondingly large aperture. The mantle has accessory lobes which come up over part of the shell when the snail is active, Typically there are two shell lobes and two mantle lobes. The genus *Vitrina* is found in the UMBS area.

Genus *Vitrina* Draparnaud

This is a Holarctic genus, living in North America in the northern part of the continent, or at higher elevations in the Rocky Mountains of the southwestern states. Two species occur in North America, one in the east (*Vitrina limpida*) and one in the west. According to Pilsbry (1946, p. 501), the genus is probably a Pleistocene immigrant from the Old World.

Vitrina limpida (Gould)
(Figs. 67, 68)

Vitrina limpida Gould 1850, in Agassiz, Lake Superior, p. 243 (Cape Gourganne, Nipigon Bay, Ontario).
Vitrina limpida Gould, Walker (1899, p. 19).
Vitrina limpida Gould, Walker (1906, p. 476, figs. 35-37).
Vitrina limpida Gould, Winslow (1926, p. 7, no. 54).
Vitrina limpida Gould, Goodrich (1932, p. 28, fig.).
Vitrina pellucida limpida Gould, Archer (1936, p. 10).
Vitrina limpida Gould, Pilsbry (1946, p. 501, figs. 274, 275).
Vitrina limpida Gould, Burch (1962, pp. 84, 196, fig. 188).
Vitrina limpida Gould, Burch & Patterson (1966, p. 9, fig. 24).

Shell: The shell is small, about 6 mm in diameter, depressed, with two and a half to three rapidly increasing whorls, which result in a relatively large body whorl. The shell is glossy and

transparent, very thin and fragile, and imperforate. Its size, in relation to the animal, is too small for the entire body to withdraw into. It is colorless, or has a pale greenish tint. The growth lines are very faint. The first whorl has microscopic spiral pits. The lip is thin, sharp, the columellar margin slightly reflected.

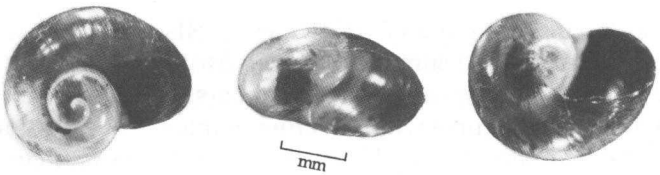


FIG. 67. Shell of *Vitrina limpida*, top, apertural and basal views; UMMZ 132196.

Animal: The pigmentation of the top of the head, neck and tentacles is a pale tannish brown. The sides of the foot are almost pigmentless. The dorsum of the tail is nearly pigmentless, but with a very faint scattering of gray pigment in the median area. The left body-lobe is covered with dark brown pigment, the right shell-lobe has black pigment. Where the left body-lobe and the right shell-lobe meet there is a band of black, more dense pigment. Another band of intense black pigment occurs around the dorsum and posterior side of the pneumostome. These two bands of dark pigment are almost parallel, and between them is a pigmentless area.

"The foot ... is very long and narrow, in motion its length more than double the diameter of the shell; sole distinctly tripartite, the areas defined by fine impressed lines. The peripodal grooves are distinct, meeting on top of the tail, but there is no caudal pore. In front of the mantle there is a median cord on the back. The left body-lobe of the mantle is very large, extending forward half way from the shell to the head, and concentrically wrinkled; right body-lobe much smaller. Left shell-lobe long but narrow, joined by a narrow isthmus with the very mobile, tongue-shaped, right shell-lobe, which extends up over the suture. The whole animal is copiously lubricated with a colorless, watery fluid in life." (Pilsbry, 1946, p. 499).

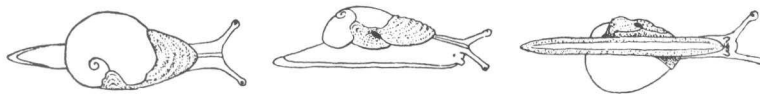


FIG. 68. Animal and shell of *Vitrina limpida*, top, side and bottom views. (From Pilsbry, 1946).

Life History: "Usually only dead shells are to be found during the spring and summer, but after frost in late autumn and early winter they appear in large numbers, lay their eggs, and probably perish during the ensuing winter. The life of an individual apparently does not extend over more than one year" (Pilsbry, 1946, p. 502). At Douglas Lake, Archer (1936, p. 10) a maple woods on shady banks in patches of *Pedicularis canadensis*.

General Distribution: Maine to Pennsylvania, west to Minnesota.

Distribution in UMBS Area: Emmet Co.: beech-maple grove, 8 miles southeast of Bay View, UMMZ 132196; beech-maple grove, Section 30, Bear Creek Township, UMMZ 170647; birch-poplar grove, Section 7, Bliss Township, UMMZ 170775; near Carp River, Section 29, Wawatam Township, UMMZ 170452; shore of Lake Michigan, Section 30, Friendship Township, UMMZ 170714; **Cheboygan Co.**: Reeses Swamp at Carp Creek (also called Little Carp River) and Hogsback Road, north 1/4 of Section 4, Burt Township, T36N, R3W, UMBS-86-5, UMBS-87-2; Douglas Lake, UMMZ 114024; Biological Station, Douglas Lake, UMMZ 57656; around steps to front entrance, Lakeside Laboratory, UMBS grounds, Douglas Lake, northwest 1/4 of Section 33, T37N, R3W, Munro Township, UMBS-87-3; 1/2 mile southeast of Freedom, UMMZ 212496; east shore of Lancaster Lake, Munro Township, UMMZ 170608; hardwood grove, 2 miles west of Wolverine, UMMZ 132219; 2 miles southwest of Wolverine at Little Sturgeon River, UMMZ 212498.

Subfamily GASTRODONTINAE

The Gastrodontinae have depressed, heliciform shells, ranging in size from minute (*Striatura*) to small (*Zonitoides*). The

mantle lacks the accessory lobes extending over the shell which characterize the Vitrininae. The main characteristics of the gastrodontines are the presence of a dart apparatus on the male genitalia (lost in *Striatura exigua* and *S. ferrea*) and a connecting duct between the penial sheath and oviduct or spermathecal duct.

Genus *Striatura* Morse

Striatura is mainly a North American genus of minute snails with depressed, umbilicate, highly sculptured shells. Elsewhere, several species occur on the Hawaiian Islands. Five species are found in North America (north of Mexico), three of which live in the UMBS area.

Key to Species of *Striatura* in the UMBS Area

1 Shell sculptured with riblets 2

Shell with a reticulate sculpture, but without riblets (Fig. 73).....*S. ferrea* (p. 102)

2(1) Riblets high and widely spaced (30-40 on the last whorl); adult shell more than 2 mm in diameter (Figs. 69, 70).....*S. exigua* (p. 97)

Riblets low and closely spaced (many more than 40 on the last whorl); adult shell less than 2 mm in diameter (Figs. 71; 72, b).....*S. milium* (p. 100)

Striatura exigua (Stimpson)
(Figs. 69, 70)

Helix exigua Stimpson 1850, *Proc. Boston Soc. nat. Hist.*, 3, p. 175 (vicinity of Boston, Mass.).
Zonitoides exiguus (Stimpson), Walker (1899, p. 20).
Zonitoides exigua (Stimpson), Walker (1906, p. 485, figs. 61, 62).
Zonitoides exigua (Stimpson), Winslow (1926, p. 8, no. 66).
Striatura (Pseudohyalina) exigua (Stimpson) H.B. Baker (1928b, p. 33, pl. 7, figs. 1-4).

Zonitoides exiguus (Stimpson), Goodrich (1932, p. 32).
Striatura exigua (Stimpson), Pilsbry (1946, p. 490, figs. 267,1-4; 268).
Striatura (Pseudohyalina) exigua (Stimpson), Burch (1962, pp. 87, 196, fig. 197).

Shell: Depressed helicoid, minute (adults 2.2 - 2.4 mm in diameter with about 3 1/2 whorls). The color is corneous with a greenish cast. The radial (transverse) riblets are more oblique than growth lines and are more widely spaced than in other species of the genus. Additional sculpture consists of closely spaced spiral striae. The first embryonic whorl is smooth, followed by spiral striae. The shell has a wide umbilicus, and a small, rounded aperture with simple, unreflected lip. The sutures are well impressed.

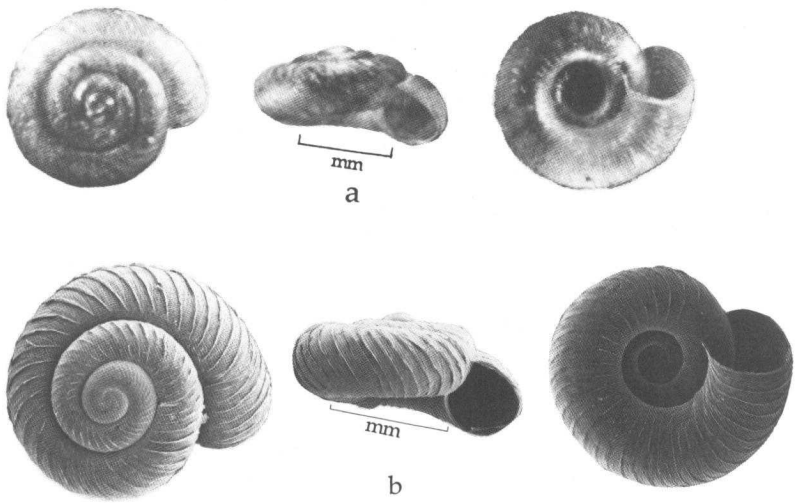


FIG. 69. Shell of *Striatura exigua*, top, apertural and umbilical views. **a**, UMMZ 178427; **b**, UMMZ 170759, 178427 (SEM photographs).

Animal: The body, in life, is light-colored, slightly greenish. The sole of the foot is relatively broad and lacks pedal waves during locomotion, but the entire foot shows some serpentine undulation. The movement of the active animal is relatively slow. The tail is rounded posteriorly. The peripodial angle is acute and hides an inconspicuous mucous depression.

The mantle collar is wide and glandular. Its right and left neck-lappets are quite large. (H.B. Baker, 1928b, p. 34).

FIG. 70. Dorsal shell surface sculpture of *Striatura exigua;* UMMZ 170759. (SEM photograph).

Habitat: "Generally preferring low, wet ground, though sometimes living in situations comparatively dry" (E.S. Morse, 1864, *J. Portland Soc. nat. Hist.,* 1(1), p. 16; for Maine). Damp woodlands, especially those of deciduous trees; occasionally in sphagnum bogs (J. Oughton, 1948, *U. Toronto Stud.,* biol. ser., 57, p. 94; for Ontario).

General Distribution: Maine to Virginia, west to Ohio, Michigan and Minnesota.

Distribution in UMBS Area: Emmet Co.: northwest 1/4 of Section 27, Wawatam Township, UMMZ 178410; near Carp River, Section 29, Wawatam Township, UMMZ 170626; **Cheboygan Co.:** woods near southcentral shore of Douglas Lake, Section 28, T37N, R3W, Munro Township, UMBS-86-1; Grapevine Point, woods pool area, Douglas Lake, Section 28, T37N, R3W, Munro Township, UMBS-86-3; Reeses Swamp, southwest 1/4 of Section 3, Burt Township, T36N, R3W, UMBS-86-11; southwest 1/4 of Section 12, T36N, R1W, near the south end of Long Lake, UMMZ 178315; Milligan Creek, on Michigan High-way 68, UMMZ 170587; Reeses Swamp, north end of Burt Lake,

UMMZ 178427; **Presque Isle Co.**: Lake Huron, Section 15, Bearinger Township, UMMZ 170759; Michigan Highway 68a, Section 30, T35N, R5E, UMMZ 178277.

Striatura milium (Morse)
(Figs. 71, 72)

Helix milium Morse 1859, *Proc. Boston Soc. nat. Hist.*, 7, p. 28.
Zonitoides milium (Morse), Walker (1899, p. 20).
Zonitoides milium (Morse), Walker (1906, p. 486, fig. 63).
Zonitoides milium (Morse), Winslow (1926, p. 8, no. 68).
Striatura (s.s.) milium (Morse), H.B. Baker (1928b, p. 35, pl. 7, figs. 8-12).
Zonitoides milium (Morse), Goodrich (1932, p. 33).
Striatura milium (Morse), Pilsbry (1946, p. 495, figs. 267,8-12; 272).
Striatura milium (Morse), Burch (1962, pp. 88, 196, fig. 199).
Striatura milium (Morse), Burch & Patterson (1966, p. 10, fig. 25).

Shell: Depressed helicoid, minute, about 1.5 mm in diameter, with 3 to 3 1/2 whorls. The color is yellowish-corneous to gray. The sculpture consists of close-set oblique riblets transversing growth lines and well-developed spiral striae. The first embryonic whorl is more or less smooth, the next one-half embryonic whorl is spirally striate, without transverse sculp-

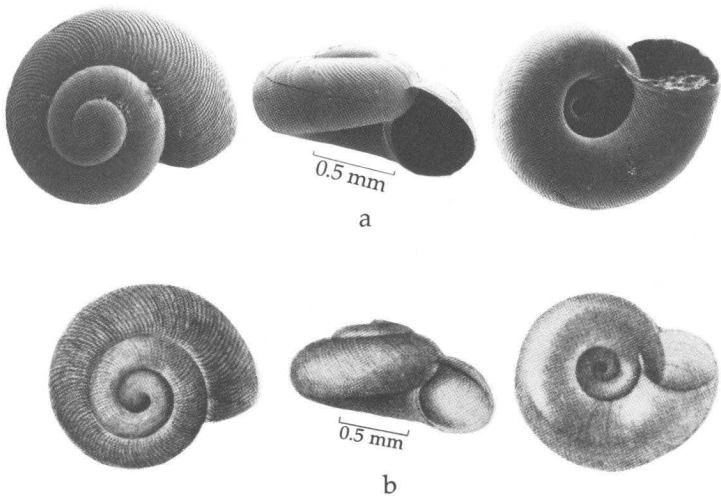
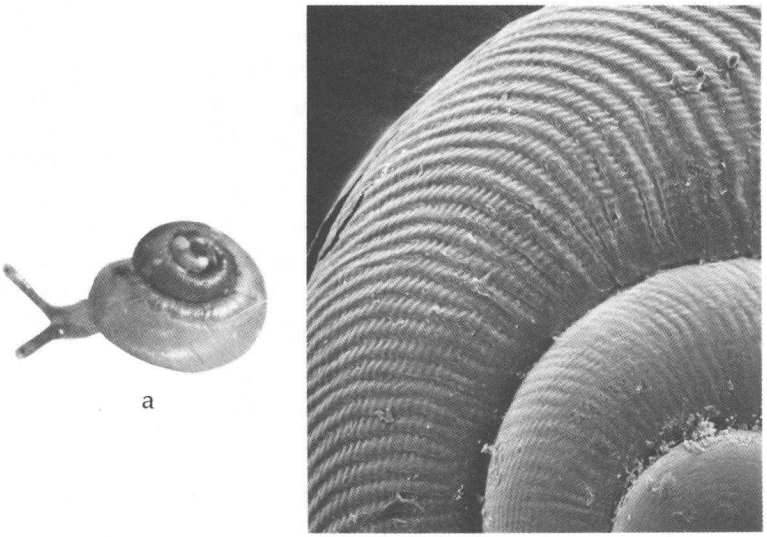


FIG. 71. Shells of *Striatura milium*, **a**, Top, apertural and umbilical views of shell; UMMZ 117376, 178314 (SEM photographs); **b**, from Pilsbry (1946).



a b

FIG 72. *Striatura milium*. **a**, Animal and shell; **b**, dorsal shell surface sculpture, UMMZ 117376. (SEM photographs).

ture. The lip is sharp, unreflected. The shell is rather widely umbilicate, the width of the umbilicus about 1/3 the shell width.

Animal: Ommatophores long. The tail is narrowly rounded posteriorly; its peripodial angle is abruptly pointed. The mantle collar is narrow, but heavy. The right and left neck-lappets are medium in size. Other external characteristics are much like *Striatura exigua* (see below). (H.B. Baker, 1928b, pp. 35, 36).

Habitat: *Striatura milium* "lives among dead leaves in the woods, and may be collected by sifting. I have found it most frequently on northern slopes with chestnut, beech or even oak timber, but Morse states that in Maine it lives also where the growth is almost exclusively pine, spruce and hemlock" (Pilsbry, 1946, p. 496).

General Distribution: Maine to Virginia, west to Minnesota and Iowa.

Distribution in UMBS Area: Emmet Co.: near Carp River, Section 29, Wawatam Township, UMMZ 170446; birch-poplar grove,

Section 7, Bliss Township, UMMZ 170772; **Cheboygan Co.**: woods near southcentral shore of Douglas Lake, Section 28, T37N, R3W, Munro Township, UMBS-86-1; Grapevine Point, woods pool area, Douglas Lake, Section 28, T37N, R3W, Munro Township, UMBS-86-3; woods at roadside rest stop on highway I-75 north, 5.2 miles south of highway C-64, northeast 1/4 of Section 24, Burt Township, T36N, R3W, UMBS-86-7; Douglas Lake, UMMZ 117376; east shore of Lancaster Lake, Munro Township, UMMZ 170605; Reeses Swamp, north end of Burt Lake, UMMZ 178426; southwest 1/4 of Section 12, T36N, R1W, near south end of Long Lake, UMMZ 178314; **Presque Isle Co.**: Ocqueoc River, 3 miles northeast of Ocqueoc, UMMZ 249456.

Striatura ferrea (Morse)
(Fig. 73)

Striatura ferrea Morse 1864, *J. Portland Soc. nat. Hist.*, 1, p. 17, figs. 36-39; pl. 2, fig. 10; pl. 7, fig. 40.
Vitrea ferrea (Morse), Walker (1899, p. 19).
Vitrea (Striatura) ferrea (Morse), Walker (1906, p. 479, figs. 45-47).
Vitrea ferrea (Morse), Winslow (1926, p. 7, no. 57).
Striatura (Striaturops) ferrea Morse, H.B. Baker (1928b, p. 36, pl. 7, figs. 5-7).
Vitrea ferrea (Morse), Goodrich (1932, p. 30).
Striatura (Striaturops) ferrea Morse, Pilsbry (1946, p. 497, figs. 267,5-7; 273).
Striatura (Striaturops) ferrea (Morse), Burch (1962, pp. 87, 107, 196, figs. 196, 258).

Shell: Very depressed, the spire hardly exerted. The diameter of adult shells with 3 1/2 to 4 whorls ranges from about 2.5 to 3.4 mm. The shell is grayish, translucent, rather dull. The last whorl enlarges rapidly, similar to that of the glyphyalinias. The sculpture consists of fine growth lines crossed by fine spiral striae. The umbilicus is narrow. The aperture is larger and more elongate than in the other two species of *Striatura*. The lip is simple, sharp, unexpanded.

Animal: The ommatophores in life are short, stout and very dark; the eyes are large. The sole of the foot is uniform and relatively broad. The foot has considerable black pigment. On the mantle, the hindgut and veins are outlined with melanin granules. The mantle collar is slightly wider than in *Striatura milium*, heavy and glandular. Right neck-lappet small, the left one large. (H.B. Baker, 1928b, p. 36).

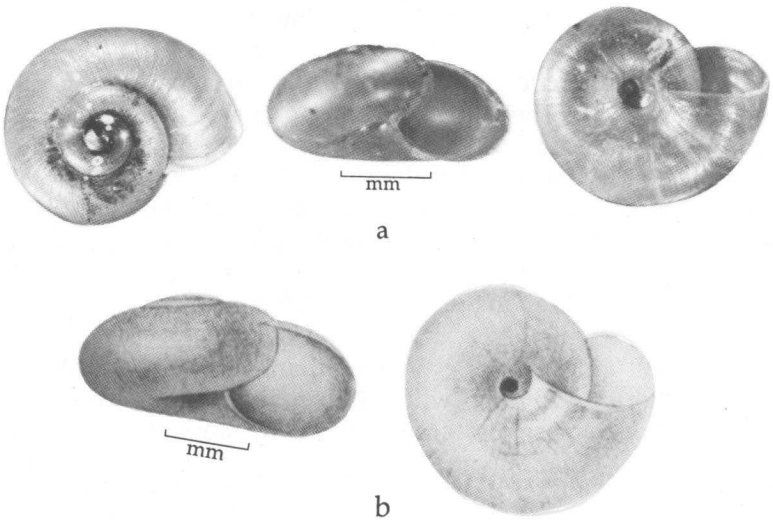


FIG. 73. Shells of *Striatura ferrea*, top, apertural and umbilical views. **a**, UMBS-86-9; **b**, from Pilsbry (1946).

Habitat: "Found in damp localities [in Maine]" (E.S. Morse, 1864, *J. Portland Soc. nat. Hist.*, 1, p. 17). Damp woodlands, especially those of deciduous trees (J. Oughton, 1948, *U. Toronto Stud.*, biol. ser., 57, p. 94; for Ontario).

General Distribution: Maine to North Carolina, west to Michigan and Tennessee.

Distribution in UMBS Area: Emmet Co.: beside small tributary on the west side of the East Branch of the Maple River, southeastern corner of Section 25, T37N, R4W, McKinley Township, UMBS-86-4; drift next to boat ramp parking lot at western end of Park road, near shore of Lake Michigan, Wilderness State Park, Section 19, T39N, R5W, UMBS-86-21; Petoskey, UMMZ 119770; **Cheboygan Co.**: Grapevine Point, woods pool area, Douglas Lake, Section 28, T37N, R3W, Munro Township, UMBS-86-3; Reeses Swamp at Carp Creek (also called Little Carp River) and Hogsback Road, north 1/4 of Section 4, Burt Township, T36N, R3W, UMBS-86-5; woods at roadside rest stop on highway I-75 north, 5.2 miles south of highway C-64, northeast 1/4 of Section 24, Burt Township, T36N, R3W, UMBS-86-7; Colonial Point Forest, Section 28, Burt Township, T36N, R3W, UMBS-86-9; Reeses Swamp, southwest 1/4 of Section 3, Burt Township, T36N, R3W, UMBS-86-11; Douglas Lake, UMMZ 119782.

Genus *Zonitoides* Lehmann

This is a Holarctic genus, with two species common in the UMBS area. The shells are small and depressed, yellowish or tan in color, and are umbilicate. The shells do not have the indented radiating lines of *Glyphyalinia*, species of which at first sight they might be confused. Also, the shells of *Zonitoides* are more tightly coiled than the shells of *Glyphyalinia*.

Key to Species in UMBS Area

1 Shell smaller, 5 - 6 mm in diameter with 4 1/2 - 5 whorls; sculptured with faint spiral striae in addition to growth lines; aperture ovally lunate; animal gray (Figs. 74, 75) ..... *Z. arboreus* (p. 104)

Shell larger, 6 - 8 mm in diameter with 4 1/2 - 5 whorls; sculptured with growth lines, but without striae; aperture roundly lunate; animal black (Fig. 76)..... ..... *Z. nitidus* (p. 107)

Zonitoides arboreus (Say)
(Figs. 74, 75)

Helix arboreus Say 1817, Conchology, in Nicholson, *W., Am. ed. Brit. encyclop.* ... , 2, sp. 2, pl. 4. fig. 4.
Zonitoides arboreus (Say), Walker (1899, p. 20).
Zonitoides arborea (Say), Walker (1906, p. 484, figs. 55, 56, 58).
Zonitoides arborea (Say), Winslow (1926, p. 8, no. 65).
Zonitoides (Zonitellus) arboreus (Say), H.B. Baker (1928b, p. 39, pl. 8, figs. 6-9).
Zonitoides arboreus (Say), Goodrich (1932, p. 32, fig.).
Zonitoides arboreus (Say), Archer (1936, p. 11).
Zonitoides arboreus (Say), Pilsbry (1946, p. 480, figs. 261, 262).
Zonitoides arboreus (Say), Burch (1962, pp. 117, 196, fig. 289).
Zonitoides arboreus (Say), Burch & Patterson (1966, p. 13, fig. 33, in part).

Shell: Small, 5 - 6 mm in diameter with 4 1/2 - 5 whorls, depressed, umbilicate, glossy, translucent, olive buff in color, sculptured with weak, irregular growth lines and very faint spiral striae. Embryonic whorls smooth. The aperture is ovately lunate, the lip thin, unexpanded.

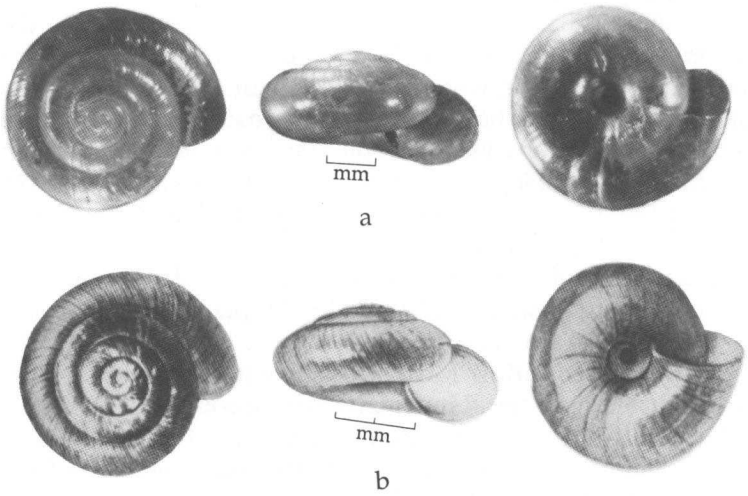


FIG. 74. Shells of *Zonitoides arboreus*, top, apertural and umbilical views. **a**, UMMZ 170565; **b**, from Pilsbry (1946).

Remarks: The shell of *Zonitoides arboreus* is very similar to that of *Z. nitidus*, but it is a little smaller, more depressed, the base is less convex, the aperture is more elongate, and there are faint spiral lines in addition to the transverse growth lines.

Animal: The anatomy is very similar to that of *Zonitoides nitidus*. *Zonitoides arboreus* is lighter in color than *Z. nitidus*, which is a good diagnostic feature for identification.

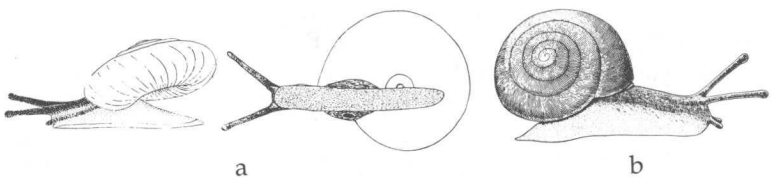


FIG. 75. Animals and shells of *Zonitoides arboreus*. **a**, Left side and bottom views (From Pilsbry, 1946); **b**, right side (from F.C. Baker, 1939, *Handb. Ill. land snails*, Nat. Hist. Surv. Div., Urbana, Ill.).

Habitat: "Under and around decaying logs in the depths of forests; under chips, sticks and bones in fields; in fence corners of

city yards; amid the flood drift of streams and the boards strewn around fishing stations" (Goodrich, 1932, p. 32). "In the eastern states and Mississippi valley this snail is everywhere abundant, to be found wherever there are trees or shelter of any kind; on or under the bark of logs, under boards, bricks or stones in the grass, or in any like situation offering protection from the sun and a reasonable degree of moisture" (Pilsbry, 1946, p. 482). In Cheboygan County, Archer (1936, p. 11) found *Zonitoides arboreus* to occur very generally throughout the area, in hardwoods, conifers and aspens (in plant debris, under rotting logs and around stumps), in open fields (under planks and logs) and along roadsides (around stumps).

General Distribution: Most of Canada; reported from all the United States; introduced into many foreign countries.

Distribution in UMBS Area: Emmet Co.: alive in beach drift behind sand dunes, shore of Lake Michigan, Wilderness State Park, Section 19, T39N, R5W, UMBS-86-19; drift next to boat ramp parking lot at western end of Park road, near shore of Lake Michigan, Wilderness State Park, Section 19, T39N, R5W, UMBS-86-21; west shore of Larks Lake, Section 17, Center Township, UMMZ 170532; near Carp River, Section 29, Wawatam Township, UMMZ 170453; oak-maple grove at Cross Village, UMMZ 170657; shore of Lake Michigan, Section 30, Friendship Township, UMMZ 170715; **Cheboygan Co.**: Woods near southcentral shore of Douglas Lake, Section 28, T37N, R3W, Munro Township, UMBS-86-1; Hook Point bay, North Fishtail Bay, Douglas Lake, Section 32, T37N, R3W, Munro Township, UMBS-86-2; Grapevine Point, woods pool area, Douglas Lake, Section 28, T37N, R3W, Munro Township, UMBS-86-3; Woods at roadside rest stop on highway I-75 north, 5.2 miles south of highway C-64, northeast 1/4 of Section 24, Burt Township, T36N, R3W, UMBS-86-7; University of Michigan Biological Station grounds, near shore, South Fishtail Bay, northwest 1/4 of Section 34, Munro Township, T37N, R3W, UMBS-86-8; Colonial Point Forest, Section 28, Burt Township, T36N, R3W, UMBS-86-9; Reeses Swamp, southwest 1/4 of Section 3, Burt Township, T36N, R3W, UMBS-86-11; Black River at Tower, UMMZ 170565; east shore of Lancaster Lake, Munro Township, UMMZ 170609; Milligan Creek, on Michigan Highway 68, UMMZ 170590; **Presque Isle Co.**: Lake Huron, north edge of Rogers City, UMMZ 170576; Lake Huron, Section 15, Bearinger Township, UMMZ 170764.

Zonitoides nitidus (Müller)
(Fig. 76)

Helix nitida Müller 1774, *Verm. terr. fluv. .succ. hist.*, 2, p. 32 (Fridrichsberg, Denmark).
Zonitoides nitidus (Müller), Walker (1899, p. 20).
Zonitoides nitida (Müller), Walker (1906, p. 483, fig. 57).
Zonitoides nitida (Müller), Winslow (1926, p. 8, no. 70).
Zonitoides (s.s.) nitidus (Müller), H.B. Baker (1928b, p. 38, pl. 8, figs. 1-5).
Zonitoides nitidus (Müller), Goodrich (1932, p. 32).
Zonitoides nitidus (Müller), Pilsbry (1946, p. 476, figs. 258, 259).
Zonitoides nitidus (Müller), Burch (1962, pp. 117, 196, fig. 288).
Zonitoides nitidus (Müller), Burch & Patterson (1966, p. 13, fig. 33, in part).

Shell: Small, 6 - 8 mm in diameter with 4 1/2 - 5 whorls, depressed, with rounded whorls, umbilicate, glossy, translucent, yellowish with an olive tint, and smooth except for weak growth lines. Embryonic whorls smooth. The aperture is roundly lunate, the lip thin, unexpanded.

Remarks: The shell of *Zonitoides nitidus* is larger, less depressed and a little more narrowly umbilicate than that of *Z. arboreus*, it lacks the faint spiral lines, and the base is more convex, the aperture rounder (Pilsbry, 1946, p. 477).

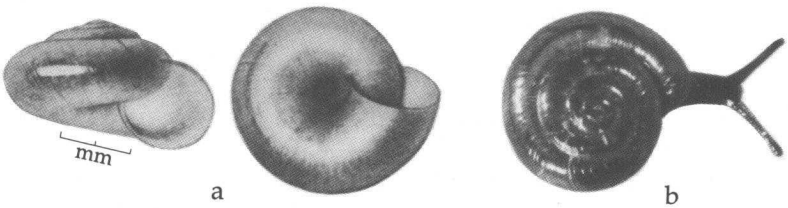


FIG. 76. *Zonitoides nitidus*. **a**, Apertural and umbilical views of shell (from Pilsbry, 1946); **b**, dorsal view of shell and animal, UMBS-86-2.

Animal: The foot is very dark. The peripodial angle is acuminate, but not protuberant. The mucous pore is in a groove just behind the peripodial angle. The sole is uniform, very long and narrow. The mantle collar is deep and thick in front of the lung. The right neck-lappet is large and complex; the left one is small. The aerating surface of the lung is deeply pigmented. (H.B. Baker, 1928b, p. 38).

Habitat: "Lives in fairly large colonies close to the water's

edge of creeks, lakes, and marshes" (Goodrich, 1932, p. 32). "*Zonitoides nitidus* is generally found near water or in marshy places, never in upland woods where *Z. arboreus* lives. In the late autumn they sometimes occur in great numbers under dead wood in wet places, where they have assembled for hibernation" (Pilsbry, 1946, p. 478).

General Distribution: Maine to Maryland, west to Washington and California.

Distribution in UMBS Area: Emmet Co.: beach drift behind sand dunes, shore of Lake Michigan, Wilderness State Park, Section 19, T39N, R5W, UMBS-86-19; drift next to boat ramp parking lot at western end of Park road, near shore of Lake Michigan, Wilderness State Park, Section 19, T39N, R5W, UMBS-86-21; near northeast shore of Walloon Lake, Section 30, Bear Creek Township, UMMZ 170735; beech-maple grove, Section 30, Bear Creek Township, UMMZ 170648; Goose Pond, Wilderness Park, UMMZ 170470; **Cheboygan Co.**: Hook Point bay, North Fishtail Bay, Douglas Lake, Section 32, T37N, R3W, Munro Township, UMBS-86-2; east shore of Lancaster Lake, Munro Township, UMMZ 170610; woods pool at public access and park, Maple Bay, Burt Lake, Section 29, Burt Township, T36N, R3W, UMBS-87-1; **Presque Isle Co.**: south end of Grand Lake, along US Highway 23, UMMZ 171637; Ocqueoc River, 3 miles northeast of Ocqueoc, UMMZ 249442.

Subfamily ZONITINAE

The Zonitinae have depressed, heliciform, minute to medium-sized, generally glossy shells The mantle lacks accessory lobes (which characterize the Vitrininae) and dart apparatus and connecting duct between penial sheath and female reproductive system (which characterize the Gastrodontinae). Four genera occur in the UMBS area, *Glyphyalinia, Hawaiia, Oxychilus* and *Paravitrea.*

Genus *Glyphyalinia* Martens

This is a Holarctic genus of small (mostly) to medium-sized snails with thin, highly depressed, transparent to translucent

shells, which are clear to amber in color, often with a greenish tint. The species range from imperforate to umbilicate. The lip is thin and unreflected. Characteristic of our species are the radiating indented lines on the shell, especially the upper surface. Species in the UMBS area are placed in three subgenera.

The animal varies in color from nearly white to black, depending on the species. The foot is narrow, with distinct aulacopod grooves on the lateral sides, and a mucous pore on the dorsal posterior end. The sole is tripartite, exhibiting pedal waves in the middle area during locomotion.

Key to Species in UMBS Area

1 Shell umbilicate.....2

Shell perforate (Fig. 78).....*G. indentata* (p. 110)

2(1) Base of shell with radiating indented lines (Fig. 80)..... .....*G. rhoadsi* (p. 113)

Base of shell smooth, except for growth lines.....3

3(2) Epiphallus well developed; spermathecal sac ovoid (Figs. 77, a; 81).....*G. wheatleyi* (p. 115)

Epiphallus poorly developed; spermathecal sac long, sausage-shaped (Fig. 77, b).....4

4(3) Shell larger, adults with 4 1/2 whorls are more than 4.5 mm in diameter; animal almost black, sole dark gray (Figs. 77, b; 82).....*G. electrina* (p. 116)

Shell smaller, adults with 4 1/2 whorls are less than 4 mm in diameter; animal almost white, sole white (Fig. 83).....*G. binneyana* (p. 118)

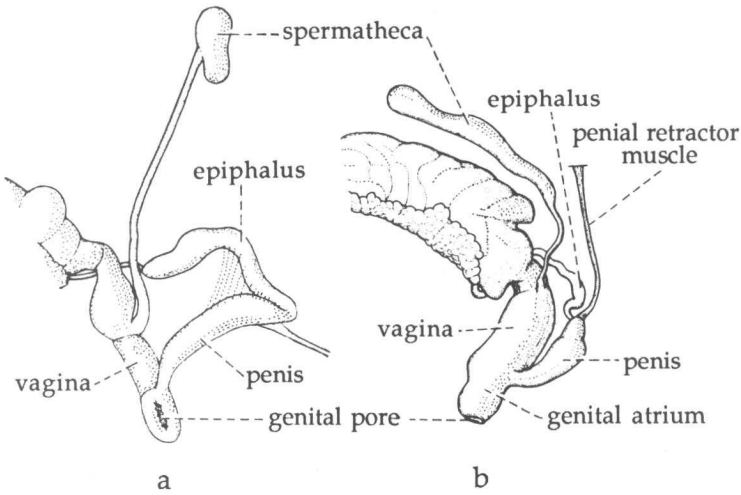


Fig. 77. Terminal genitalia of **a**, *Glyphyalinia wheatleyi*; **b**, G. *electrina*. (From H.B. Baker, 1928b; 1930, *Proc. Acad. nat. Sci. Philad.*, 82).

Subgenus *Glyphyalinia s.s.*

The subgenus *Glyphyalinia s.s.* has been characterized by H.B. Baker (1930 [1931], *Proc. Acad. nat. Sci. Philad.*, 82, pp. 195-196) as having a penis without a flagellum and a shell with closely spaced spiral striae, as well as possessing a well developed epiphallus, short spermatheca and vagina, a papillate chamber at the penial apex, and serrate outer marginal teeth of the radula.

Glyphyalinia indentata (Say)
(Figs. 78, 79)

Helix indentata Say 1823, *J. Acad. nat. Sci. Philad.*, 2, p. 372 (Harrigate and New Jersey).
Vitrea indentata (Say), Walker (1899, p. 19).
Vitrea (Glyphyalina) indentata (Say), Walker (1906, p. 480, fig. 48).
Vitrea indentata (Say), Winslow (1926, p. 7, no. 59).
Glyphyalinia (s.s.) indentata (Say), H.B. Baker (1928b, p. 20, pl. 3, figs. 6-8).
Vitrea indentata (Say), Goodrich (1932, p. 30, fig.).
Retinella indentata (Say), Archer (1936, p. 10).
Retinella indentata (Say), Pilsbry (1946, p. 288, fig. 146,a).

Retinella (Glyphyalinia) indentata (Say), Burch (1962, pp. 101, 194, figs. 238,b; 239).
Retinella indentata (Say), Burch & Patterson (1966, p. 11, fig. 28, in part).

Shell: Diameter 4.5 to nearly 6 mm with 4 1/4 to 4 3/4 whorls, strongly depressed, perforate or rimately perforate, transparent, amber colored, very glossy. Whorls well rounded. Embryonic whorls smooth, except for periodic shallow indented radial lines. Rest of shell sculptured with rather regularly spaced indented radial lines on both the apical and basal sides. Also present are very fine spiral lines. The aperture is lunate, the lip thin, sharp and unexpanded.

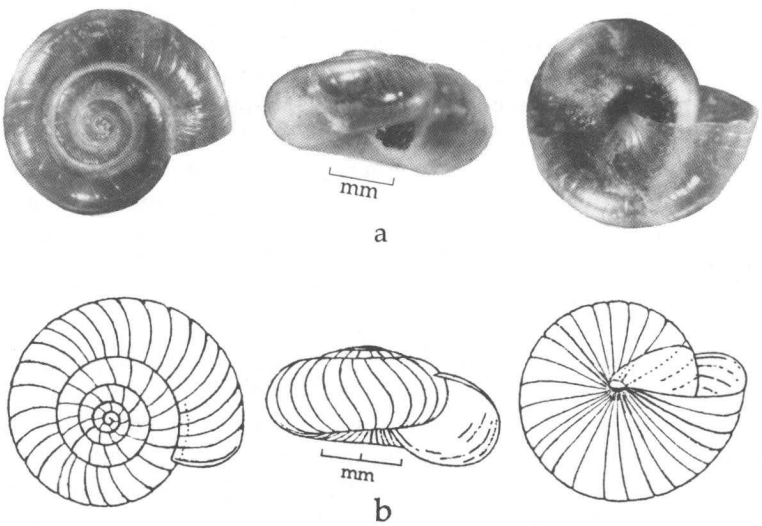


Fig. 78. Shell of *Glyphyalinia indentata*, top, apertural and basal views. **a**, UMMZ 119606 (somewhat immature); **b**, from Pilsbry (1946).

Animal: The animal is mainly white, it shades into pearl-gray on the tail and towards the mantle collar. The exposed epidermis is very heavy and has prominent tesselloid bosses. The foot is not quite so large in proportion to the shell as it is in *Glyphyalinia electrina;* the sole is slender and has less deeply impressed longitudinal furrows. The peripodial angle of the tail is slightly notched and has a small triangular shelf. The mucous groove is in an arrow-shaped swelling, which may

extend slightly beyond the tip of the sole. The mantle collar has large right and left neck-lappets and a small but distinct umbilical shell-lobe. (H.B. Baker, 1928b, p. 20).

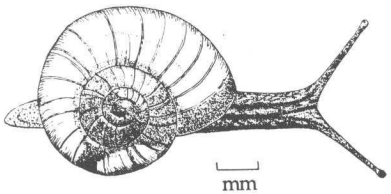


Fig. 79. Shell and animal of *Glyphyalinia indentata*. (From Pilsbry, 1946).

Habitats: "River valleys, in wooded areas and in former prairie lands [in Illinois]. ... Its most favorable habitat ... is in woodlands of oak, elm, maple and hickory. It may be found under loose bark, woodland debris and fallen limbs of trees." (F.C. Baker, 1939, *Handb. Ill. land snails*, Nat. Hist. Surv. Div., Urbana, Ill., p. 71). In Cheboygan County, Archer (1936, p. 10) found *Glyphyalinia indentata* under loose bark and rotting logs, in leaf debris and pine needles, and under the sides of planks in open country.

General Distribution: Maine to Georgia, west to Utah and Arizona.

Distribution in UMBS Area: Emmet Co.: beech-maple grove, Section 30, Bear Creek Township, UMMZ 170643; **Cheboygan Co.**: woods near southcentral shore of Douglas Lake, Section 28, T37N, R3W, Munro Township, UMBS-86-1; woods at roadside rest stop on highway I-75 north, 5.2 miles south of highway C-64, northeast 1/4 of Section 24, Burt Township, T36N, R3W, UMBS-86-7; Colonial Point Forest, Section 28, Burt Township, T36N, R3W, UMBS-86-9; Douglas Lake, UMMZ 119609; Biological Station, Douglas Lake, UMMZ 57646; around steps to front entrance, Lakeside Laboratory, UMBS grounds, Douglas Lake, northwest 1/4 of Section 33, T37N, R3W, Munro Township, UMBS-87-3; Grapevine Point, Douglas Lake, Section 33, T37N, R3W, UMMZ 232334; Indian River, UMMZ 119590; **Presque Isle Co.**: on US Highway 23, extreme northwest Section [*sic*], UMMZ 170617; Michigan Highway 68a, Section 30, T35N, R5E, UMMZ 178283.

Subgenus ***Glyphyalops*** H.B. Baker

In the subgenus *Glyphyalops*, the central tooth is larger than the first lateral tooth and has a broad mesocone, the lateral teeth lack entocones, and the indented radiating lines are strong on the umbilical side of the shell and much more prominent than the growth lines on the apical side. Also, the epiphallus is well developed, the spermatheca is long, the outer marginal teeth of the radula are not serrate, and the shell is umbilicate (H.B. Baker, 1930 [1931], *Proc. Acad. nat. Sci. Philad.*, 82. pp. 195-196).

Glyphyalinia rhoadsi (Pilsbry)
(Fig. 80)

Vitrea rhoadsi Pilsbry 1899, *Nautilus*, 12, p. 101.
Vitrea rhoadsi Pilsbry, Walker (1906, p. 480, fig. 49).
Vitrea rhoadsi Pilsbry, Winslow (1926, p. 8, no. 61).
Glyphyalinia (Glyphyalops) rhoadsi (Pilsbry), H.B. Baker (1928b, p. 21, pl. 4, figs. 4-8).
Vitrea rhoadsi Pilsbry, Goodrich (1932, p. 30).
Retinella rhoadsi (Pilsbry), Archer (1936, p. 10).
Retinella rhoadsi (Pilsbry), Pilsbry (1946, p. 286, fig. 145).
Retinella (Glyphyalops) rhoadsi (Pilsbry), Burch (1962, pp. 95, 193, fig. 221).
Retinella rhoadsi (Pilsbry), Burch & Patterson (1966, p. 11, fig. 28, in part).

Shell: Diameter 4.0 - 4.7 mm with about 4 whorls, strongly depressed, umbilicate, nearly transparent with a brownish tinge, very glossy. Whorls well rounded. Embryonic whorls basically smooth. Rest of shell sculptured with rather regularly spaced indented lines on both the top and bottom sides of the

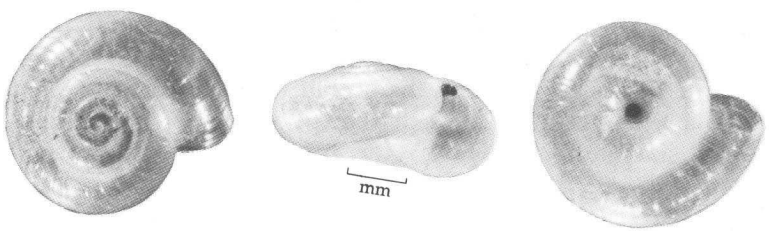


FIG. 80. Shell of *Glyphyalinia rhoadsi*, top, apertural and umbilical views; UMMZ 132195.

shell. Some very weak spiral striae can be seen in places. The lip is thin, sharp and unexpanded.

Remarks: The shell of *Glyphyalinia rhoadsi* is very similar to *G. indentata,* except for being umbilicate.

Animal: The animal is mainly white in color. The sole of the foot is acuminate posteriorly and projects some distance beyond the abruptly pointed peripodial angle. The mucous pore is without a swelling. The mantle collar is much wider than that of *Glyphyalinia indentata,* more glandular dorsally and the left neck-lappet is much longer and more acuminate. (H.B. Baker, 1928b, p. 21).

Habitat: Damp woodlands, especially those of deciduous trees; found occasionally in sphagnum bogs (J. Oughton, 1948, *U. Toronto Stud.,* biol. ser., 57, p. 94; for Ontario). In Cheboygan County, Archer found *Glyphyalinia rhoadsi* most commonly in leaf debris, but also under the sides of rotting logs and fallen bark.

General Distribution: Maine to south Carolina, west to Michigan and Alabama.

Distribution in UMBS Area: Emmet Co.: beech-maple grove 8 miles southeast of Bay View, UMMZ 132195; beech-maple grove, Section 30, Bear Creek Township, UMMZ 170644; Carp Lake, UMMZ 119691; **Cheboygan Co.**: Grapevine Point, woods pool area, Douglas Lake, Section 28, T37N, R3W, Munro Township, UMBS-86-3; Douglas Lake, UMMZ 119693.

Subgenus *Glyphyalus* H.B. Baker

This subgenus is characterized by the central tooth of the radula being about as large as the first lateral tooth and having an elongate mesocone, and by tricuspid lateral teeth. Further, the epiphallus is well developed and the radiating indented lines are weak on the umbilical side of the shell, and only a little more prominent than the growth lines on the dorsal shell surface. (H.B. Baker, 1930 [1931], *Proc. Acad. nat. Sci. Philad.,* 82, p. 195).

Glyphyalinia wheatleyi (Bland)
(Figs. 77, a; 81)

Zonites wheatleyi Bland 1883, *Ann. N. Y. Acad. Sci.*, 2, p. 368, fig. 1.
Vitrea wheatleyi (Bland), Walker (1899, p. 19).
Vitrea wheatleyi (Bland), Walker (1906, p. 478, fig. 43).
Vitrea wheatleyi (Bland), Winslow (1926, p. 8, no. 62).
Vitrea wheatleyi (Bland), Goodrich (1932, p. 29).
Retinella wheatleyi (Bland), Pilsbry (1946, p. 272, figs. 134; 141,1-3).
Retinella (Glyphyalus) wheatleyi (Bland), Burch (1962, pp. 98, 193, fig. 230).
Retinella wheatleyi (Bland), Burch & Patterson (1966, p. 11, fig. 28, in part).

Shell: Diameter 5.0 - 5.5 mm with about 5 whorls, strongly depressed with well rounded whorls. The shell is nearly transparent, brownish, horn-colored (Bland) or bright, coppery horn-colored (H.B. Baker, 1930). The apical surface is sculptured with unevenly and rather closely spaced radial grooves; the basal surface is smooth. Spiral striae may or may not be present, depending on the population. Embryonic whorls smooth, except for several very shallow indented radial grooves. The aperture is lunate, the lip thin, sharp and unexpanded.

Fig. 81. Shell of *Glyphyalinia wheatleyi* (somewhat immature), top, apertural and umbilical views; UMMZ 170530.

Animal: The animal is darkly pigmented, the foot almost black. The right lappet of the mantle edge is large, the left one thin but extensive. The left accessory lappet is very small, tongue-shaped. (H.B. Baker, 1930, *Proc. Acad. nat. Sci., Philad.*, 82, p. 204).

Habitats: "In much the same habitats [in Illinois] as [*Glyphyalinia*] *electrina*; rarely in woodlands bordering agricultural lands" (F.C. Baker, 1939, *Handb. Ill. land snails*,

Nat. Hist. Surv. Div., Urbana, Ill., p. 70).

General Distribution: Massachusetts to Alabama and Louisiana, west to Michigan and Arkansas.

Distribution in UMBS Area: Emmet Co.: west shore of Larks Lake, Section 17, Center Township, UMMZ 170530; near Carp River, Section 29, Wawatam Township, UMMZ 170625; **Cheboygan Co.**: Black River at Tower, UMMZ 170562; Milligan Creek, on Michigan Highway 68, UMMZ 170586; **Presque Isle Co.**: Lake Huron, north edge of Rogers City, UMMZ 170573. [Unconfirmed records from the UMMZ.]

Subgenus ***Perpolita*** H.B. Baker

In the subgenus *Perpolita*, the epiphallus is poorly developed, the spermathecal sac is long, sausage shaped and flabby, the central and lateral teeth of the radula are large, squarish and tricuspid, and purportedly the shell is sculptured with rounded growth wrinkles and lacks the indented radial grooves of other members of *Glyphyalinia*, (H.B. Baker 1930 [1931], *Proc. Acad. nat. Sci. Philad.*, 82, p. 195).

***Glyphyalinia electrina* (Gould)**
(Figs. 77, b; 82)

Helix electrina Gould 1841, Invert. Mass., p. 183, fig. 111.
Vitrea hammonis (Ström), Walker (1899, p. 19).
Vitrea hammonis (Ström), Walker (1906, p. 477, fig. 42).
Vitrea hammonis (Ström), Winslow (1926, p. 7, no. 58).
Retinella hammonis (Ström), Baker (1928, p. 16, pl. 3, figs. 1-4).
Vitrea hammonis (Ström), Goodrich (1932, p. 28).
Retinella electrina (Gould), Archer (1936, p. 14).
Retinella electrina (Gould), Pilsbry (1946, p. 256, figs. 126; 127,1-4).
Retinella (Perpolita) electrina (Gould), Burch (1962, pp. 101, 193, fig. 240).
Retinella electrina (Gould), Burch & Patterson (1966, p. 11, fig. 28, in part).

Shell: Diameter 4.5 - 5^{+} mm with 4 to 4 1/2 whorls, strongly depressed, deeply umbilicate, nearly transparent, glossy, with a faint yellow or green tint. Embryonic whorls smooth. Rest of shell sculptured with crowded radial grooves on the apical side, smooth on the umbilical side. Spiral striation is lacking or very weak. The aperture is lunate, its lip thin, sharp and unexpanded.

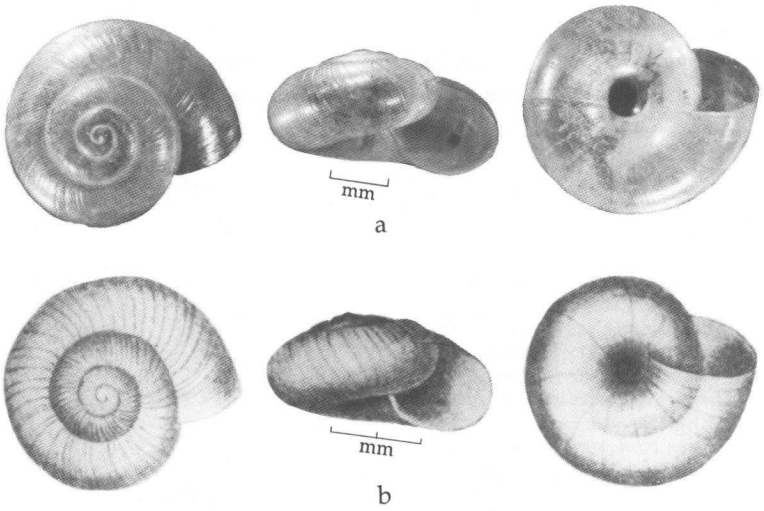


Fig. 82. Shell of *Glyphyalinia electrina*, top, apertural and umbilical views. **a**, UMMZ 118710; **b**, from Pilsbry (1946).

Animal: The animal is very dark in color, with a heavy pebbled skin. The liver, showing through the mantle, is light orange. The foot is large and rounded posteriorly. The peripodial angle is truncate or slightly emarginate. The mucous pore is in the form of a transverse, crescentic slit. The mantle collar is broad and heavy, with large right and left neck-lappets and a third smaller lobe in the palatal region. The umbilical lobe is weak. (H.B. Baker, 1928b, p. 16).

Habitat: "Found ... in large colonies under sticks, logs, and stones, preferring apparently the moist shores of streams and lakes" (Goodrich, 1932, p. 28). "Common [in Illinois] under logs and loose bark in some of the large ... river valleys and their adjoining ravines" (F.C. Baker, 1939, *Handb. Ill. land snails*, Nat. Hist. Surv. Div., Urbana, Ill., p. 70). "In November I found [*Glyphyalinia*] *electrina* under sticks and bark frozen in a little globule of ice. The animal was lively when thawed out" (G.H. Clapp, in Pilsbry, 1946, p. 259).

General Distribution: Canada (Labrador and Newfoundland west to Ontario) and the United States (Maine to Virginia, west to Washington and Arizona).

Distribution in UMBS Area: Emmet Co.: Crooked Lake, UMMZ 118686; **Cheboygan Co.**: Grapevine Point, woods pool area, Douglas Lake, Section 28, T37N, R3W, Munro Township, UMBS-86-3; Cheboygan, UMMZ 118710; Biological Station, Douglas Lake, UMMZ 57645; hotel, Mullet Lake, UMMZ 118663. [Unconfirmed records from the UMMZ.]

Glyphyalinia binneyana (Morse)
(Fig. 83)

Hyalina binneyana Morse 1864, *J. Portland Soc. nat. Hist.*, 1(1), pp. 13, 61, figs. 25, 26; pl. 2, fig. 9; pl. 6, fig. 27.
Vitrea binneyana (Morse), Walker (1899, p. 19).
Vitrea binneyana (Morse), Walker (1906, p. 479, fig. 44).
Vitrea binneyana (Morse), Winslow (1926, p. 7, no. 55).
Retinella (Perpolita) binneyana (Morse) H.B. Baker (1928b, p. 18, pl. 3, fig. 5).
Vitrea binneyana (Morse), Goodrich (1932, p. 29).
Retinella binneyana (Morse), Archer (1936, p. 10).
Retinella binneyana (Morse), Pilsbry (1946, p. 259, fig. 126,a; 127,5).
Retinella (Perpolita) binneyana (Morse), Burch (1962, pp. 102, 193, fig. 241).
Retinella binneyana (Morse), Burch & Patterson (1966, p. 11, fig. 28, in part).

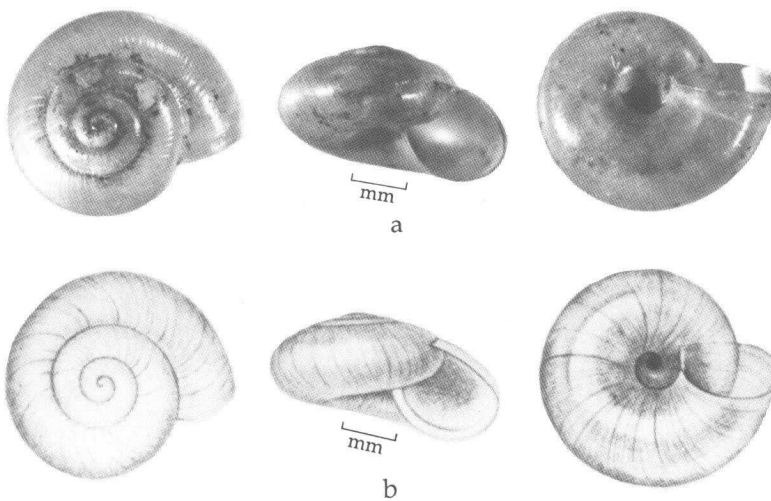


FIG. 83. Shells of *Glyphyalinia binneyana*. **a**, UMMZ 117705; **b**, from Pilsbry, 1946).

Shell: Diameter generally less than 4 mm with 4 1/2 whorls, strongly depressed, umbilicate, nearly transparent, almost colorless, but with a greenish tinge. First whorl nearly smooth, the rest sculptured with closely spaced radial grooves on the upper side, smooth on the base. Spiral striation is lacking or very weak. The aperture is lunate, the lip thin, sharp and unexpanded.

Remarks: The main difference in the shell between this species and *Glyphyalinia electrina* is size.

Animal: The anatomy of this species is almost identical with that of *Glyphyalinia electrina*, except the animal is almost white with dark tentacles. The liver is chocolate brown in uninfected specimens. (H.B. Baker, 1928b, p. 18).

Habitat: Damp woodlands, especially those of deciduous trees; found occasionally in sphagnum bogs (J. Oughton, 1948, *U. Toronto Stud.*, biol. ser., 57, p. 94; for Ontario). In Cheboygan County, Archer (1936, p. 10) found *Glyphyalinia electrina* in hardwood stands, most commonly in leaf debris , but also under rotting logs and fallen bark.

General Distribution: Maine to Pennsylvania, west to Washington and California.

Distribution in UMBS Area: Emmet Co.: Petoskey, UMMZ 117694; northwest 1/4 of Section 27, Wawatam Township, UMMZ 178409; **Cheboygan Co.**: Douglas Lake, UMMZ 117705; Biological Station, Douglas Lake, UMMZ 65955; southwest 1/4 of Section 12, T36N, R1W, near the south end of Long Lake, UMMZ 178319; Reeses Swamp, north end of Burt Lake, UMMZ 178417; hardwood grove, 2 miles southwest of Wolverine at Little Sturgeon River, UMMZ 213941; **Presque Isle Co.**: Michigan Highway 68a, Section 30, T35N, R5E, UMMZ 178286. [Unconfirmed records from the UMMZ.]

Genus *Hawaiia* Gude

This genus is monotypic in the United States and Canada, although several subspecies are recognized (in eastern USA, and in the southwest and Mexico). It is common and widely distributed, and is easily introduced beyond its natural boundaries by human activities. It has been carried to many lands, including Pacific islands, the Far East and Europe. The

genus was named inappropriately for Hawaii, where it was introduced long ago and once believed to be a native snail.

Hawaiia minuscula (Binney)
(Fig. 84)

Helix minuscula Binney 1840, *Boston J. nat. Hist.*, 3, p. 435, pl. 22, fig. 4.
Zonitoides minusculus (Binney), Walker (1899, p. 20).
Zonitoides minuscula (Binney), Walker (1906, p. 485, fig. 60).
Zonitoides minuscula (Binney), Winslow (1926, p. 8, no. 69).
Pseudovitrea minuscula (Binney), H.B. Baker (1928b, p. 25, pl. 5, figs. 1-4).
Zonitoides minusculus (Binney), Goodrich (1932, p. 32).
Hawaii minuscula (Binney), Pilsbry (1946, p. 420, figs. 228,a,b; 229,1-3).
Hawaiia minuscula (Binney), Burch (1962, pp. 106, 195, fig. 254).
Hawaii minuscula (Binney), Burch & Patterson (1966, p. 12, fig. 31).

Shell: Minute, 2.0 - 2.8 mm in diameter with 4-5 whorls, very depressed, umbilicate, pale gray to corneous, sculptured with uneven growth lines which become less distinct on the base. The embryonic whorls are smooth. The aperture is roundly lunate, the lip sharp and unexpanded.

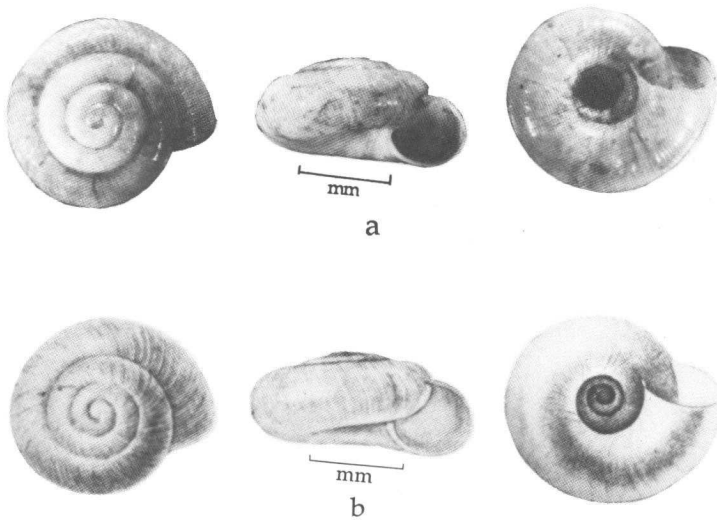


FIG. 84. Shell of *Hawaii minuscula*, top, apertural and umbilical views. **a**, UMMZ 170582; **b**, from Pilsbry (1946).

Animal: The animal is light-colored. The foot is rather small and not especially elongate. The sole is uniform and its posterior end is narrowly rounded. The peripodial angle of the tail is rounded, slightly protruding over the inconspicuous mucous depression. The mantle collar is quite wide and heavy; its right and left neck-lappets are medium in size. (H.B. Baker, 1928b, p. 26).

Habitat: "Found ... usually by the borders of streams and lakes" (Goodrich, 1932, p. 33). "Its most common habitat [in Illinois] is in woodlands of oak, hickory and sycamore" (F.C. Baker, 1939, *Handb. Ill. land snails*, Nat. Hist. Surv. Div., Urbana, Ill., p. 72).

General Distribution: United States generally.

Distribution in UMBS Area: Emmet Co.: drift next to boat ramp parking lot at western end of Park road, near shore of Lake Michigan, Wilderness State Park, Section 19, T39N, R5W, UMBS-86-21; Crooked Lake, UMMZ 117625; **Cheboygan Co.:** Milligan Creek, on Michigan Highway 68, UMMZ 170582.

Genus *Oxychilus* Fitzinger

Oxychilus is Palearctic genus of small to medium-sized snails, several species of which have been introduced into North America. One species, *Oxychilus cellarius*, has been found in the UMBS area. The animal is characterized externally by a long and narrow foot with tripartite sole, a small, slit-like caudal pit, and a single, long, narrow reck lappet.

Oxychilus cellarius (Müller)
(Fig. 85)

Helix cellaria Müller 1774, *Verm. terr. fluv. ... succ. hist.*, 2, p. 28 (wine cellars of Copenhagen).
Vitrea cellaria (Müller), Walker (1899, p. 19).
Vitrea cellaria (Müller), Walker (1906, p. 477, fig. 41).
Vitrea cellaria (Müller), Winslow (1926, p. 7, no. 56).
Vitrea cellaria (Müller), Goodrich (1932, p. 27, fig.)
Oxychilus cellarius (Müller), Pilsbry (1946, p. 249, fig. 123,c).
Oxychilus cellarius (Müller), Burch (1962, pp. 93, 195, fig. 215).
Oxychilus cellarius (Müller), Burch & Patterson (1966, p. 10, fig. 27).

Shell: Medium in size, 8 - 9 mm in diameter with 4 1/2 to 5 whorls, strongly depressed (nearly discoidal), narrowly umbilicate, translucent, very glossy, color pale horn with a greenish tint, sculptured with faint growth lines and very faint spiral lines. Aperture ovate-lunate, with thin, unreflected lip.

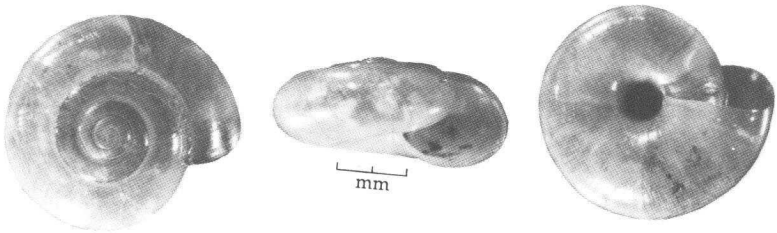


FIG. 85. Shell of *Oxychilus cellarius*, top, apertural and umbilical views; UMMZ 170612.

Animal: "The animal is light gray, darker above, with a pale sole, and the edge of the mantle is spotted with brown" (Ellis in Pilsbry, 1946, p. 249).

Habitat: In and around greenhouses, in cellars, under sticks and boards of stableyards, and under rubbish in neglected city and suburban gardens (Goodrich, 1932, p. 27; Pilsbry, 1946, p. 249).

General Distribution: A native of Europe; introduced into the Atlantic states from Maine to South Carolina, and into Michigan, Indiana, Illinois, Missouri, Oregon and California.

Distribution in UMBS Area: Cheboygan Co.: vacant lot, Cheboygan, UMMZ 170612.

Genus *Paravitrea* Pilsbry

This is a genus of eastern United States and Canada, and is especially prevalent in the Appalachian Mountains. Its species have small, very glossy shells, which are sculptured with radial grooves similar to those of *Glyphyalinia*. The adult shell of *Paravitrea* differs from *Glyphyalinia* by being more tightly coiled, thereby having more whorls (generally 6+ vs. 4.5) and by having teeth or lamellae in the last whorl, visible in the aperture or through the basal shell.

Paravitrea multidentata (Binney)
(Fig. 86)

Helix multidentata Binney 1840, *J. Boston Soc. nat. Hist.*, 3, p. 425, pl. 22, fig. 5 (Massachusetts).
Gastrodonta multidentata (Binney), Walker (1899, p. 21).
Vitrea (Paravitrea) multidentata (Binney), Walker (1906, p. 481, fig. 50).
Vitrea multidentata (Say), Winslow (1926, p. 8, no. 60).
Paravitrea (Paravitreops) multidentata (Binney), H.B. Baker (1928b, p. 31, pl. 6, figs. 1-3).
Vitrea multidentata (Binney), Goodrich (1932, p. 29, fig.).
Paravitrea multidentata (Binney), Pilsbry (1946, p. 352, figs. 184,6,6a; 185).
Paravitrea (Paravitreops) multidentata (Binney), Burch (1962, pp. 105, 194, fig. 252).
Paravitrea multidentata (Binney), Burch & Patterson (1966, p. 12, fig. 30).

Shell: Minute, 2.5 - 3.0 mm in diameter with 6 slowly increasing, shouldered whorls; depressed, narrowly umbilicate, transparent, very glossy, smooth, growth lines not prominent. Within the last whorl, and seen through the base of the shell, are two to four rows of small white teeth on the basal wall, radiating from the columella. The aperture is narrow, lunate, its lip sharp, unexpanded.

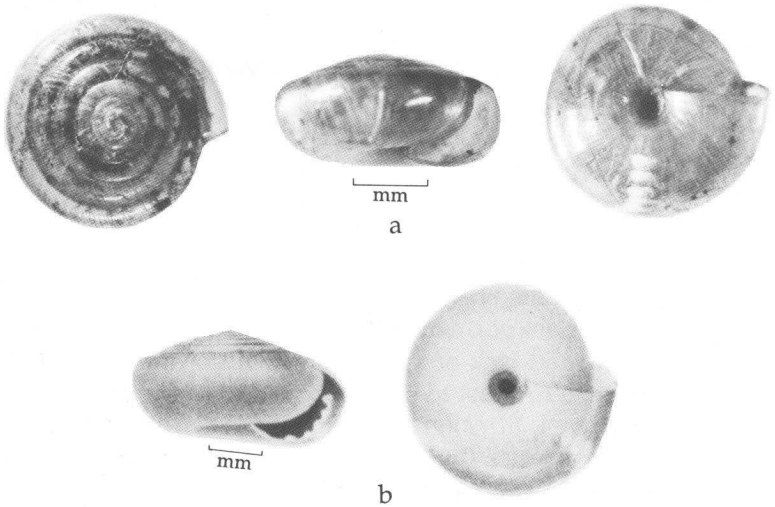


FIG. 86. Shells of *Paravitrea multidentata*. **a**, UMMZ 120181; **b**, from Pilsbry (1946).

Animal: The animal is mainly white. The eye stalks are darker and the foot is grayish. (H.B. Baker, 1928b, p. 31).

Habitat: Damp woodlands, especially those of deciduous trees (J. Oughton, 1948, *U. Toronto Stud.*, biol. ser., 57, p. 94; for Ontario).

General Distribution: Maine to North Carolina, west to Michigan and Arkansas.

Distribution in UMBS Area: Emmet Co.: Carp Lake, UMMZ 120176; Petoskey, UMMZ 120171; Wequetonsing, UMMZ 120177; **Cheboygan Co.**: Grapevine Point, woods pool area, Douglas Lake, Section 28, T37N, R3W, Munro Township, UMBS-86-3; Douglas Lake, UMMZ 120181; **Presque Isle Co.**: south end of Grand Lake along US Highway 23, UMMZ 171630; Michigan Highway 68a, Section 30, T35N, R5E, UMMZ 178282.

Family EUCONULIDAE

The Euconulidae have a wide distribution in the world, but in North America the family contains few species. They have small to minute shells, mostly with convex or dome-shaped spires. The species differ anatomically from the Vitrinidae by the possession of a digitiform appendix on the penis. Only the genus *Euconulus* is found in the UMBS area, where it has two species: *E. fulvus* and *E. chersinus polygyratus*. In *Euconulus*, shell lappets are absent on the mantle collar, but such lappets occur in other members of the family elsewhere.

Genus *Euconulus* Reinhardt

The most obvious characteristics of the shells of *Euconulus* are their dome-shapes, smooth surfaces, sharp, unexpanded apertural lips, and lack of apertural armature (the latter three characters are in contrast to the other small dome-shaped genus of the UMBS area, *Strobilops*). *Euconulus* is a Holarctic genus, with only two species (but with several named subspecies) in the United States and Canada.

Key to Species in UMBS Area

1 Adult, silky luster (Fig. 87).....
.....*E. chersinus polygyratus* (p. 125)

Adult shell with 5 1/2 - 6 whorls, glossy (Fig. 88).....
.....*E. fulvus* (p. 126)

Euconulus chersinus polygyratus (Pilsbry) (Fig. 87)

Conulus chersinus polygyratus Pilsbry 1899, *Nautilus*, 12, p. 116.
Conulus chersinus polygyratus Pilsbry, Walker (1899, p. 20).
Euconulus chersinus polygyratus (Pilsbry), Walker (1906, p. 482, fig. 54).
Euconulus chersinus polygyratus (Pilsbry), Winslow (1926, p. 8, no. 63).
Euconulus (Euconulops) chersinus polygyratus (Pilsbry), H.B. Baker (1928b, p. 11, pl. 2, fig. 3).
Euconulus chersinus polygyratus Pilsbry, Goodrich (1932, p. 31).
Euconulus chersinus (Say), Archer (1936, p. 10).
Euconulus chersinus polygyratus (Pilsbry), Pilsbry (1946, p. 240, fig. 119,c; 119, bis [p. 241]).
Euconulus chersinus (Say), in part, Burch (1962, pp. 103, 195).
Euconulus chersinus (Say), in part, Burch & Patterson (1966, p. 11).

Shell: Small, 2.9 - 3.5 mm in diameter with 6 - 8 whorls, dome-shaped, imperforate, with angular periphery. The shell is thin, glossy, transparent, rather dull, yellowish-white in color, and sculptured with faint growth lines and fine spiral striae. The aperture is narrowly lunate, the lip is thin, sharp, expanded only at the columellar margin.

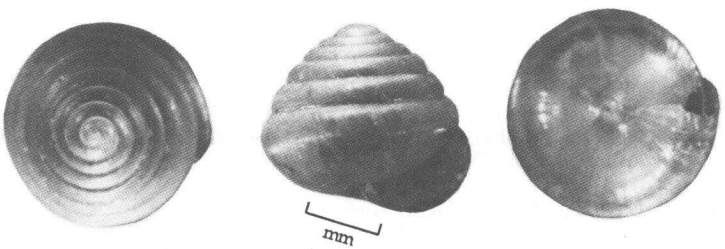


FIG. 87. Shell of *Euconulus chersinus polygyratus*, top apertural and basal views; UMMZ collection.

Remarks: The shells of *Euconulus chersinus* differ from those of *E. fulvus* by their more elevated spires, greater number of whorls, and their dull silky luster (Pilsbry, 1946, p. 240). We have used the width of the individual whorls as seen in dorsal view as the most convenient character to separate the two species. Anatomically, *E. chersinus* differs from *E. fulvus* by the well developed epiphallus and by having an apical chamber in the penis (H.B. Baker, 1928b).

Animal: The animal of *Euconulus chersinus polygyratus* is lighter in color than *E. fulvus* (H.B. Baker, 1928b, p. 11).

Habitat: Inhabits leaf mold in hardwood stands (Archer, 1936, p. 10). "Abundant [in Illinois] in hilly regions bordering ... large rivers. Occasionally ... found in isolated woodlands containing oak, cherry, hickory or ironwood. (F.C. Baker, 1939, *Handb. Ill. land snails,* Nat. Hist. Surv. Div., Urbana, Ill., p. 76).

General Distribution: Canada: Ontario to Saskatchewan; United States: Maine to Wisconsin, south to Maryland, West Virginia and Illinois.

Distribution in UMBS Area: Emmet Co.: northeast shore of Walloon Lake, Section 30, Bear Creek Township, UMMZ 170720; Carp Lake, UMMZ 121586; Petoskey, UMMZ 121587; **Cheboygan Co.**: Grapevine Point, woods pool area, Douglas Lake, Section 28, T37N, R3W, Munro Township, UMBS-86-3; Douglas Lake, UMMZ 121601, 121609; Biological Station, Douglas Lake, UMMZ 57630; east shore of Lancaster Lake, Munro Township, UMMZ 170599; Milligan Creek, on Michigan Highway 68, UMMZ 170579.

Euconulus fulvus (Müller)
(Fig. 88)

Helix fulva Müller 1774, *Verm. terr. fluv ... succ. hist.*, 2, p. 56.
Conulus fulvus (Müller), Walker (1899, p. 19).
Euconulus fulvus (Müller), Walker (1906, p. 482, fig. 53).
Euconulus fulvus (Müller), Winslow (1926, p. 8, no. 64).
Euconulus (s.s.) f fulvus (Müller), H.B. Baker (1928b, p. 9, pl. 1, figs. 6-8).
Euconulus fulvus (Müller), Goodrich (1932, p. 31, fig.).
Euconulus fulvus (Müller), Archer (1936, p. 10).
Euconulus fulvus (Müller), Pilsbry (1946, p. 235, figs. 116, 117).
Euconulus fulvus (Müller), Burch (1962, pp. 102, 195, fig. 243).
Euconulus fulvus (Müller), Burch & Patterson (1966, p. 11, fig. 29, in part).

Shell: Small, 2.8 - 3.4 mm in diameter with 5 1/2 - 6 whorls, dome-shaped, perforate or imperforate, with rounded or weakly angular periphery. The shell is thin, transparent, glossy, cinnamon or tawny in color (*fulvus* is latin for tawny), and sculptured with fine growth lines and faint spiral striae. The aperture is narrowly lunate, with a thin lip, expanded only at the columellar margin.

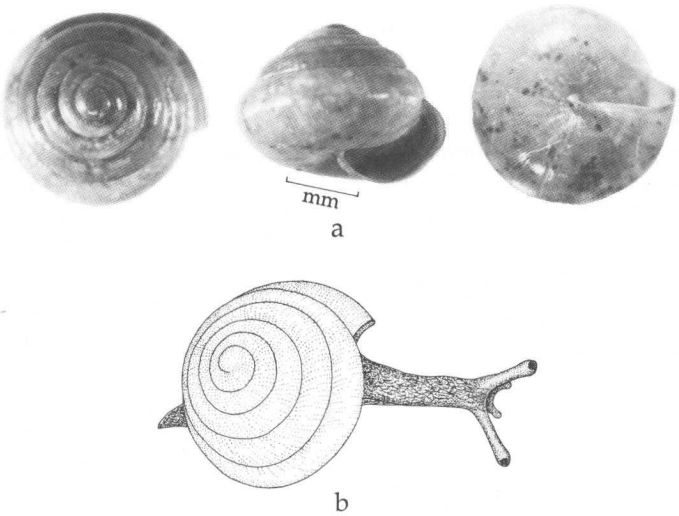


FIG. 88. *Euconulus fulvus*. **a**, dorsal, apertural and basal views of shell, UMMZ 178430; **b**, animal and shell, UMBS-87-1.

Animal: The animal is grayish, with darker tentacles. The mantle is covered with large black blotches. The liver is orange, overlain by dark pigment at the sutural edge. The sole is very long and slender, tripartite, with a median zone about 2/3 as wide as either of the lateral zones. The tail is weakly keeled above. It is truncate, and its projection quite low and rounded. The mantle collar is narrow and has prominent right and left neck lappets and a double free edge. (H.B. Baker, 1928b, p. 10).

Habitat: "The favorite habitat [is] the damp under side of decaying logs" (Goodrich, 1932, p. 31). "*Euconulus fulvus* lives among damp leaves in well-shaded places, and may usually be obtained by leaf sifting where its presence would otherwise be

unsuspected" (Pilsbry, 1946, p. 236). Near Douglas Lake, it was found in leaves at the bases of black ash (Archer, 1936, p. 10).

General Distribution: Holarctic in distribution but absent from the southern states from South Carolina to Texas; western Texas.

Distribution in UMBS Area: **Emmet Co.**: beach drift behind sand dunes, shore of Lake Michigan, Wilderness State Park, Section 19, T39N, R5W, UMBS-86-19; northwest 1/4 of Section 27, Wawatam Township, UMMZ 178399; near Carp River, Section 29, Wawatam Township, UMMZ 170620; birch-poplar grove, Section 7, Bliss Township, UMMZ 170767; **Cheboygan Co.**: around steps to front entrance, Lakeside Laboratory, UMBS grounds, Douglas Lake, northwest 1/4 of Section 33, T37N, R3W, Munro Township, UMBS-87-3; Reeses Swamp, southwest 1/4 of Section 3, Burt Township, T36N, R3W, UMBS-86-11; Reeses Swamp, north end of Burt Lake, UMMZ 178430; woods pool at public access and park, Maple Bay, Burt Lake, Section 29, Burt Township, T36N, R3W, UMBS-87-1; **Presque Isle Co.**: Lake Huron, north edge of Rogers City, UMMZ 170568; Michigan Highway 68a, Section 30, T35N, R5E, UMMZ 178284; Ocqueoc River, 3 miles northeast of Ocqueoc, UMMZ 249448.

Family MESODONTIDAE (Polygyridae)

The Mesodontidae are a family of small to large helicid snails with reflected lips and often with toothed apertures. Endemic to North America, they are one of the continent's dominant land snail families. Although mainly a family of temperate climates, the range of the Mesodontidae extends from Alaska to eastern Canada and south into the tropics. Its species are most abundant in humid regions and are mainly woodland snails. Immature individuals are difficult to identify; the lip of the shells is not reflected and usually apertural teeth have not yet developed in dentate species. Shells of the many species are nearly always unicolored, of some shade of yellow, tan or brown. Shells of several species (one in the UMBS area) have reddish spiral color bands. In the United States, there are nine genera of mesodontids, three of which (*Mesodon, Stenotrema* and *Triodopsis*) occur in the UMBS area. These are placed in two subfamilies, Mesodontinae (*Mesodon*

and *Stenotrema*) and Triodopsinae (*Triodopsis*), which are distinguished by anatomical characters. Members of the genus *Stenotrema* are clearly distinguishable by their characteristic shells, but there is much convergence or parallelism exhibited by the shells of the other mesodontid genera.

Key to Genera in the UMBS Area

1 Shell umbilicate; penis a simple tube, without a sheath (Fig. 89, a, b).....2

Shell imperforate; penis with a penial sheath (Fig. 89, c) .....*Triodopsis* (p. 138)

2(1) Adult shell 15 mm or more in diameter...*Mesodon* (p. 130)

Adult shell less than 12 mm in diameter.....
.....*Stenotrema* (p. 134)

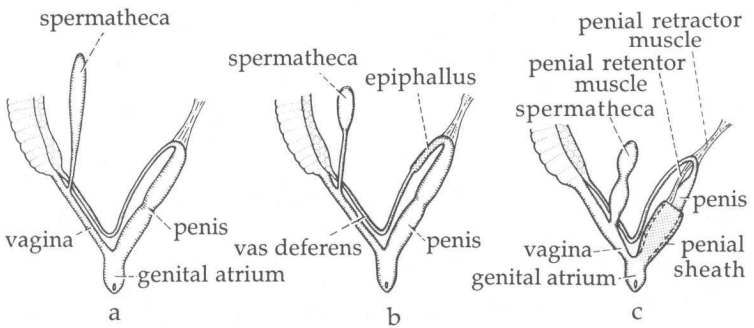


FIG. 89. Diagnostic features of the male terminal genitalia of **a**, *Mesodon*; **b**, *Stenotrema*; **c**, *Triodopsis*.

Subfamily MESODONTINAE

The Mesodontinae are distinguished from the Triodopsinae by the absence of an penial sheath in the male reproductive system, and by the terminal positions of the penial retractor

muscle and vas deferens on the penis. (The Triodopsinae have a penial sheath, and the penial retractor muscle is inserted on the epiphallus or vas deferens, with strands running to the the penis at the end of the sheath.) (Pilsbry, 1940). Two genera of Mesodontinae occur in the UMBS area, *Mesodon* and *Stenotrema*.

Genus *Mesodon* Rafinesque

The genus *Mesodon* is common in the eastern United States and Canada. It is a large genus, with most of its species diversity occurring in the southern Appalachian Mountains and in the Ozarks. Two species, *M. sayanus* and *M. thyroidus*, occur in the UMBS area. Both have umbilicate shells, which distinguishes them from the two local species of *Triodopsis*.

Key to Species in UMBS Area

1 Adult shell umbilicate and with a basal tooth in the aperture (Fig. 90) ..... *M. sayanus* (p. 130)

Adult shell rimate and without a basal tooth in the aperture (Fig. 91) ..... *M. thyroidus* (p. 132)

Mesodon sayanus (Pilsbry)
(Fig. 90)

Helix sayi Binney 1840, *Boston J. nat. Hist.*, 3, p. 379, pl. 16. [Not *Helix sayii* Wood 1828].
Polygyra sayii (Binney), Walker (1899, p. 12).
Polygyra sayana Pilsbry 1906, *Proc. Acad. nat. Sci. Philad.*, 58, p. 127.
Polygyra (Triodopsis) sayana Pilsbry, Walker (1906, p. 464, fig. 10).
Polygyra sayana Pilsbry, Winslow (1926, p. 6, no. 25).
Polygyra sayana Pilsbry, Goodrich (1932, p. 13, fig.).
Polygyra sayana Pilsbry, Archer (1936, p. 11).
Mesodon sayanus (Pilsbry), Pilsbry (1940, p. 762, figs. 457, 458,a-c).
Mesodon (Appalachina) sayanus (Pilsbry), Burch (1962, pp. 171, 200, fig. 430).
Mesodon sayanus (Pilsbry), Burch & Patterson (1966, p. 15, fig. 38, in part).

Shell: The adult shell of *Mesodon sayanus* ranges from about 20 to 27 mm in diameter, and has about 5 1/2 whorls. The shape of the shell is depressed helicoid. The shell is rather dull to

somewhat glossy, and is sculptured with well developed rib-striae and weak incised spiral lines. The embryonic whorl is smooth. The sutures are rather strongly impressed. There is nearly always a parietal tooth in the aperture, as well as a baso-columellar tooth. The latter is especially useful in identifying this species. The apertural lip is strongly reflected, but noticeably narrow.

Remarks: The shell of *Mesodon sayanus* is more depressed than *M. thyroidus*, its umbilicus wider, and its apertural lip is not as broad and tends to be convex rather than concave along its length. Also, the spiral incised lines are less prominent on *M. sayanus*, and the sutures are more impressed.

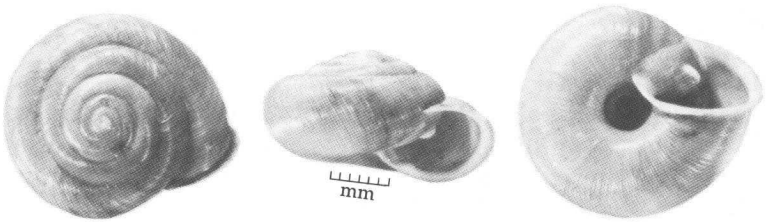


FIG. 90. Shell of *Mesodon sayanus*, top, apertural and umbilical views; UMMZ 171605.

Habitat: *Mesodon sayanus* "lives among leaves on wooded hillsides, also in stone fences and under logs in pastures" (Pilsbry, 1940, p. 764). Archer (1936, p. 11) reported this species to have a tendency to live in open country. "In open fields it lives under palings and rotten logs. In hardwoods it also lives under rotten logs. It appears to shun pines, but it is not adverse to hemlocks or arbor vitae."

General Distribution: Maine to North Carolina, west to Michigan and Tennessee.

Distribution in UMBS Area: Cheboygan Co.: south shore of Black Lake, Black Lake Ranch, UMMZ 171622; Douglas Lake, UMMZ 102276; **Presque Isle Co.**: head of Black Lake, UMMZ 102272; south end of Grand Lake along US Highway 23, UMMZ 171632; banks of the Ocqueoc River, about 1/2 mile above Ocqueoc Falls, UMMZ 171605; banks of the Ocqueoc River about 3 miles northeast of Ocqueoc, UMMZ 171608.

Mesodon thyroidus (Say)
(Fig. 91)

Helix thyroidus Say 1817, Conchology, in Nicholson, W., *Am. ed. Brit. encyclop.* ..., under *Helix albolabris* [sp. 1].
Polygyra thyroidus (Say), Walker (1899, p. 14).
Polygyra (Triodopsis) thyroidus (Say), Walker (1906, p. 468, fig. 19).
Polygyra thyroidus (Say), Winslow (1926, p. 6, no. 26).
Polygyra thyroidus (Say), Goodrich (1932, p. 19, fig.).
Polygyra thyroidus (Say), Archer (1936, p. 12).
Mesodon thyroidus (Say), Pilsbry (1940, p. 706, figs. 431,a,b; 432,a-e).
Mesodon thyroidus (Say), Burch (1962, pp. 170, 176, 200, figs. 428, 443).
Mesodon thyroidus (Say), Burch & Patterson (1966, p. 15, fig. 38, in part).

Shell: The adult shell of *Mesodon thyroidus* occasionally reaches a diameter of 30 mm in states south of Michigan, but our specimens are commonly only about 20 mm in diameter. Adult shells have 5 to 5 1/2 whorls. The shell shape is depressed helicoid. The color ranges from pale tannish horn to Dresden Brown. Pilsbry (1940, pp. 706, 709) also listed ivory yellow and chamois, with a pale cinnamon buff tint on the upper surface. The surface is a little glossy, and is covered with fine, even, transverse rib-striae crossed by fine, crowded, incised, spiral

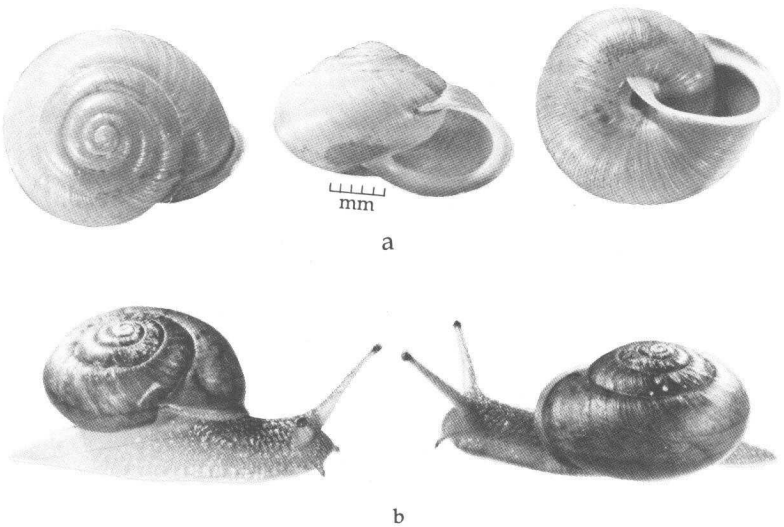


FIG. 91. *Mesodon thyroidus*. **a**, dorsal, apertural and umbilical views of shell, UMMZ 171606; **b**, right and left lateral views of animal and shell, UMBS-86-7.

lines. The embryonic whorls are smooth. The shell is rather narrowly umbilicate, with the reflection of the basal lip partially covering the umbilical opening. The apertural lip is well reflected, white, and a little concave. The basal lip often has a slight thickening or callous on its inner margin. A parietal tooth may or may not be present.

Habitat: This species "frequents open woods that have not been pastured and is occasionally found under logs in dry and sunlit fields" (Goodrich, 1932, p. 19).

Life History: [From T.D. Foster, in Pilsbry, 1940, p. 710]. *Mesodon thyroidus* was "found mating in September and November, and in the field the first eggs were found on May lst., laying continuing to August 15th. They are usually deposited in shallow holes excavated by the snail in the soil, the clutches of 20 to 70 eggs each. ... Practically all of the snails that pass one winter as immature young attain full growth, form a reflexed lip on the shell and are recognizable as mature adults by the following fall. Typically, the first breeding season is in the third year. ... Maturity requires more than one full year. The individuals which attain a lip in the fall of their second growing season produce eggs the following spring when they have just completed their second year or are entering on their third year. Three or possibly four years seems to be the usual length of life for individuals of this species."

Food: Foster found *Mesodon thyroidus* to chiefly eat woods nettles (*Laportea canadensis*). "F.T. and F.A. Wolf (1939) found leaves of lilac *(Syringa vulgaris)* in Durham, North Carolina, infected by the powdery mildew *Microsphaera alni,* and noting peculiar markings on some of them, examined at night, found them to be feeding tracks of *M. thyroidus.* Snails placed in jars were found to consume numerous larger fungi, as well as slime molds and a lichen. All of the species of fungi offered were eaten, in preference to lettuce or other chlorophyll-containing food. *M. thyroidus* thus appears to be decidedly mycophagous in its food preferences."

General Distribution: Massachusetts and New York to Florida, west to Minnesota, Nebraska and Texas.

Distribution in UMBS Area: Cheboygan Co.: Grapevine Point, woods pool area, Douglas Lake, Section 28, T37N, R3W, Munro Township, UMBS-86-3; woods at roadside rest stop on highway I-75

north, 5.2 miles south of highway C-64, northeast 1/4 of Section 24, Burt Township, T36N, R3W, UMBS-86-7; hardwoods, 2 miles west of Wolverine, UMMZ 132212; **Presque Isle Co.**: Michigan Highway 68a, Section 30, T35N, R5E, UMMZ 178279; banks of the Ocqueoc River, about 1/2 mile above Ocqueoc Falls, UMMZ 171606.

Genus *Stenotrema* Rafinesque

The genus *Stenotrema* was named in 1819 by Rafinesque, who, in the same and a later publication, also added three and possibly four synonyms for this same group. However, except for the brief early use of *Polygyra*, a name previously used to include nearly all of the Mesodontidae (Polygyridae), *Stenotrema* has been in common use.

The characteristic which can be used to readily recognize nearly all stenotremas, i.e., the long, narrow, slit-like shell aperture, is lacking in the two species found in the UMBS area. The apertures of *Stenotrema leai* and *S. fraternum*, while not as large, relatively, as those of *Mesodon* and *Triodopsis*, are more open than in other stenotremas and lack the basal lip notch which the other stenotremas nearly always possess. The two UMBS species differ also from the other members of the genus by being umbilicate.

Key to Species in UMBS Area

1 Adult shell of medium size, 10 mm or more in diameter (Fig. 92).....*S. fraternum* (p. 134)

Adult shell small, less than 10 mm in diameter (Fig. 93).....*S. leai* (p. 136)

Stenotrema fraternum (Say)
(Fig. 92)

Helix fraterna Say 1824, in *Narr. Expedit. St. Peter's River. ...*, 2, appendix, p. 257, pl. 15, fig. 3.
Polygyra monodon fraterna (Say), Walker (1899, p. 15).
Polygyra monodon albida Walker 1899, Walker (1899 p. 15).

Polygyra (*Stenotrema*) *fraterna* (Say), Walker (1906, p. 470, fig. 23).
Polygyra monodon fraterna (Say), Winslow (1926, p. 6, no. 16).
Polygyra monodon fraterna (Say), Goodrich (1932, p. 18).
Polygyra fraterna (Say), Archer (1936, p. 11).
Stenotrema fraternum (Say), Pilsbry (1940, p. 681, fig. 422,a).
Stenotrema fraternum (Say), Burch (1962, pp. 141, 169, figs. 341, 427).
Stenotrema fraternum (Say), Burch & Patterson (1966, p. 14, fig. 36, in part).

Shell: The shell of *Stenotrema fraternum* is very similar to that of *S. leai.* Because of this similarity, *S. fraternum* has often been considered in the past as a subspecies of *S. leai.* The main difference in the shells of the two species is that *S. fraternum* is larger, adult shells ranging in diameter from 7.8 to 11.4 mm, but usually being 10 mm or more. Also, the shell of *S. fraternum* is more rimate, i.e., the reflection of the columellar lip covers a larger proportion of the umbilical opening than in *S. leai.* A third difference is that the shell of *S. fraternum* is less tightly coiled. Color opaque horn to Tawny Olive.

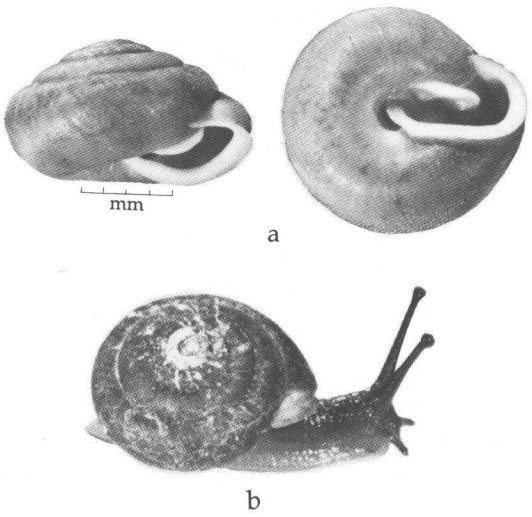


FIG. 92. *Stenotrema fraternum.* **a**, Apertural and umbilical views of shell, UMMZ 132191; **b**, animal and shell, UMBS-86-9.

Habitat: "This ... is an upland form rather than an inhabitant of the margins of swamps and marshes" (Goodrich, 1932, p. 18). "*Stenotrema fraternum* frequents dryer situations,

chiefly in hard-wood tracts under logs, bark or leaves, where the larger helices occur. Also in grass, in uncultivated orchards and pastures." (Pilsbry, 1940, p. 678). "In hardwoods and aspens this snail lives in leaf debris and under rotten logs. In open country it lives among sumac, in grass, under boards and rotten logs, in lumber piles, and under rejected building plaster. ... It has a marked preference for the less shady spots, and is a characteristic species of the open fields (Archer, 1936, p. 11).

General Distribution: Maine to Georgia, west to Minnesota and Oklahoma.

Distribution in UMBS Area: Emmet Co.: beech-maple grove, 8 miles southeast of Bay View, UMMZ 132191; Carp Lake, UMMZ 99829; northwest 1/4 of Section 27, Wawatam Township, UMMZ 178401; **Cheboygan Co.**: Grapevine Point, woods pool area, Douglas Lake, Section 28, T37N, R3W, Munro Township, UMBS-86-3; Colonial Point Forest, Section 28, Burt Township, T36N, R3W, UMBS-86-9; Douglas Lake, UMMZ 99882; Douglas Lake, old camp, wood pile and forest floor, Section 34, T37N, R3W, UMMZ 232338; hardwoods, 2 miles west of Wolverine, UMMZ 132213; **Presque Isle Co.**: Ocqueoc River, 3 miles northeast of Ocqueoc, UMMZ 249455.

Stenotrema leai (Binney)
(Fig. 93)

Helix leai 'Ward' Binney 1840, *Boston J. nat. Hist.*, 3, p. 362.
Polygyra leai (Ward), Walker (1899, p. 16).
Polygyra monodon (Rackett), Walker (1899, p. 15).
Polygyra (Stenotrema) monodon Rackett, Walker (1906, p. 471, fig. 24).
Polygyra monodon Rackett, Winslow (1926, p. 6, no. 16).
Polygyra monodon (Rackett), Goodrich (1932, p. 17, fig.).
Polygyra monodon (Rackett), Archer (1936, p. 11).
Stenotrema leai ('Ward' Binney), Pilsbry (1940, p. 421,a,b; 1948, p. 1099).
Stenotrema leai (Binney), Burch (1962, pp. 140, 169, 199, figs. 340, 426).
Stenotrema leai (Binney), Burch & Patterson (1966, p. 14, fig. 36, in part).

Shell: The adult shell of *Stenotrema leai* is small, 9 mm or less in diameter, and has 5 1/2 to 6 1/2 tightly coiled whorls. The shell is depressed-dome shaped, and has a well developed umbilicus. The color ranges from cinnamon-buff to cinnamon-brown. Characteristic of stenotremas, its shell is densely

hirsute. The embryonic whorls are sculptured with transverse elongate granules or striae. The lip is white, narrow, concave, its basal and outer margins strongly reflected. The columellar lip is reflected over part of the umbilicus. Behind the lip is a depression. An elongate, low tooth is situated on the parietal wall.

Remarks: The shell of *Stenotrema leai* (and of *S. fraternum*) differ from other stenotremas by their larger, more open apertures, simpler basal lip, and more poorly developed parietal tooth.

FIG. 93. Shell of *Stenotrema leai*, top, apertural and umbilical views; UMMZ 99347.

Habitat: "When found in the southeastern part of the state, it is usually in quite damp places and occasionally in very large colonies" (Goodrich, 1932, p. 18). It is "a snail of damp places near the water, while *Stenotrema fraternum* frequents dryer situations" (Pilsbry, 1940, p. 678). In Cheboygan County, Archer (1936, p. 11) found it under rotting logs in hardwoods, and he found a high-spired form under logs in meadows.

General Distribution: New York to Virginia, west to South Dakota and Texas.

Distribution in UMBS Area: Emmet Co.: beach drift behind sand dunes, shore of Lake Michigan, Wilderness State Park, Section 19, T39N, R5W, UMBS-86-19; drift next to boat ramp parking lot at western end of Park road, near shore of Lake Michigan, Wilderness State Park, Section 19, T39N, R5W, UMBS-86-21; Cecil Bay, UMMZ 99347; near Carp River, Section 29, Wawatam Township, UMMZ 170624; Sturgeon Bay driftwood, UMMZ 198389; **Cheboygan Co.**: around steps to front entrance, Lakeside Laboratory, UMBS grounds, Douglas Lake, northwest 1/4 of Section 33, T37N, R3W, Munro

Township, UMBS-87-3; south shore of Black Lake near Black Lake Ranch, UMMZ 171619; 2 miles southwest of Wolverine on Little Sturgeon River, UMMZ 130767; **Presque Isle Co.**: Lake Huron, Section 14, Ocqueoc Township, UMMZ 170660.

Subfamily TRIODOPSINAE

The Triodopsinae are differentiated on the basis of their male genital anatomy. They do not have the simple penes of the Mesodontinae, but instead have their penes enclosed in a sheath, with the retractor musculature attached to the epiphallus or vas deferens. One genus, *Triodopsis,* is found in the UMBS area.

Genus *Triodopsis* Rafinesque

The genus *Triodopsis* is common and widely distributed in North America, and contains many species, most of which have medium or large shells. Many species have barriers or "teeth" in their apertures, and, in fact, the genus gets its name from its three-toothed members. But, neither of the two species found in the UMBS area have this characteristic. Our two local species, *T. albolabris* and *T. multilineata,* are usually without apertural barriers, but occasionally a specimen of either species may be found with a low parietal tooth. In the UMBS area, the shells of *Triodopsis* can be distinguished from those of *Mesodon* by their closed (rather than open) umbilicuses.

Key to Species in UMBS Area

1 Shell unicolored, without spiral reddish color bands (Figs. 94, 95)..... *T. albolabris* (p. 139)

Shell with spiral reddish color bands (Fig. 96)..... ..... *T. multilineata* (p. 141)

Triodopsis albolabris (Say)
(Figs. 94, 95)

Helix albolabris Say 1817, Conchology, in Nicholson, W., *Am. ed. Brit. encyclop.* ..., sp. 1, pl. 1, fig. 1.
Polygyra albolabris (Say), Walker (1899, p. 12).
Polygyra albolabris maritima Pilsbry, Walker (1899, p. 12).
Polygyra albolabris minor Sterki, Walker (1899, p. 12).
Polygyra (Triodopsis) albolabris (Say), Walker (1906, p. 464, fig. 11).
Polygyra albolabris (Say), Winslow (1926, p. 5, no. 6).
Polygyra albolabris (Say), Goodrich (1932, p. 14, fig.).
Polygyra albolabris (Say), Archer (1936, p. 12).
Polygyra albolabris dentata Tryon, Goodrich (1932, p. 14).
Polygyra albolabris maritima Pilsbry, Goodrich (1932, p. 15).
Triodopsis albolabris (Say), Pilsbry (1940, p. 835, figs. 488, 489,2-6,8).
Triodopsis (Neohelix) albolabris (Say), Burch (1962, pp. 175, 201, fig. 441).
Triodopsis albolabris (Say), Burch & Patterson (1966, p. 15, fig. 37, in part).

Shell: Shells of adult *Triodopsis albolabris* are generally 25 - 30 mm in diameter, and have about 5 1/2 whorls. The shell is helicoid with a moderately depressed spire. Its color is

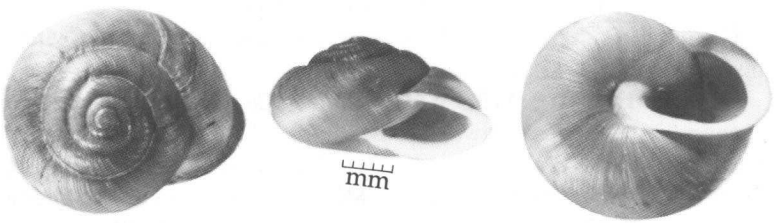


FIG. 94. Shell of *Triodopsis albolabris*, top, apertural and basal views; UMMZ 171613.

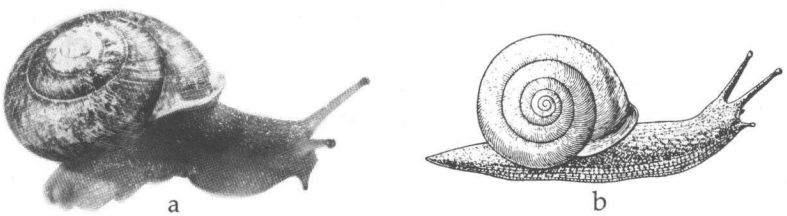


FIG. 95. Animal and shell of *Triodopsis albolabris*. **a**, UMBS-86-7; **b**, from F.C. Baker [after various authors] (1939, *Handb. Ill. land snails*, Nat. Hist. Surv. Div., Urbana, Ill.)

yellowish-horn to Dresden Brown [or, according to Pilsbry, 1940, p. 836, "typically cream-buff to chamois colored (but often cinnamon-buff, becoming darker above to a russet apex)"]. The umbilicus is covered over by the reflected columellar lip, making the shell imperforate. The lip is strongly reflected, flat, and white. The sculpture consists of rather evenly spaced growth undulations or riblets crossed by close-set incised spiral lines. The embryonic whorls are nearly smooth.

Remarks: *Triodopsis albolabris* is one of the largest native land snails in North America. It is also the first (in 1817) land snail to be named by a native American (Thomas Say). The shells of some Michigan specimens attain a size of 30 mm in diameter, while individuals from southern U.S.A. populations may surpass 40 mm in diameter.

Habitats: *Triodopsis albolabris* species lives commonly in leaf mold or rotting logs in hardwoods, aspens, arbor vitae and mixtures of aspens and pines (Archer, 1936, p. 12). In open fields, it lives in grass and under planks and logs, and congregates in old furrow lines in abandoned fields. Normal-sized specimens come from hardwood stands, while smaller form are found on hill tops, sandy soils and in aspens.

General Distribution: Maine to Georgia, west to the Mississippi River; Oklahoma.

Distribution in UMBS Area: Emmet Co.: beech-maple grove, Section 30, Bear Creek Township, UMMZ 170641; beech-maple grove 8 miles southeast of Bay View, UMMZ 132189; shore Lake Michigan, Section 30, Friendship Township, UMMZ 170708; northeast Walloon Lake, Section 30, Bear Creek Township, UMMZ 170728; **Cheboygan Co.**: Grapevine Point, woods pool area, Douglas Lake, Section 28, T37N, R3W, Munro Township, UMBS-86-3; woods at roadside rest stop on Highway I-75 north, 5.2 miles south of Highway C-64, northeast 1/4 of Section 24, Burt Township, T36N, R3W, UMBS-86-7; Douglas Lake, UMMZ 94837, 102276; 2 miles west of Wolverine, UMMZ 209239; Little Sturgeon River 2 miles southwest of Wolverine, UMMZ 209238; **Presque Isle Co.**: just east of Little Ocqueoc River on Michigan Highway 68, UMMZ 171613.

Triodopsis multilineata (Say)
(Fig. 96)

Helix multilineata Say 1821, *J. Acad. nat. Sci. Philad.*, 2, p. 150.
Polygyra multilineata (Say), Walker (1899, p. 13).
Polygyra multilineata (Say), Walker (1906, p. 466, fig. 15).
Polygyra multilineata (Say), Winslow (1926, p. 6, no. 17).
Polygyra multilineata (Say), Goodrich (1932, p. 16, fig.).
Triodopsis multilineata (Say), Pilsbry (1940, p. 847, fig. 493).
Triodopsis multilineata (Say), Burch (1962, pp. 159, 172, 201, figs. 398, 433).
Triodopsis multilineata (Say), Burch & Patterson (1966, p. 15, fig. 37, in part).
Triodopsis multilineata (Say), Hubricht (1985, p. 49, map 515).

Shell: Medium to large in size, 14.5 - 32.0 mm in diameter with 5 1/2 - 6 whorls, helicoid with a moderately depressed spire, imperforate, somewhat glossy, ivory yellow to olive buff in color, with reddish brown bands, sculptured with transverse striae and weak spiral striae. Embryonic whorls smooth. The aperture is lunate, the lip reflected, white. The parietal wall is generally without a tooth, but occasionally one is present.

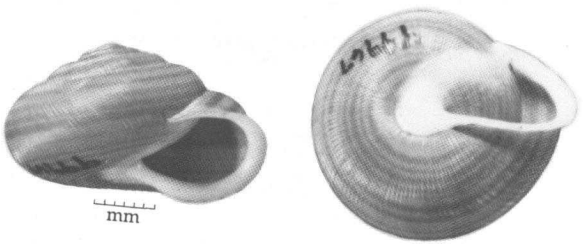


FIG. 96. Shell of *Triodopsis multilineata*, apertural and basal views; UMMZ 99967.

Animal: Body generally blackish, with white granules separated by darker zones. Sole of foot black. (F.C. Baker, 1939, *Handb. Ill. land snails*, Nat. Hist. Surv. Div., Urbana, Ill., p. 72).

Habitats: Wet woods and at the edges of marshes and swamps (Goodrich, 1932, p. 17). "Edges of swamps, in low ground subject to overflow or in damp woods of oak, hickory, box elder, tamarack, maple or cottonwood" (F.C. Baker, 1939, *Handb. Ill. land snails*, Nat. Hist. Surv. Div., Urbana, Ill., p. 72).

General Distribution: Western New York and western Maryland, west to Minnesota, Iowa, eastern Nebraska and eastern Kansas, south to Mississippi and Arkansas.

Distribution in UMBS Area: Cheboygan County (Hubricht, 1985, p. 170, map 515; no specific locality given).

THE SLUGS

Slugs are snails without external shells and they are common in many terrestrial biotopes of the earth. Some species are very hardy and have adapted very well when introduced by man into far-flung regions of the world. Three families of slugs occur in Michigan, and species of all three are found in the UMBS area. One of the families, the Philomycidae, is native, whereas all species in eastern North America except one (*Deroceras laeve* of the Limacidae) of the other two families have been introduced from Europe.

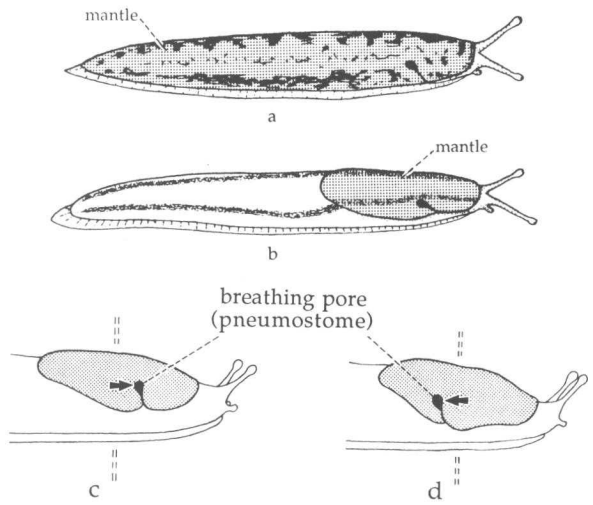


FIG. 97. Diagnostic characters of Michigan slug families. **a**, Mantle covering nearly the entire dorsum of the animal (Philomycidae); **b**, mantle covering only on anterior portion; **c**, breathing pore in the anterior half of the right side of the mantle (Arionidae); **d**, breathing pore in the posterior half of the right side of the mantle (Limacidae).

Key to the Slug Families in the UMBS Area

1 Mantle covering nearly the entire back of the animal (Fig. 97, a).....PHILOMYCIDAE (p. 143)

Mantle covering only the anterior portion of the animal (Fig. 97, b).....2

2(1) Breathing pore in the anterior half of the right side of the mantle (Fig. 97, c); back never keeled in adults; posterior end rounded when viewed from above..... .....ARIONIDAE (p. 147)

Breathing pore in the posterior half of the right side of the mantle (Fig. 97, d); back keeled at posterior end; posterior end pointed when viewed from above..... .....LIMACIDAE (p. 150)

Family PHILOMYCIDAE

This family of primitive aulacopod slugs is related to the slug family Arionidae, and to the Punctidae, the latter a family with well developed external shells. In the United States, philomycids are found only east of the Rocky Mountains, but the family's extralimital distribution includes part of Canada, humid temperate and tropical Middle and South America, and parts of the Orient. The philomycids differ from other geophile slugs of the United States by the long mantle, which covers their entire back. A large shell sac is located inside the mantle, but contains no shell. Two genera occur in Michigan, *Philomycus* and *Pallifera*.

Key to Genera in the UMBS Area

1 Animal generally relatively small, usually less than 30 mm in length; mantle lacking spots or with only poorly developed spots in a mid-dorsal line (Fig. 98); slime clear..... *Pallifera* (p. 144)

Animal relatively large, more than 50 mm in length; mantle covered with spots, which may coalesce to form bands (Fig. 99); slime milky ..... *Philomycus* (p. 145)

Genus *Pallifera* Rafinesque

Pallifera is a genus of small slugs, less than 30 mm in length. They are similar to *Philomycus* in their long mantle, but differ in their size and body pigment patterns. They also differ from *Philomycus* in lacking a "dart" apparatus in their reproductive system. A number of specific names have been proposed for *Pallifera* species, but, as with *Philomycus*, a thorough taxonomic revision of the genus is needed. In the UMBS area, we found only one species, *Pallifera dorsalis.*

Pallifera dorsalis (Binney)
(Fig. 98)

Philomycus dorsalis Binney 1842, *Boston J. nat. Hist.*, 4, p. 174.
Pallifera dorsalis (Binney), Walker (1906, p. 498, fig. 100).
Pallifera dorsalis (Binney), Winslow (1926, p. 8, no. 78).
Pallifera dorsalis (Binney), Goodrich (1932, p. 42).
Pallifera dorsalis (Binney), Pilsbry (1948, p. 760, figs. 407,a-f; 408, 409).
Pallifera dorsalis (Binney), Burch (1962, pp. 69, 191, fig. 143).
Pallifera dorsalis (Binney), Burch & Patterson (1966, p. 6, fig. 16, in part).
Pallifera dorsalis (Binney), Hubricht (1985, p. 17, map 149).

Animal: The adult body of *Pallifera dorsalis* is about 18 mm in length when extended. The mantle covers the entire dorsum, except for the head. The mantle is "ashy with a shade of blue" and may or may not have a longitudinal line of black dots extending down the center of the back. None of our UMBS specimens had such a medial line of dots. The tentacles are black and the foot is white. The anterior lateral sides and front of the foot are stained red. The pneumostome is minute, located on the right side about 3 mm behind the insertion of the ommatophore. (see Binney, 1842, *Boston J. nat. Hist.*, 4, p. 174.)

General Distribution: Vermont and Connecticut south to North Carolina, west to Iowa.

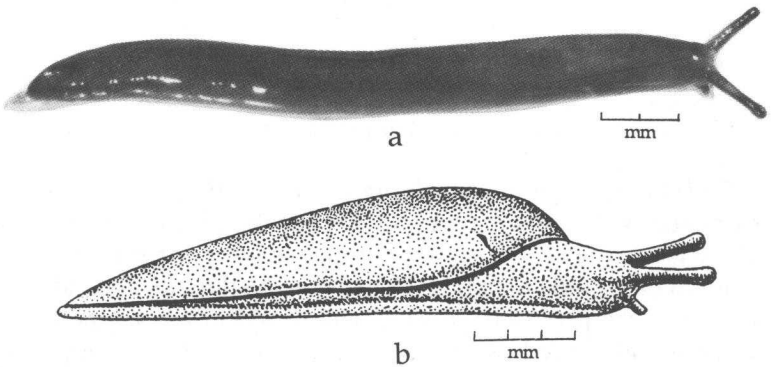


FIG. 98. *Pallifera dorsalis*. **a**, UMBS-86-7; **b**, drawing from F.C. Baker (1939, *Handb. Ill. land snails*, Nat. Hist. Surv. Div., Urbana, Ill.).

Distribution in UMBS Area: Cheboygan Co.: woods near southcentral shore of Douglas Lake, Section 28, T37N, R3W, Munro Township, UMBS-86-1; Hook Point bay, North Fishtail Bay, Douglas Lake, Section 32, T37N, R3W, Munro Township, UMBS-86-2; Grapevine Point, woods pool area, Douglas Lake, Section 28, T37N, R3W, Munro Township, UMBS-86-3; woods at roadside rest stop on Highway I-75 north, 5.2 miles south of Highway C-64, northeast 1/4 of Section 24, Burt Township, T36N, R3W, UMBS-86-7; Colonial Point Forest, Section 28, Burt Township, T36N, R3W, UMBS-86-9.

Genus *Philomycus* Rafinesque

Philomycus is a genus of large slugs, reaching 100 mm in length. They are shy, very "sluggish" animals, confined to forests. They differ from *Pallifera* not only in their size, but also by the possession of a large "dart" apparatus near the terminal end of the female genital tract. Unlike the introduced European slugs (*Arion* and the limacids), *Philomycus* is never found in urbanized areas. *Philomycus* has several nominal species in North America, the taxonomy of which need investigation. In the northern Michigan area, we have recognized only one form of this genus, *P. carolinianus flexuolaris*.

Philomycus carolinianus flexuolaris Rafinesque (Fig. 99)

Philomycus flexuolaris Rafinesque 1820, *Ann. Nature*, (1), p. 10.
Philomycus carolinianus flexuolaris Rafinesque, Pilsbry (1948, p. 756, figs. 405, 406).
Philomycus carolinianus (Bosc) Archer (1936, p. 9).

Philomycus carolinianus flexuolaris is a rather large slug, its extended body measuring up to 10 cm. The ground color of its body is cream, which shows through most clearly along and close to the mantle margins. Elsewhere, the dorsum and sides of the body are profusely covered with gray-brown pigment. A longitudinal black band of spots or mottlings runs along each

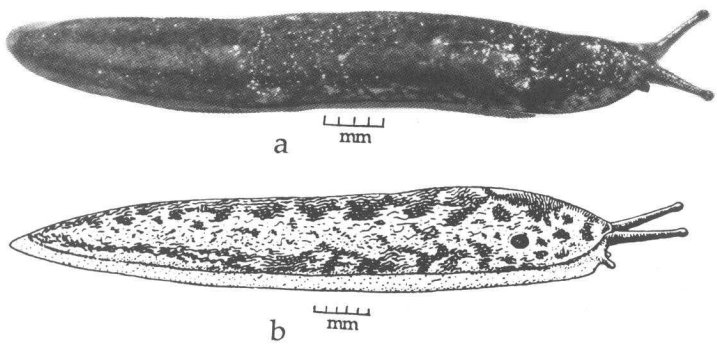


FIG. 99. *Philomycus carolinianus flexuolaris*. **a**, Living specimen, UMBS-86-7; **b**, drawing from F.C. Baker (1939, *Handb. Ill. land snails*, Nat. Hist. Surv. Div., Urbana, Ill.).

side of the mantle; between these runs a broader band of brown pigment. The foot is without pigment, except for a fine dusting of faint gray on the anterior lateral margins. The pedal groove is very distinct. The sole is not tripartite.

Philomycus carolinianus flexuolaris differs from *P. c. carolinianus* by lacking the two rows of black spots running down the center of the mantle.

Habitats: Largely confined to pines and aspens, inhabiting the under sides of fallen pine trunks (Archer, 1936, p. 9).

Distribution in UMBS Area: Cheboygan Co.: woods near south-central shore of Douglas Lake, Sect. 28, T37N, R3W, Munro Township, UMBS-86-1; Grapevine Point, woods pool area, Douglas Lake, Section

28, T37N, R3W, Munro Township, UMBS-86-3; woods at road-side rest stop on Highway I-75 north, 5.2 miles south of Highway C-64, northeast 1/4 of Sect. 24, Burt Township, T36N, R3W, UMBS-86-7.

Family ARIONIDAE

The Arionidae are slugs or semi-slugs. In the Western Hemisphere, the native species are restricted to western North America. Extralimitally, the arionids are native to Europe, Asia and Africa. Species of the introduced European genus *Arion* are common in various parts of North America, including Michigan.

The Arionidae are aulacopod gastropods with an oval mantle on the anterior part of the back. The mantle has a slit on the right side which ends posteriorly in a breathing pore (pneumostome). The mantle extends forward as a free lobe under which the head can be retracted during rest or when the animal is disturbed. The shell is completely embedded in the mantle of *Arion*. It is usually a simple non-spiral oval plate, or sometimes it is reduced to only a few granules. The sides of the foot are well marked with pedal and "suprapedal" grooves.

The Arionidae superficially resemble slugs of the family Limacidae, but they are more closely related to the shelled family Punctidae, and to the philomycid slugs. The arionids probably evolved independently from the latter, but from the same shelled ancestors. The arionids differ from the limacids in many details, such as the ridged jaw, the wide, short basal plates of the marginal teeth, the posterior separation of the free retractor muscles, the broadness of the band below the pedal groove, and the arhythmic progression of the foot while crawling (Table 2).

Arionid slugs flourish only in regions of high or moderate humidity, and in the eastern U.S.A. they are found almost entirely in the northern states.

Genus *Arion* Férussac

Arion is a European genus which has been introduced into North America during the past two centuries. Seven species are

Table 2. Comparison of the slug families Arionidae and Limacidae in the UMBS area.

Feature	ARIONIDAE	LIMACIDAE
Breathing pore	Anterior	Posterior
Caudal pit	Present	Absent
Muscular movements of the foot sole while crawling	Arhythmic, or with faint waves in the central area of the sole	In distinct waves
Jaw	Ridged	Smooth
Basal plates of marginal radular teeth	Wide and short	Narrow
Free retractor muscles	Remain separate	All united into a single band posteriorly

now recorded in the United States. Two of these, *A. subfuscus* and *A. silvaticus*, are found in the UMBS area.

Arion has a mucous pit on its dorsal tail at the posterior tip where the pedal grooves meet. Both of the species found in the UMBS area have two longitudinal pigment stripes on their mantle and body. The location of these stripes on the mantle is useful in recognizing the species.

Key to Species in the UMBS Area

1 Foot fringe without dark vertical pigment lines; sole of foot porcelain-white; mucus clear (Fig. 100) .... *Arion silvaticus* (p. 149)

Foot fringe with dark vertical pigment lines; sole of foot yellow or orange; mucus yellow or orange (Fig. 101) ....*Arion subfuscus* (p. 150)

Arion silvaticus Lohmander
(Fig. 100)

Arion silvaticus Lohmander 1937, Chichester & Getz (1973, *Sterkiana*, (51): 31, fig. 4c).
Arion circumscriptus Johnson, Burch & Jung (1987a, p. 93, fig. 57).
Arion cf. *silvaticus* Lohmander, Burch & Jung (1987b, p. 297).

Arion silvaticus is a rather small slug, extended adults measuring less than 40 mm in length. The backs of the animals in the populations found in the UMBS area are pale gray with a longitudinal dark gray band on both sides. The sides of the body beneath the bands is nearly white. The mantle is similarly marked, but also has a paler, more diffuse, broader median band. The pneumostome is on the right side of the mantle beneath the darker gray band on that side. The reproductive opening is on the right side of the body, below and anterior to the pneumostome. The lateral sides of the foot (the "foot fringe") lack transverse (i.e., vertical) pigment stripes, a character which is especially helpful in differentiating *A. silvaticus* from *A. subfuscus*. The foot fringe and sole of the foot are white.

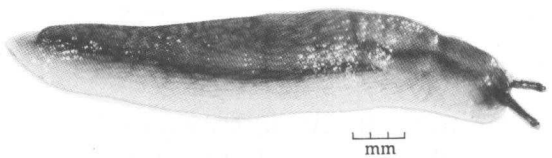


FIG. 100. *Arion silvaticus*, UMBS-86-5.

Distribution in UMBS Area: Emmet Co.: in drift next to boat ramp parking lot at western end of Park road, near shore of Lake Michigan, Wilderness State Park, Section 19, T39N, R5W, UMBS-86-21. **Cheboygan Co.:** Reeses Swamp at Carp Creek (also called Little Carp River) and Hogsback Road, north 1/4 of Section 4, Burt Township, T36N, R3W, UMBS-86-5, UMBS-87-2; Hook Point peninsula, North Fishtail Bay, Douglas Lake, Section 22, T37N, R3W, Munro Township, UMBS-86-22.

Arion subfuscus (Draparnaud)
(Fig. 101)

Limax subfuscus Draparnaud 1805, *Hist. nat. Moll. terr. fluv. France*, p. 125, pl. 9, fig. 8.
Arion subfuscus Draparnaud, Pilsbry (1948, p. 670, fig. 364i).
Arion subfuscus (Draparnaud), Burch (1962, pp. 74, 192, fig. 156.
Arion subfuscus (Draparnaud), Burch & Jung (1987a, p. 93, fig. 58).
Arion fasciatus Nilsson, Burch & Jung (1987b, p. 297).

Arion subfuscus is a slug of medium size, active adults measuring 50-80 mm in length. The population found in the UMBS area has a deep yellow ground color, with a gray longitudinal band on each side of the body. The medial dorsum has gray pigment, which may taper off just before reaching the longitudinal gray bands on each side. The sides of the body and mantle are yellow. The mantle also has two lateral longitudinal gray bands. The pneumostome is surrounded with gray pigment. The reproductive opening is beneath the pneumostome. The foot fringe is marked with distinct vertical gray pigment stripes. The foot fringe and sole of the foot are yellow. The tentacles are gray.

FIG. 101. *Arion subfuscus*, UMBS-86-8.

Distribution in UMBS Area: Cheboygan Co.: University of Michigan Biological Station grounds, near shore, South Fishtail Bay, northwest 1/4 of Sect. 34, Munro Township, T37N, R3W, UMBS-86-8.

Family LIMACIDAE

The Limacidae are a family of slugs native to Europe and adjacent parts of Asia and Africa; several species of one of its genera, *Deroceras*, also occur naturally in northeastern Asia and one species occurs naturally in North America. All other mem-

bers of this family in the United States have been introduced, mainly from Europe.

Limacid slugs can be distinguished from arionid slugs by the position of the pneumostome, which is located in the posterior half of the mantle, rather than in the anterior half as in the arionids. Also, the limacids lack the caudal mucous pore of the arionids.

Genus *Deroceras* Rafinesque

The genus *Deroceras* contains rather small species with truncated tails (in side view), rounded posterior mantle margins, and a concentric mantle surface pattern. The concentric mantle ridges originate from the right side of the mantle, near the breathing pore. The foot is tripartite.

The genus has a number of species in North America, two of which, *D. laeve* and *D. reticulatum*, have been found in the UMBS area. *Deroceras reticulatum* was found only once, but *D. laeve* is a common slug of the Douglas Lake area, and probably has a general distribution in the UMBS region.

Key to Species in the UMBS Area

1 Animal small, about 25 mm when extended; usually uniformly yellowish, sometimes flecked with gray; mantle situated nearly in middle of body; exudes watery slime when irritated (Fig. 102)..... *Deroceras laeve* (p. 151)

Animal medium in size, 35-40 mm when extended; whitish, cream or similar shade with gray markings; mantle situated forward near the head; exudes milky adhesive slime when irritated. (Fig. 103)..... ..... *Deroceras reticulatum* (p. 153)

Deroceras laeve (Müller)
(Fig. 102)

Limax laevis Müller 1774, *Verm. terr. et fluv. Hist.*, 2, p. 2.
Agriolimax campestris (Binn.), Walker (1899, p. 21).

Agriolimax campestris (Say), Walker (1906, p. 489, fig. 75).
Agriolimax campestris (Say), Winslow (1926, p. 8).
Agriolimax campestris (Say), Goodrich (1932, p. 41, fig.).
Deroceras laeve campestre (Say), Archer (1936, p. 10).
Deroceras laeve (Müller), Pilsbry (1948, p. 539, figs. 289c-293).
Deroceras laeve (Müller), Burch (1962, pp. 83, 193, fig. 186).
Deroceras laeve (Müller), Burch & Patterson (1966, p. 7, fig. 19).

Deroceras laeve is a small slug, active adults extending to about 25 mm in length. Its color ranges from light gray or tan to dark brown or nearly black. It is generally flecked or mottled, sometimes extensively, with gray pigment. When the animal is extended, its mantle may appear to be nearly centrally located because of the animal's long neck.

Deroceras laeve exudes watery slime when irritated, which helps differentiate it from *D. reticulatum*, a species which secretes milky, adhesive slime under similar circumstances.

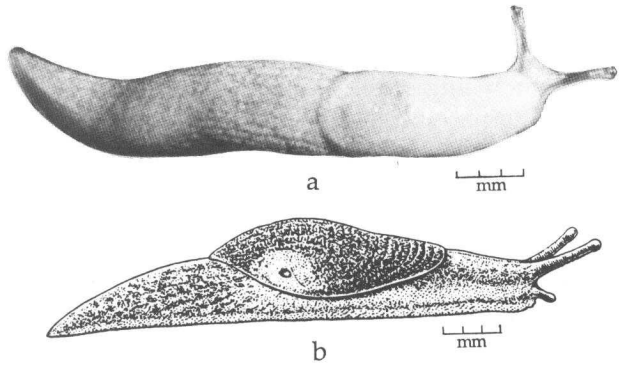


FIG. 102. *Deroceras laeve*, UMBS-86-3.

Distribution in UMBS Area: Cheboygan Co.: Hook Point bay, North Fishtail Bay, Douglas Lake, Section 32, T37N, R3W, Munro Township, UMBS-86-2; Grapevine Point, woods pool area, Douglas Lake, Section 28, T37N, R3W, Munro Township, UMBS-86-3; Reeses Swamp, southwest 1/4 of Section 3, Burt Township, T36N, R3W, UMBS-86-11; Hook Point peninsula, North Fishtail Bay, Douglas Lake, Section 32, T3N, R3W, Munro Township, UMBS-86-22.

Deroceras reticulatum (Müller)
(Fig. 103)

Limax reticulatus Müller, *Verm. terr. et fluv. Hist.*, 2, p. 10.
Agriolimax agrestis (L.), Walker (1899, p. 21).
Agriolimax agrestis (Linnaeus), Walker (1906, p. 489, fig. 74).
Agriolimax agrestis (Linné), Winslow (1926, p. 8).
Agriolimax agrestis (Linnaeus), Goodrich (1932, p. 41).
Deroceras reticulatum (Müller), Pilsbry (1948, p. 534, figs. 287, 288).
Deroceras reticulatum (Müller), Burch (1962, pp. 83, 193, fig. 185).
Deroceras reticulatum (Müller), Burch & Patterson (1966, p. 7, fig.19).

Deroceras reticulatum is a medium-sized slug, measuring 35-50 mm when extended. Its color ranges from nearly white or pale tan to mottled brown or nearly black. A white border surrounds the pneumostome. The sole of the foot is white or gray. When the slug is extended, its mantle is more anteriorly situated than is the mantle of *D. laeve*.

Deroceras reticulatum exudes a milky, sticky slime when irritated.

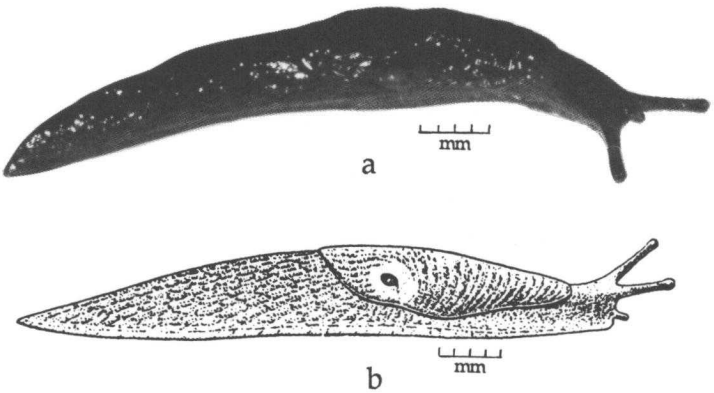


FIG. 103. *Deroceras reticulatum*, UMBS-86-21.

Distribution in UMBS Area: Emmet Co.: alive in drift next to boat ramp parking lot at western end of Park road, near shore of Lake Michigan, Wilderness State Park, Section 19, T39N, R5W, UMBS-86-21.

APPENDICES

IDENTIFICATION

Since one of the main purposes of this manual is to facilitate identification of land snails, some general comments should be made on characters used for species determination. All land snails, with the exception of the slugs, possess an external hard calcareous structure, the shell, which covers the viscera, providing protection, and into which the snail can withdraw in times of danger, inadequate moisture or unfavorable temperature, or simply to rest. In most snails, the shell is twisted in a spiral, which progressively increases in diameter. The characteristics of this shell are different for each species, but within each species the appearance of the shell is constant, except for slight individual variations, or differences due to age of the snail, and sometimes minor diversity as exhibited between different local populations. Because of the constant appearance of the shell for each species, its characteristics are

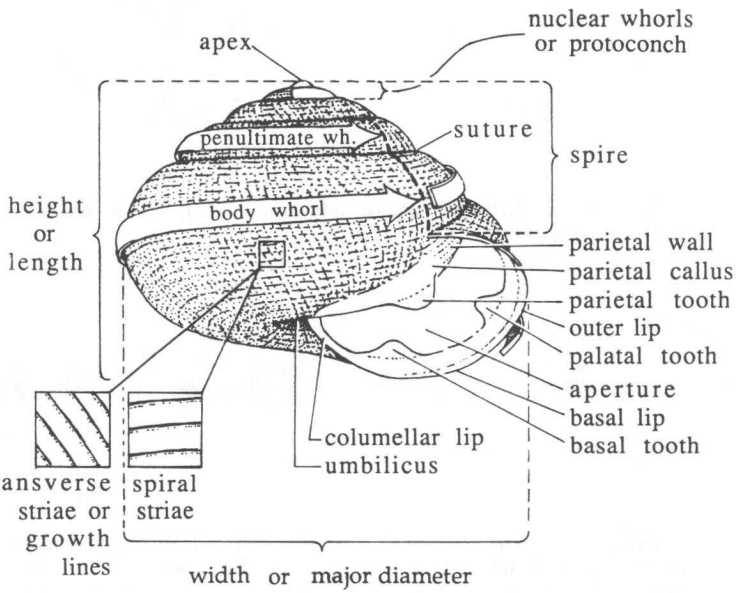


FIG. 104. Shell terminology.

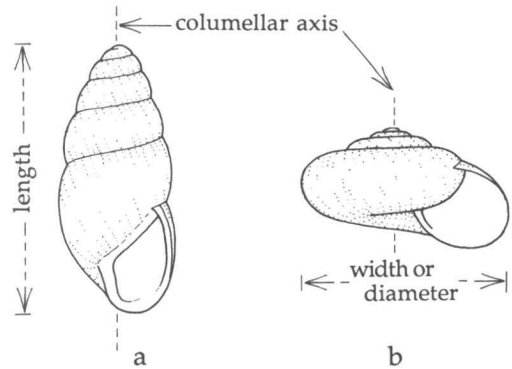


FIG. 105. **a**, An elongate shell (longer than wide); **b**, a depressed shell (wider than long).

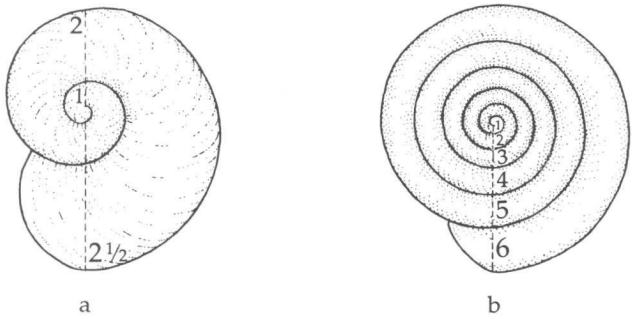


FIG. 106. **a**, Shell with few (in this case 2 1/2) whorls; **b**, shell with many (here 6) whorls.

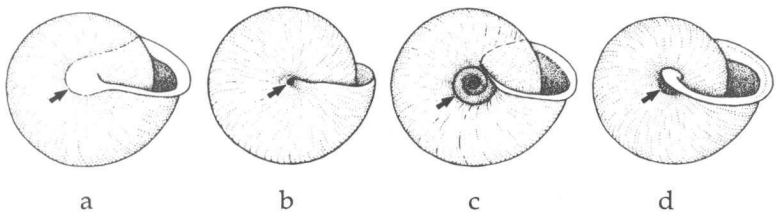


FIG. 107. **a**, Imperforate shell (with closed umbilicus); **b**, perforate shell (with very small umbilical opening); **c**, umbilicate shell (with noticeable umbilical opening); **d**, rimate shell (with umbilical opening partially closed by apertural lip).

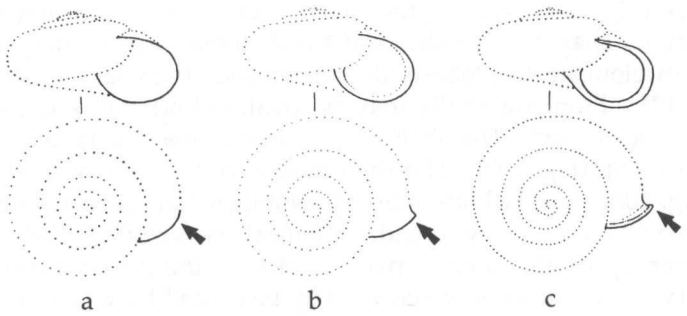


FIG. 108. **a**, Shell lip neither expanded nor reflected; **b**, lip expanded; **c**, lip reflected.

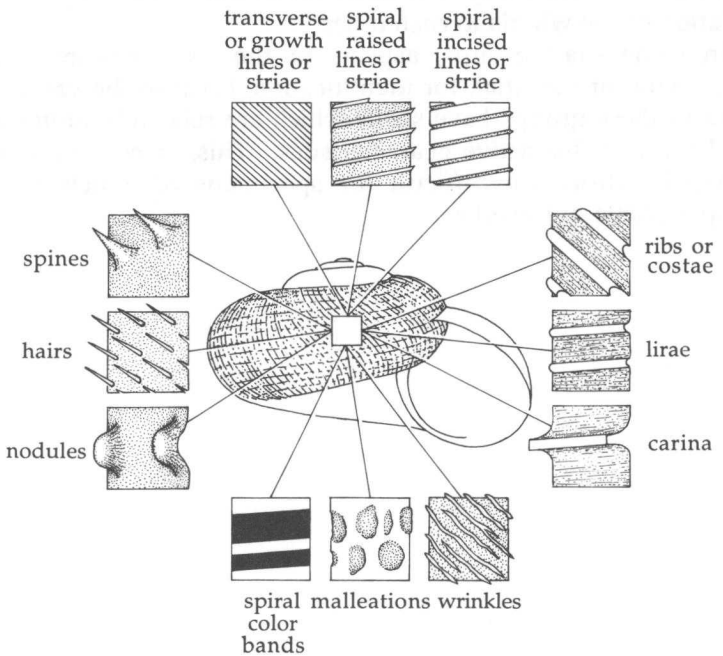


FIG. 109. Shell surface markings.

very important in species recognition, and usually for generic and family placement as well. For that reason, it is important to know the terminology for the various parts of the snail's

shell (Fig. 104). Among the various species, the shell may take various shapes. The shells of the different species may vary from elongate to globose, depressed and discoidal (see Fig. 4, p. 12). Elongate shells may be oval, cylindrical, conical or spindle-shaped. The shell may be longer than wide, or wider than long (Fig. 105). The shell may have few or many whorls (Fig. 106), may lack an opening (umbilicus) at its base, or may have either a narrow or wide umbilical opening (Fig. 107). The outer lip of the shell it may be either straight or variously curved, and in some species it may be turned back or reflected (Fig. 108). The surface of the shell may be marked in various ways (i.e., differentially colored or sculptured (Fig. 109)), or simply may be unicolored and smooth. The outline of the shell aperture ("mouth") may take many forms due to the shape and relation of the whorls to each other.

In some snail groups, aspects of the soft anatomy are important, or essential, for identification, because the various taxa in these groups have shells which are relatively uniform or have few distinctive characteristics. This, of course, may make identification difficult for specimens of which only empty shells are available.

GLOSSARY

Acteophile. A common-name adjective referring to a member of the pulmonate snail order Acteophila.

Acuminate. Having a long, tapering point.

Albumen gland. A gland of the female reproductive system (see Fig. 49) which supplies an envelope of nutritive material (albumen) to the egg immediately after the egg is fertilized. In pulmonate snails, the albumen gland is embedded in the liver just apical to the lung.

Anterior end of shell. That part of the shell closest to the snail's head when the animal is active, generally that part of the shell farthest from the apex.

Aperture. The opening or "mouth" of a snail shell (see Fig. 104) through which the head-foot protrudes when the snail is active.

Apex. The tip of a gastropod shell farthest from the aperture (see Fig. 104).

Arionid. A common name adjective referring to a member of the slug family Arionidae.

Aulacopod. A common-name adjective referring to a member of the sigmurethran pulmonate snail infraorder Aulacopoda. These snails are characterized by longitudinal pedal grooves on the lower lateral sides of the foot (Fig. 5, a).

Axial. Parallel to the axis or columella of a shell, i.e., transverse to the direction of the shell's spiral coil (see Fig. 105).

Axial sculpture. Surface markings on a snail shell which are parallel to the axis and lips of the shell and at right angles to the direction of the whorls; transverse sculpture (see Figs. 104, 109).

Base. The part of the shell opposite the apex. When a shell is held with the apex directed upward, it is the "bottom" part of the shell. In regard to the natural position of the shell as carried by the snail, in an elongate shell the "base" is the anterior end.

Basommatophoran. A common-name adjective referring to a member of the pulmonate snail order Basommatophora (= Acteophila + Lymnophila).

Bicuspid. Having two cusps (in reference to a radular tooth with two cusps, i.e., cutting projections).

Bifid. Divided into halves by a linear sinus, with straight margins.

Biramose. Having two lateral branches.

Body whorl. The last complete whorl or volution of a spiral snail shell, measured from the outer lip back to a point immediately above the outer lip (Fig. 104). It is normally the largest whorl of the shell and is called the body whorl because it encloses the greatest part of the snail's body.

Boss. A protuberance; a prominence; a projecting knob or stud.

Callus (adj. callous). A layer of calcareous material on a shell (e.g., see parietal callus, Fig. 104) secreted by the snail's mantle.

Cochlicopid. A common-name adjective referring to a member of the land snail family Cochlicopidae.

Caudal pore. A conspicuous mucous pore on the dorsum near the posterior tip of the foot in some land snails.

Color bands. Revolving spiral stripes of a darker hue or different color from the ground or background color which occur on some species of gastropod shells (see Fig. 109).

Columella. The internal column around which the whorls revolve; the axis of a spiral shell.

Columella lamella. A calcareous projection or lamella ("tooth") on the shell's columella (e.g., see Figs. 3, b; 8).

Columellar lip. The apertural margin at the columellar region of a coiled gastropod shell (see Fig. 104).

Compressed. Refers to the spire of a gastropod shell that is relatively flattened, i.e., is not elongated; depressed (see Figs. 4, e"; 105, b).

Conchology. The science dealing with molluscan shells, i.e., the nature and formation of molluscan shells, and the practice of classifying mollusks by their shells.

Conical. Shaped like a cone, i.e., tapering evenly from a wide, circular base to a point.

Contractile. Capable of reducing length by shortening and thickening, e.g., the tentacles of most acteophile and lymnophile (basommatophoran) snails (e.g., see Figs. 2, a; 7, c).

Corneous. Resembling horn in color or consisting of a horn-like material.

Costa (pl. costae). A transverse rib or rounded ridge of considerable size on the surface of a shell (see Fig. 109).

Costate. Refers to a shell in which the surface is sculptured with heavy, regular transverse ridges or ribs.

Crenulate, crenulated. Notched on the edges.

Crescentic. Shaped like a crescent, or new moon.

Cusp. The cutting blade or blades projecting from each tooth of the molluscan radula.

Cylindrical. Shaped like a cylinder; round in diameter, with more or less parallel sides; tube-shaped (Figs. 4, d; 27, a).

Deflected. Bent downward from the natural plane of growth, as in the terminal part of the last whorl in some snail shells.

Depressed. Flattened dorso-ventrally or postero-anteriorally, as the spire of a shell (see Figs. 4, e"; 105, b).

Discoidal. Round and flat like a disc.

Disk. The flat ventral part, or sole, of the gastropod foot (as used in the older literature).

Dome-shaped. Shaped like a dome; hemispherical (Fig. 4, f).

Elongate. Lengthened; extending length-wise; especially higher than wide (see Fig. 105, a).

Emarginate. Bluntly notched; terminating in a notch.

Embryonic shell. The shell formed by the embryo; protoconch (see Fig. 104). The embryonic shell of many species have a different surface sculpture from the shell formed after hatching or settling.

Endodontoid. A common-name adjective referring to shelled members of the aulacopod superfamily Arionoidea. These snails were formerly commonly placed in the single family Endodontidae Pilsbry 1895. The oldest family-group name for endodontoid snails is Punctidae Morse 1864. The most recent revision of these snails raises the previously used punctid subfamilies one level higher in the taxonomic hierarchy, i.e., to the status of full families (see p. 79).

Entire. Refers to the lip of a shell that forms a complete circle or oval, i.e., it is not interrupted by a space where it meets the parietal wall of the body whorl.

Epiphallus. The apical chamber of the penis in many pulmonate land snails (see Figs. 48-50, 77), and in these snails it is not eversible, as is the penis. The spermatophore develops in the epiphallus in those snails that produce spermatophores.

Euconulid. A common-name adjective referring to the land snail

family Euconulidae.

Evaginate. To turn inside out.

Expanded. Spread out; trumpet shaped; as the adult shell aperture of some snail species (see Figs. 3, a; 108, b).

Eye stalk. A peduncle bearing an eye at its tip, i.e., in geophile land snails it is one of the larger, upper pair of tentacles; an ommatophore.

Family (adj. familial). A taxonomic group of genera sharing certain basic features that set them off from other such groups of genera. The family is a level of classification between the genus and the order. Names of families end in *-idae.*

Fold. A structure made by, or appearing to be made by, folding, i.e., a bending of one part over itself.

Foot. The muscular ventral surface of the body on which the snail moves.

Form. A particular variation or aggregate of variations within a population. The terms "form" or "forms" have same utility in discussing such interpopulational variations, but a "form" has no formal standing in our system of zoological nomenclature.

Furrow. A shallow groove.

Fusiform. Spindle-shaped, i.e., with a relatively thick middle and tapered to a point at each end (Fig. 4, c).

Genital atrium. The common chamber into which male and female tracts open in geophile land snails (see Figs. 77, 89). The genital atrium opens to the outside by way of the genital pore.

Genital pore. The common opening to the outside of both male and female reproductive systems in geophile land snails; gonopore.

Genus (pl. genera; adj. generic). A basic category of biological classification above the species level which contains (usually) two or more related species which share certain features. A few genera are monotypic, i.e., contain only one species.

Geophile. A common-name adjective referring to a member of the pulmonate snail order Geophila, the taxon that includes the great majority of the land snails. A synonym of geophile is stylommatophoran.

Globose. Globular or spherical; approaching a globe or sphere

in shape (Fig. 4, g).

Glossy. Smooth and shining; highly polished.

Groove. A narrow channel in the surface; furrow.

Growth lines. Minute lines on the outer shell surface indicating minor rest periods during growth (see Figs. 104, 109). Not to be confused with the major "rest marks" or varices, caused by prolonged growth arrest (as during winter).

Haplotrematid. A common-name adjective referring to a member of the land snail family Haplotrematidae.

Headfoot. The combined head and foot organ of a snail. The foot (the snail's locomotory organ) anteriorly is in close proximity to and is generally not separated from the snail's head.

Helicoid. In the form of a low three-dimensional spiral; with a somewhat depressed spire and whorls that increase regularly in diameter.

Holarctic realm. The zoogeographic region which consists of the combined Palearctic and Nearctic realms.

Holopod. A common-name adjective referring to a member of the sigmurethran pulmonate snail infraorder Holopoda. These snails are characterized by the absence of longitudinal pedal grooves on the lower lateral sides of the foot (Fig. 5, b).

Imperforate. Refers to a spiral gastropod shell which has no opening or external cavity at its base (Fig. 107, a). In such a case, the inner sides of the coiled whorls are appressed, leaving no cavity, or, if they are not appressed and a cavity is formed, then in adult shells its opening is completely covered by a callus or the reflected columellar apertural lip.

Incised. Grooved; engraved (see Fig. 109).

Inferior tentacles. The lower, anterior and smaller pair of tentacles of a geophile snail. They apparently function mainly as tactile organs.

Invaginable. Capable of withdrawing by being inverted, e.g., the tentacles of geophile (stylommatophoran) snails (see Fig. 2, b).

Inverted. Turned inward; in a reversed position from normal.

Keel. A prominent ridge; a carina (see Fig. 109).

Labial palp. One of the two velar lobes on either side of the mouth, especially seen in acteophile and lymnophile snails (e.g., see Fig. 11, b).

Lamella (pl. lamellae). A calcareous plate, blade, "tooth" or scale-like structure.

Lappet. A small lap or flap (e.g., see Fig. 11, b).

Large (in reference to shell size). A term used to refer to a snail shell that is more than 30 mm in length or diameter.

Lateral teeth. The teeth on each side of the central or rachidian tooth in a transverse row of radular teeth.

Length. In conchology, the distance from one end of a shell to the other, measured along the shell's columellar axis. Used mainly in regard to elongate shells (see Fig. 105, a).

Limacid. A common-name adjective referring to a member of the slug family Limacidae.

Lip. Edge of the aperture of a shell (see Fig. 104); peristome; peritreme .

Lira (pl. lirae). A large ridge, specifically a spiral ridge, on the outer surface of a snail shell (see Fig. 109).

Lirate. Refers to a shell with spiral ridges on its external surface.

Lunate. In the shape of a half-moon; crescent-shaped.

Lung. An internal, vascularized cavity used for respiration. All members of the large gastropod subclass Pulmonata possess a lung (pulmonary cavity).

Lymnophile. A common-name adjective referring to a member of the pulmonate snail order Lymnophila. This group includes all of the freshwater pulmonate snails.

Mantle. The skin covering the viscera of a mollusk. Also called pallium. It normally lies next to and under the shell, and secretes the shell.

Mantle collar. The edge of the mantle (see Fig. 11, b), often thickened, which lies next to and under the apertural lip of a snail's shell.

Mantle lappet. A lobe or flap of the mantle, near (or part of) the mantle collar (e.g., see Fig. 11, b).

Major diameter. The widest diameter of a snail's shell as measured from the outer apertural lip to the outer edge of the body whorl opposite the aperture. When only the single word "diameter" is used in giving a shell's measurement, it is always the major diameter.

Medium (in relation to shell size). A term used to refer to a snail shell that is 10-30 mm in largest dimension (length or

diameter).

Mesodontid. A common-name adjective referring to a member of the land snail family Mesodontidae.

Minute (in relation to shell size). A term used to refer to a snail shell that is less than 3 mm in length (for an elongate shell) or width (for a depressed shell that is wider than high).

Monotypic. A taxon (e.g., genus, family) consisting of only one species.

Nearctic realm. The zoogeographic region which consists of all of North America (including Greenland) south to central Mexico.

Nodule. A small knot, tubercle, lump or irregularly shaped mass, such as the projections occurring on the shell surface of some freshwater snails (see Fig. 109).

Nominal. Existing in name only, e.g., a "species" named for a minor growth or ecological form of an already named species; any species name, without regard to the biological validity of the species.

Nuclear whorl(s). The first whorl(s) of a shell, formed by the embryo; embryonic whorl(s); protoconch (see Fig. 104). The nuclear whorls often have a surface sculpture differing from that of the rest of the shell.

Obsolete. Rudimental; poorly developed; obscure; indistinct; atrophied.

Ommatophore. One of the upper, posterior tentacles of a geophile snail, which bears an eye at its tip.

Opaque. Not emitting light; neither translucent nor transparent.

Outer lip. The outer or palatal edge of the shell aperture (see Fig. 104).

Oval, ovate. In the shape of the longitudinal section of a hen's egg, i.e., oblong and curvilinear, with one end narrower than the other.

Ovate-conic. Oval in shape, and somewhat conically elongated (Fig. 27, c).

Ovotestis. A gonad (see Fig. 49, a) which produces both eggs (ova) and sperm within the same acinus, often, or usually, simultaneously. In pulmonate land snails, the ovotestis is embedded in the digestive gland.

Palatal. Pertaining to the outer lip or terminal part of the

body whorl of a snail shell.

Palearctic realm. The zoogeographic region which includes Europe, the Near East, Africa, Asia south to the Himalayas, and some islands (Iceland, Canary Islands, Cape Verde Islands, Japan).

Parietal. Pertains to the inside wall of the shell aperture (see Fig. 104).

Pedal grooves. The more ventrally placed and the least conspicuous of the two longitudinal grooves on each side of the lower lateral foot of aulacopodus sigmurethran snails (Fig. 5, a).

Pedal waves. Undulations of the ventral surface of the foot of a snail in motion caused by rhythmic muscular contractions.

Penial retentor muscle. A band of muscle fibers between the epiphallus and penis or penial sheath (see Fig. 89, c).

Penial retractor muscle. The muscle (see Figs. 49, 77, 89) which introverts the penis following copulation.

Penial sheath. A wall around the penis or penial complex, which is distinct from the muscular walls of the penis (see Fig. 50, b, c).

Penis. The male copulatory organ. In pulmonate snails, it is an introvert, which is everted when functioning, but it is usually described and illustrated when introverted (see Figs. 48-50; 77).

Perforate. Refers to a spiral gastropod shell which has a very narrow perforation at its base, formed where the inner sides of the coiled whorls do not join (Fig. 107, b).

Periostracal rib, ridge or spine. A projection, e.g., a "rib," ridge or spine, on the shell surface composed of periostracal material rather than shell (calcareous) material.

Periostracum (adj. periostracal). The thin proteinaceous external layer covering most mollusk shells.

Periphery. The edges of a shell as seen in outline.

Philomycid. A common-name adjective referring to a member of the slug family Philomycidae.

Pneumostome. The opening from the outside into the respiratory cavity (pulmonary cavity; lung) of a pulmonate snail; breathing pore. The pneumostome is in the mantle collar of shelled snails (see Fig. 11, b), and on the right side of the mantle hump in slugs (see Fig. 97, c, d).

Posterior end of shell. The end of a snail's shell opposite to that in which its head normally points when the animal is active. In an elongate or high-spired shell, the posterior end is the apical end.

Prostate gland. Any glandular part of the secondary sperm duct (e.g., see Fig. 49, a).

Pulmonate. A common-name adjective referring to a member of the gastropod subclass Pulmonata. These snails have a lung as a respiratory organ rather than the gills which characterize the other two gastropod subclasses.

Punctid. A common-name adjective referring to a member of the land snail family Punctidae.

Pupa-shaped. Shaped like an insect pupa, i.e., more or less cylindrical with tapering, rounded ends (Fig. 4, b).

Pupillid. A common-name adjective referring to a member of the land snail family Pupillidae.

Pupilline. A common-name adjective referring to a member of the pupillid land snail subfamily Pupillinae.

Quadrate. Shaped like a square, i.e., having four more or less equal and parallel sides.

Race. A geographically or ecologically isolated group of individuals or populations that differ in one or more characters from other individuals or populations of the same species in other locations; a subspecies.

Radula (pl. radulae). A rasp-like structure in the anterior end of the digestive tract of all mollusks except pelecypods which is used to scrape off food during feeding. The radula consists typically of a number of longitudinal and transverse rows of minute sharp "teeth", each with one or more cutting blades or "cusps."

Reflected. Turned outward, e.g., a portion of the apertural lip of some snails' shells (Fig. 108, c).

Reticulate. Having lines crossing each other like a network; constructed like the meshes of a net.

Rib. A transverse elevation or ridge of considerable size on the surface of a shell; costa (see Fig. 109).

Riblet. A small rib.

Rimate. Refers to a coiled gastropod shell that has at its base a rather narrow "umbilical" opening which is partially closed by the expansion of the anterior columellar lip (Fig.

107, d).

Rounded. Having a more or less evenly curved contour, in contrast to being angular.

Sculpture. The natural surface markings, other than those of color, usually found on snail shells, and often furnishing identifying marks for species recognition (see Fig. 109).

Semi-slug. A snail with a relatively small external shell, much too small to withdraw into. An advanced stage in the evolution leading to the slug form in which the shell is still external, but reduced and not yet completely lost.

Sensu lato (abbr. *s. lat.* or *s.l.*). In the broad sense.

Sensu stricto (abbr. *s. str.* or *s.s.*). In the strict sense.

Serpentine. Resembling a serpent; moving in a winding fashion, turning one way and the other, like a serpent.

Shell mouth. The opening or aperture of a snail shell (see Fig. 104) through which the head-foot protrudes when the snail is active.

Shoulder. A bend in the curvature of a snail shell at the periphery just below (anterior to) the suture which resembles a human shoulder in shape.

Shouldered. Refers to the appearance (in outline) of the posterior outer peripheral part of a whorl that is sharply rounded in contrast to the more even curvature of the rest of the shell.

Sigmurethran. A common-name adjective referring to a member of the land pulmonate snail suborder Sigmurethra. These snails are characterized by, and get their name from, the sigmoid arrangement of their kidney and ureter.

Sinuate, sinuous. Wavy or S-shaped.

Slug. A snail without an external shell, the shell having been lost in the snail's ancestors through a long series of evolutionary stages in which the shell became progressively smaller and increasingly enveloped by the mantle (see Figs. 6, 97).

Small (in reference to shell size). A term used to refer to a snail shell that is more than 3 mm in length (or diameter for a shell with a depressed spire), and less than 10 mm.

Snail. A member of the molluscan class Gastropoda. Gastropods all undergo torsion, i.e., a developmental process during early embryology in which the viscera, mantle and

mantle cavity are twisted 180° in relation to the head-foot. Most snails are characterized by possessing a spirally coiled external shell consisting largely of calcium carbonate and used for protection.

Sole. The flat ventral part of a snail's foot (called the "disk" in older literature), on which the snail crawls during locomotion.

Species (pl. species; adj. specific). A taxonomic group comprising the same 'kinds' of closely related individuals potentially able to breed with one another, and unable to breed with other 'kinds'.

Spermatheca. An organ at the end of the apex of the vagina (see Figs. 49, a; 77; 89) in the female genital system for storage of sperm received from the mating partner. During mating in spermatophore-producing species, the spermatheca receives the spermatophore from the mate.

Spindle-shaped. Shaped like a spindle, i.e., with a relatively thick middle and tapered to a point at both ends; fusiform (Fig. 4, c).

Spine. An elongate, tapering, sharply-pointed projection (see Fig. 109).

Spiral. Winding, coiling or circling around a central axis; winding around a fixed point and continually receding from it; the form of the shell of most snails.

Spiral sculpture. Surface markings on a snail shell which follow the direction of the shell's spiral and pass continuously around the whorls more or less parallel to the suture (see Figs. 104, 109).

Spire. The whorls of a snail shell, excepting the last or body whorl (see Fig. 104). The spire is measured as the distance (parallel to the columella) from the suture where the apertural lip meets the body whorl to the shell apex.

Stria (pl. striae). A slight superficial spiral groove or fine furrow on the outer shell surface (see Fig. 109), or a fine spiral threadlike line or streak. Commonly used also, in a less precise sense, for raised spiral threads on the shell surface.

Striate. Refers to a shell having fine, spiral, incised lines or striae on its surface (see Fig. 109). Also used, less precisely, for shells with spiral raised lines, or for shells covered with fine transverse lines.

Strobilopsid. A common-name adjective referring to a member of the land snail family Strobilopsidae.

Stylommatophoran. A common-name adjective referring to a member of the pulmonate snail order Stylommatophora (= Geophila).

Subfamily (adj. subfamilial). A taxonomic category or group between the genus and family in the hierarchy of animal classification. Subfamilies are used when it is necessary to divide a family into more than one group of closely related genera. The subfamily is therefore a subordinate category to the family. Each subfamily contains one or more genera. Names of subfamilies end in *-inae*.

Subgenus (pl. subgenera; adj. subgeneric). A taxonomic category or group between the species and genus in the hierarchy of animal classification. Subgenera are used when it is necessary to divide a genus into more than one group of closely related species. The subgenus is therefore a subordinate category to the genus. Each subgenus contains one or more species.

Subglobose. Not exactly globular or spherical in shape, but approaching such a form.

Subovate. Not exactly oval in shape, but approaching such a form.

Subspecies (pl. subspecies; adj. subspecific; syn. race, variety). One or more populations of a species which inhabit a distinct geographic area and which share morphological features setting them off from other populations of the species.

Succineid. A common-name adjective referring to a member of the land snail family Succineidae.

Succiniform. *Succinea*-like, i.e., with a thin and fragile shell, which has a large oval aperture and body whorl and a small spire (Fig. 4, a).

Superfamily. A taxonomic category or group between the family and order in the hierarchy of animal classification. Superfamilies are used when it is necessary to divide an order into more than one group of closely related families. Names of superfamilies end in *-oidea* (although it also has been common practice in malacology to use the ending *-acea*).

Superior tentacles. The upper, posterior and larger pair of tentacles of a geophile snail. Each of these tentacles has an

eye at its tip, and consequently are sometimes referred to as ommatophores.

Suprapedal grooves. The more dorsally placed and the most conspicuous of the two longitudinal grooves on each side of the lower lateral foot of aulacopodus sigmurethran snails (see Fig. 5, a).

Suture. The external line on the shell where the surfaces of two adjacent whorls meet (see Fig. 104).

Tail. The posterior end of the foot in a land snail.

Taxon (pl. taxa). Any taxonomic group, e.g., a subspecies, species, genus, family, order, etc.

Tentacle. One of a pair of elongated, flexible organs on the head of snails used for feeling, or for sensing light. Geophile snails have two pairs of tentacles, with an eye at the tip of each tentacle of the larger, upper pair (Fig. 2, b). The Carychiidae (Fig. 2, a) and the freshwater snails have one pair of tentacles, with an eye at the base of each tentacle.

Tessellate; tessellation; tesselloid. Formed into or of squares (tessellae; tesserae); checkered.

Tongue-shaped. Shaped like a tongue, i.e., elongate and bluntly round at the end.

Tooth (pl. teeth). A hard, sharp, chitinous projection of the molluscan radula which tears away or punctures the food surface, or is modified for food capture. Also, a hard, calcareous nodule or projection in or around the aperture of the shell (see Fig. 104) of many snail species which functions to restrict entry into the shell by predators. The position and arrangement of these "teeth" are usually of diagnostic value in snail taxonomy.

Translucent. Partially transparent; allowing diffused light to be transmitted.

Transparent. Clear; transmitting light without scattering, so that structures lying beyond are clearly visible.

Transverse. At right angles to the spiral direction of the whorls; parallel to the columella or axis of the shell; in the same direction as (i.e., parallel to) the growth lines of a snail shell (see Fig. 104).

Transverse sculpture. Surface markings on a snail shell which are parallel to the axis and lip of the shell and at right angles to the direction of coiling of the whorls (see Fig. 104);

axial sculpture.

Trapezoidal. Having a quadrilateral shape, no two sides of which are parallel.

Tricuspid. Having three cusps (in reference to a radular tooth with three cusps, i.e., cutting projections).

Tripartite. Consisting of three parts, as the three longitudinal sections of the sole of the foot of some snails.

Truncate, truncated. Cut off at the end; terminating abruptly; ending in a transverse line.

Tubercle. A nodule (see Fig. 109) or small eminence, such as a solid elevation occurring on the shell surface of some gastropods.

Tuberculate. Covered with tubercles or rounded knobs.

Umbilical side of shell. The side or end of the shell in which the umbilicus is located; the side of the shell opposite the apex (see Fig. 104).

Umbilicate. Refers to a spiral gastropod shell which has an opening or cavity at its base , and more specifically to one in which the opening is more than a very narrow perforation (Fig. 107, c). This cavity is formed in those shells in which the inner sides of the coiled whorls do not join.

Umbilicus. An opening or cavity in the center of the columella or axis of the shell (see Figs. 107, b, c, d), formed in those shells in which the inner walls of the whorls at the central axis do not coalesce to form a solid center.

Vagina. The copulatory sheath of the female system (see Figs. 48, 49, 77, 89). It extends from the genital atrium to the spermatheca duct.

Valloniid. A common-name adjective referring to a member of the land snail family Valloniidae.

Vertiginine. A common-name adjective referring to a member of the pupillid land snail subfamily Vertigininae.

Vitrinid. A common-name adjective referring to the land-snail family Vitrinidae.

Whorl (spelled 'whirl' in early literature). One complete turn or coil of a spiral gastropod shell (see Fig. 104).

Width. In conchology, the diameter of a snail's shell (see Fig. 104).

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