"The shell characters that may be used to distinguish the species and subgenera of *Retinella* are: 1) growth sculpture, 2) spiral striae, and 3) shell form. In all of the species, the ordinary growth-wrinkles (minor series) become much weaker on the umbilical side of the shell. In all of the subgenera except *Perpolita*, sharply incised, radiating lines (major series) are superimposed in the growth series; these become more evident (although slightly weaker) on the umbilical side of the whorls because the contrast between them and the ordinary growth-wrinkles is intensified. For the study of sculpture, fresh shells (and a high-powered binocular!) are necessary; the spiral striae, especially, disappear almost completely from leached individuals and may even become very faint in old museum specimens. Although some traces of spirals are present in all of the species, considerable contrasts in their strength indicate specific difference, even if evaluation of the effects of weathering is almost impossible." (H. B. Baker.)

Key to North American subgenera [71]

A. Epiphallus poorly developed; spermathecal sac long, sausage-shaped and flabby; centrals and laterals of radula large, squarish and tricuspid; shell with quite uniform, rounded growth-wrinkles (major series lacking); whorls with less overlap, suture with less oblique (usually narrower) bevel and sutural spiral (as viewed apically) relatively wider.....Subg. *Perpolita* H. B. B.

AA. Epiphallus well developed; spermathecal sac distinct and ovoid; shells with a major series of impressed, radiating lines superimposed in the minor series of growth wrinkles.

B. Spermatheca of long type; vagina present; outer marginals of radula not serrate; shell umbilicate.

C. Central of radula about as large as first lateral, with elongate mesocone; laterals also tricuspid; major growth-striae weak on umbilical side of shell and little more prominent than minor ones on apical surface.
Subg. *Glyphyalus* H. B. B.

D. Penis with epiphallar opening almost apical; major growth-striae of shell widely and irregularly spaced; epidermis (in fresh shells) colored.....Sect. *Glyphyalus* s. s.

DD. Penis with epiphallar opening much below apex; major growth-striae closely and quite regularly spaced; epidermis hyaline and almost white.....Sect. *Glyphyaloides* H. B. B.

CC. Central larger than first lateral, with broad mesocone; laterals without entocones; major growth-striae strong on umbilical side of shell and much more prominent than minor ones on apical surface.
Subg. *Glyphyalops* H. B. B.

BB. Spermatheca of short type; vagina very short; penial apex a papillate chamber; outer marginals of radula serrate; shell narrowly umbilicate to imperforate. Radula and shell otherwise as in *Glyphyalops*.
Subg. *Glyphyalinia* Von Martens

E. Penis with terminal retractor; shell with more closely spaced spiral striae.....Sect. *Glyphyalinia* s. s.

EE. Penis with a slender continuation beyond insertion of retractor (very short in *subdola*); shell with more widely spaced spiral striae (less conspicuously so in *praecox*); umbilicus rimate.
Sect. *Glyphognomon* H. B. B.

[71] Taken with small alterations from H. B. Baker, 1931.

Subgenus PERPOLITA H. B. Baker

The main characters of this group are that an epiphallus is not distinctly differentiated from the vas deferens, and the shell sculpture of growth-wrinkles is nearly uniform, without more widely spaced deeper grooves.[72]

The following key to the North American species of *Perpolita*, composed by Dr. H. B. Baker, may assist in their identification:

A. Whorls more rapidly expanding; umbilicus markedly funicular and usually smaller; northern species (typical group).
  B. Shells (at least under same conditions) larger (major diameter of adults with 4¼ whorls usually over 4.5 mm.); spiral striae almost completely obsolete; epidermis corneous and animal darkly pigmented (except in very rare albinos); northern U. S. and Canada (southward in Rocky Mts.)... .....*R. electrina*
  BB. Shells smaller (major diameter of adults with 4¼ whorls usually less than 4 mm.); spiral striae present or epidermis hyaline and highly polished.
    C. Shell intermediate between *electrina* and *binneyana* in size; epidermis corneous, less polished and animal darkly pigmented (except in albino forms); spiral striae present; palearctic.....*R. hammonis*
    CC. Shell always smaller than *electrina* from the same locality; epidermis hyaline (whitish) or nearly so, more polished; northern U. S. and Canada (southward in western mountains).....*R. binneyana*
      D. Epidermis slightly more corneous; spiral striae present; animal often darkly pigmented; Pacific Coast, intergrading with *binneyana* in the Rockies.....*R. binneyana occidentalis*
      DD. Epidermis hyaline; spiral striae almost obsolete; animal almost white; northeastern U. S. and Canada.....*R. binneyana binneyana*

AA. Whorls more gradually expanding; umbilicus more open and usually slightly larger (about 4 times in major diameter); spiral striae present; southern species (group of *R. subhyalina*).
  E. Shell larger (about size of *binneyana*); spire and whorls depressed (more so than in *binneyana*); Mexico. (subsp. *? socorroënsis* has slightly higher spire).....*R. subhyalina* (Pfeiffer)
  EE. Shell smaller; whorls more rounded and spire usually higher; Florida.....*R. dalliana*

Retinella electrina (Gould) Fig. 126.

Helix electrina Gould, 1841, Invert. Mass., p. 183, fig. 111.—A. Binney, 1841, Jour. Bost. Soc. N. H., 3: 423, pl. 22, fig. 2 (shores of Fresh Pond, Cambridge, Mass.).

Helix janus C. B. Adams, 1841, Amer. Jour. Sci., 40: 274, footnote *, as synonym of *H. electrina* Gld.

Zonites radiatulus Alder, var. *alba* Jeffreys, 1872, Ann. Mag. N. H. (4) 10: 245. New name for *H. electrina* Gld.

Zonites viridulus, Mke., Binney, 1878, Terr. Moll., 5: 115, pl. 29, fig. 1.

Hyalina pellucida Lehnert, 1884, Science Record 2: 172 (Point Barrow, Alaska).

Vitrea radiatula Alder, Dall, 1905, Harriman Alaska Exped., Mollusca, 13: 38.

Hyalinia radiatula electrina Gould, Taylor, 1908, Monograph British Land and Freshwater Mollusca, 3: 97, fig. 139.

Vitrea hammonis (Ström), Pilsbry, Nautilus, 11: 129; 1902, Proc. Acad. Nat. Sci. Phila., p. 431, pl. 23, figs. 10-12.

---

[72] *Perpolita* was used by the author in MS. of a work on New York mollusks, but it was actually published in a paper by Dr. Baker. Dr. C. M. Cooke proposed *Nesovitrea* for a species belonging to a closely related group.

Retinella hammonis Ström. H. B. Baker, 1928, Proc. Acad. Nat. Sci. Phila., 80: 16, pl. 3, figs. 1-4 (anatomy, Cheboygan Co., Mich.).

The shell is deeply umbilicate, umbilicus about one-sixth the total diameter; transparent, with a faint yellow or green tint, glossy. Sculpture of crowded radial grooves, wanting on the first whorl, and not reaching the

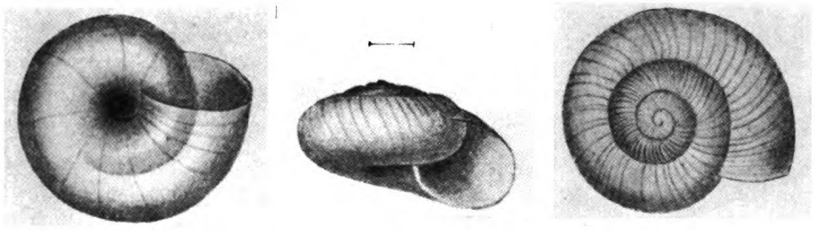

Fig. 126. *Retinella electrina,* Mohawk, N. Y. Scale line = 1 mm.

base, which is smooth except for some faint growth-wrinkles. Microscopic spiral striation is wanting or very weak. Whorls $3\frac{3}{4}$-$4\frac{1}{4}$, the last convex below. Aperture rotund-lunate.

Height 2.82 mm., diameters 5.15 and 4.54 mm.; umbilicus 4.4 times in diameter; whorls $4\frac{1}{4}$. Cambridge.

Height 2.54 mm., diameters 4.60 and 4.13 mm.; umbilicus 4.5 times in diameter; whorls $4\frac{1}{4}$. Philadelphia.

EASTERN CANADA: Labrador. Newfoundland. Prince Edward Island. Magdalen Is. Anticosti I. Nova Scotia. Quebec. Ontario.

UNITED STATES: MAINE. VERMONT. MASSACHUSETTS. NEW YORK. PENNSYLVANIA: in Northampton, McKean, Allegheny, Monroe and Philadelphia counties. NEW JERSEY: Sussex, Warren, Monmouth, Burlington and Gloucester counties. MARYLAND: Baltimore Co., District of Columbia. VIRGINIA: Fairfax Co. OHIO: Tuscarawas Co. INDIANA: Dearborn and Tippecanoe Co. MICHIGAN. WISCONSIN. ILLINOIS: Champaign and Will counties. MINNESOTA. IOWA. MISSOURI: Jasper Co. NORTH DAKOTA. SOUTH DAKOTA. KANSAS: Shawnee Co. MONTANA. WYOMING: Fort Bridger, Uintah Co. COLORADO: Summit, El Paso, Telluride, Chaffee and Mesa counties. IDAHO: Washington Co. UTAH: Weber Co. NEW MEXICO: San Miguel and Luna counties and Gallinas Canyon, Grant Co. ARIZONA: Apache Co. OREGON: Rock Creek, Klamath Co. WASHINGTON: Yakima Co.

BRITISH COLUMBIA: East Kootenay District.

ALASKA: Kodiak Island.

The distribution given is that verified by Dr. Baker from the collection of the Academy. Where only the state is mentioned, several or many localities are represented in the collection. Many localities in Manitoba, Alberta, British Columbia and Alaska have been given by Dall (1905). It seems generally spread north to Point Barrow on the Arctic Ocean.

Retinellae formerly referred to "*hammonis*," now to *R. electrina* and *R. binneyana occidentalis*, occur throughout the mountain states from New Mexico and Arizona north. These races are typically distinguished by the microscopic spiral striation present in *occidentalis*, weak or wanting in *electrina;* but much of the material in collections, upon which published

locality records were based, is not in perfect living mature condition, and the minute sculpture is often impaired or lost by slight weathering. Moreover, some intergradation certainly exists in apparently fresh specimens. The distinction should not be taken too seriously.

R. electrina has usually appeared in our literature under some one of the three names commonly applied to a closely allied European snail,[73] and in fact the separation of the American race specifically is more a matter of convenience than of definable constant diversity; the subspecific rank seems more fitting. However, there is still uncertainty about the proper name of the European species, while there is none about the names given to American forms of this group. Dr. H. B. Baker has given the following reasons for the specific separation of *electrina* and the palearctic *hammonis:*

"1. Although the two approach each other quite closely, adult shells of *electrina* are appreciably larger and never have more than extremely faint and discontinuous traces of spiral sculpture (short striae occasionally discernible in fresh shells under a magnification of more than 100 diameters).

"2. Although fresh shells of *binneyana* and *electrina*, wherever they occur together, are always readily separable, *R. binneyana occidentalis* approaches the palearctic *R. hammonis* even more closely than does *R. electrina*. In other words, although *electrina* and *binneyana* are clearly distinct species, either of them might, with almost equal reason be considered a subspecies of *hammonis!*

"3. From the standpoint of nomenclature, no simplification results from the use of the palearctic name for the American species, because *R. hammonis* is usually known as *R. radiatula* (Alder) or *R. viridula* (Menke) in Europe."

Dr. Binney described and figured this snail as an unpublished species of Gould, in the last number of the Boston Journal, Vol. 3, for November, 1840; but the title page of the volume is dated 1841, and it appears that no. 4 of vol. 3 did not appear until sometime in that year.[74] Whether it actually preceded Gould's description is not known, but it seems fair to give Gould the benefit of the doubt.

The animal is shaped as in *P. indentata.* The collar, back and tentacles are almost black; the shade becomes a little lighter towards the foot edges and sole which are very dark gray. The whole shell is yellow, with a dark line below the suture, in the living animal. The sole is tripartite, the areas

[73] *Helix hammonis* Ström, 1767, Drontheimischen Gesellschaft Schriften, 3: 392, pl. 6, fig. xvi (Norway).

Helix viridula Menke, 1830, Synopsis Methodica Molluscorum, edit. 2, p. 127 (Eschenberg, Hassia; Bösingfelde, Lippe).

Helix radiatula Alder, 1830, Catalogue Testacea of Newcastle upon Tyne, p. 12, No. 50.

[74] In reply to an inquiry as to the date of this part of the Boston Journal, I was informed (1917) that the actual date of issue could not be found in the Boston Society's records.

separated by impressed lines. The kidney is triangular, a little longer than the pericardium. A specimen from Philadelphia has 27.3.1.3.27 teeth. Central tricuspid, as large as the laterals, and as in the latter, the mesocone projects beyond the basal plate. Three laterals have well-developed endoconal cusps borne high on the mesocones, and ectocones; the fourth a transitional tooth with a minute ectocone, no endocone, and otherwise like the marginals, which are simple and thorn-shaped.

" In November I have found *P. h. electrina* under sticks and bark frozen in a little globule of ice. The animal was lively when thawed out. At the same time, *Vitrina limpida* was most active." (G. H. Clapp.)

Dr. H. B. Baker has described the anatomy as follows:

" Lung: very short; about 1⅓ times as long as its base or length of kidney; principal pulmonary vein large; minor venation indistinct. Kidney: large, about as long as wide and 1½ times length of pericardium; secondary ureter closed.

" Ovotestis (Fig. 127: 2): four groups of ovoid alveoli with especially large connecting tubes; duct long, gradually swollen and convoluted near base; talon tapering towards apex and recurved; carrefour obovoid. Uterus: complexly sacculate, of medium length. Free oviduct: very short, with a small, elliptic mass of yellow, glandular tissue on columellar wall. Spermatheca: sac long, imbedded along columellar side of uterus, with apex some distance short of loop of aorta; duct very short. Vagina: large and stout, with heavy, whitish walls. Prostate: large, of long type. Vas deferens: passing almost directly to apex of penis. Epiphallus (Fig. 127: 1): a slight but distinct swelling with thinner walls and larger lumen just above apex of penis; penial pore on one side of apex of penis. Penis: relatively small, with thick walls and numerous longitudinal folds, which leave open a small simple-walled cavity in the bell-shaped apical region, and are interrupted about ⅓ length from apex by a series of elliptic, sucker-shaped thickenings. Penial retractor: insertion at apex of penis; intimate sheath complete. Cloaca: short but stout; opening near center of side of visceral stalk.

" Columellar muscle gives off: (1) buccal retractor, which is practically free; (2, 3) right and left free retractors near base of tail; and continues as (4) tail fan, which is not as heavy as either lateral one. Free retractors: origin of tentacular muscle high; lateral fan large and heavy, right one with strand to base of cloaca. Radular formula (Fig. 127: 3): 22 to 24-3-1-25 to 27; 59 transverse rows counted. Central: almost as large as first lateral; tricuspid with squarish base. Laterals: squarish, tricuspid, with large entocone carried high on mesocone; third tooth transitional. Marginals: unicuspid. Salivary glands; ovoid in shape, situated above oesophagus; left one largest; ducts about as long as glands. Intestine: S-loops imbedded in liver tissue, although anterior one catches albumen gland." (H. B. Baker.)

(*Electrina*, from *electrum*, amber.)

Retinella binneyana (Morse) Fig. 127 a.

Hyalina binneyana Morse, 1864, Jour. Portland Soc. Nat. Hist., 1: 13, 61, figs. 25, 26, pl. 2, fig. 9; pl. 6, fig. 27.

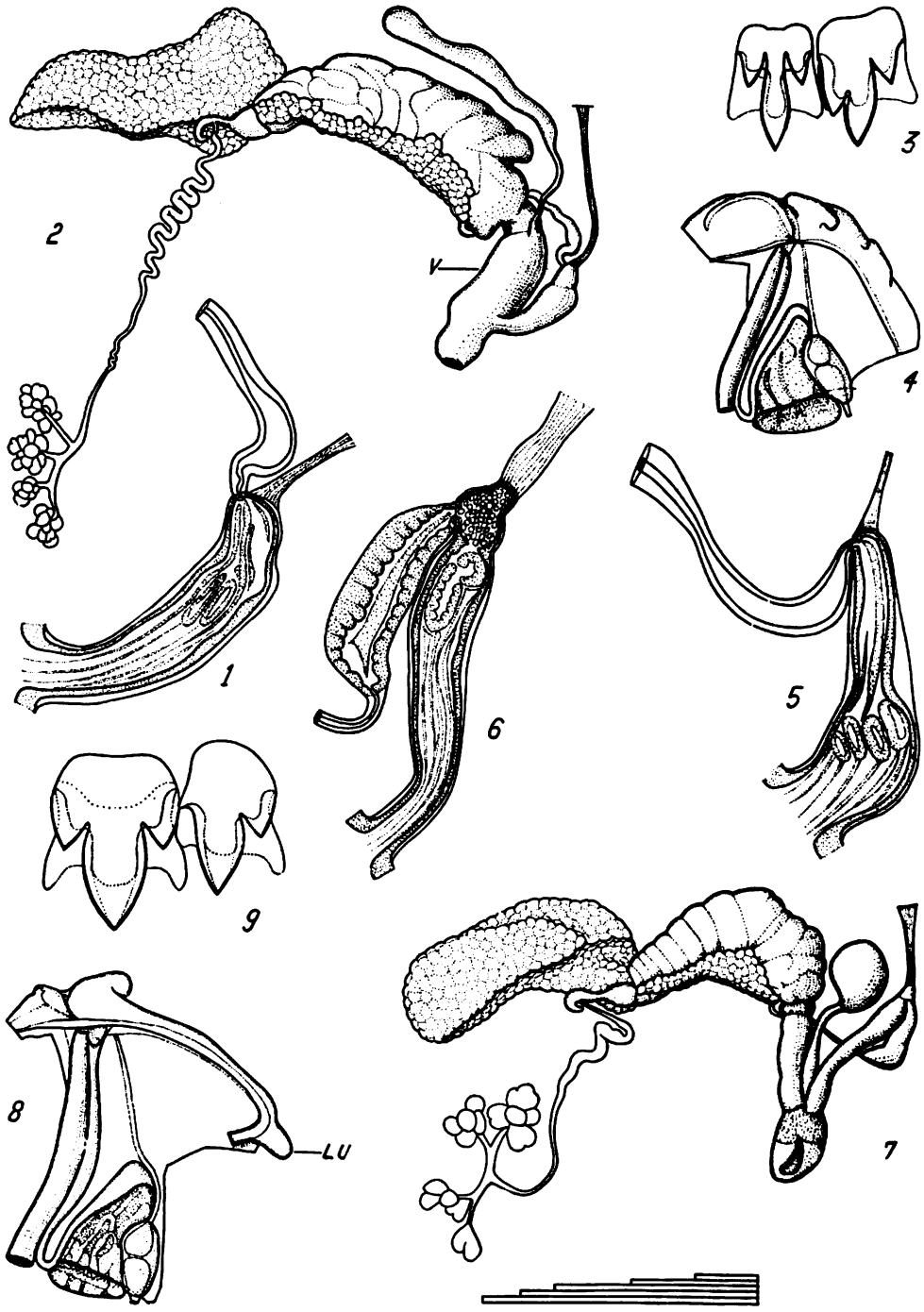

Fig. 127. 1-4. *Retinella electrina,* Michigan. 5, R. *binneyana,* Michigan, penis and accessories. 6, 7, *R. indentata,* Michigan. 8, internal view pallial complex. LU, umbilical shell lobe. 9, *R. carolinensis,* Virginia, teeth.

Zonites binneyanus Morse. W. G. Binney, 1878, Terr. Moll., 5: 120.

Helix morsei Tryon, 1865, Amer. Jour. Conch., 1: 188 (substitute for *binneyana*).

Retinella (*Perpolita*) *binneyana* (Morse), H. B. Baker, 1928, Proc. Acad. Nat. Sci. Phila., 80: 18, pl. 3, fig. 5 (anatomy).—F. C. Baker, 1939, Canad. Jour. Research, 17: 100.

"Body bluish, disk white, viscera bright orange color. Shell thin, pellucid, nearly colorless, composed of nearly four whorls gradually en-

Fig. 127 a. *Retinella binneyana.* Knox Co., Maine. Scale line = 1 mm.

larging; spire slightly elevated; aperture well rounded; umbilicus showing all the volutions. Periostraca slightly wrinkled by lines of accretion; numerous short rugae also run obliquely across the incremental lines. Diameter .13, axis .07 inch (4.25 × 1.75 mm.). (Morse.)

ONTARIO: Thunder Bay district: Wauwiag River. Rainy River district: Mack Lake; Agnes Lake; west end Russell Lake; near Mackenzie Arm of Lake Kahnipiminanikok. Kenora district: Kennedy Island. MAGDALEN Is.: Grindstone. MAINE: Type locality (Morse); Cumberland, Kennebec, Penobscot and Piscataquis counties. NEW YORK: Essex, Onondaga, Ulster counties (and reported from Huntington, L. I.). PENNSYLVANIA: Pike Co. OHIO: Tuscarawas Co. MICHIGAN: Chippewa, Emmet and Cheboygan counties.

"This species is nearest allied to *H. electrina.* It differs from that species in the following particulars: it is nearly one-third smaller than *H. electrina;* its color is quite different, being nearly white with a greenish tinge." (Morse.) Some small differences in the jaw and teeth are also pointed out by Morse, and the color of the living animal is not the same; but the shell differs from *electrina* chiefly in size, which seems rather constant.

"My specimens," Dr. Baker writes, "are from Cheboygan County, Michigan; five were examined. Out of these, two had numerous trematode sporocysts in the liver, while one had two relatively large round-worms between mantle and shell. The largest animal with an exceptionally heavy infestation of the sporocysts, showed a remarkably rudimentary reproductive system. The sporocysts give the liver a golden-yellow color (Cf. Morse, l. c.), while in healthy specimens it is chocolate brown. The anatomy of this species is almost identical with that of *R. hammonis* [*electrina*], and only a few points of comparison will be noted.

"Animal: almost white with darker tentacles. Ovotestis: 3 groups of lobules; talon relatively stouter; carrefour more slender. Vas deferens: relatively shorter and stouter. Epiphallus (Fig. 127: 5): similar but basal end attached along penis. Penis: with same fundamental structure, but zone of sucker-shaped thickenings about ⅓ length from base; as penis is stoutest in this region, its shape is quite different. Radular formula: 21-3-1-24; 65 transverse rows counted; teeth very similar to those of *R. hammonis*." (H. B. Baker.)

(Named for William G. Binney.)

Retinella binneyana occidentalis H. B. Baker Fig. 128: 1-3.

R. (Perpolita) binneyana occidentalis H. B. Baker, 1930, Proc. Acad. Nat. Sci. Phila., 82: 198, pl. 9, figs. 1-3.

"Shell (Fig. 128: 1-3): more burnished, with lower but more sharply outlined growth-wrinkles; spiral striae distinct (for *Perpolita*); epidermis slightly more corneous (relatively thicker?). Height 1.93 mm., diameters 3.57 and 3.05 mm., 4 whorls; umbilicus in diameter 5.1 times.

Animal usually more darkly pigmented (especially when alive, rapidly fading in alcohol); surface coarsely pebbled (showing white spots, which are probably parasites). Genitalia: much as in typical *binneyana* (*i. e.*, with its peculiarly shaped penis which is proportionately smaller than in *electrina*) but insertion of penial retractor more laterad.

BRITISH COLUMBIA: Nanaimo, Vancouver I. WASHINGTON: Clallam, Snohomish and King counties; type from along McAleer Creek, near border of King Co., just north of Seattle; A.N.S.P. 150605. OREGON: Klamath Co. CALIFORNIA: Siskiyou Co., also Bear Creek and Pavilion Dome. From Rocky Mts. BRITISH COLUMBIA: East Kootenay District. ALBERTA: Banff. MONTANA: Glacier National Park. COLORADO: Clear Creek, Telluride and El Paso counties.

"The much stronger spiral sculpture of the shells from the Pacific Coast is the most important distinction of *occidentalis*. The specimens from the Rocky Mts. seem to be intermediate in this character, but no very fresh shells have been examined. As much of the material of both *electrina* and *occidentalis* from the Rockies consists of drought-killed and bleached material, the identification of some lots (especially of juvenile individuals) is almost impossible; these dubious data are usually omitted from the foregoing records, although those from New Mexico and Arizona (included under *electrina*) are mainly based on bleached shells. In northern California (around Mt. Shasta), a form with the burnished, hyaline shell, the spiral sculpture and the genitalia (animals from near Weed, Siskiyou Co.) of *occidentalis* attains a much larger size and actually approaches the dimensions of *electrina*." (H. B. Baker.)

Retinella dalliana (Pilsbry & Simpson) Fig. 129.

Zonites dallianus "Pils. and Simp." Simpson, 1888, Conch. Exch., 2: 96 (name only; Shaw's Point, Manatee Co., and Little Sarasota Bay).[75]—Pilsbry, 1889. Proc.

[75] As Simpson, who collected the type lot and discussed it with me, published this name in 1888, though without description, I am quoting him as joint author.

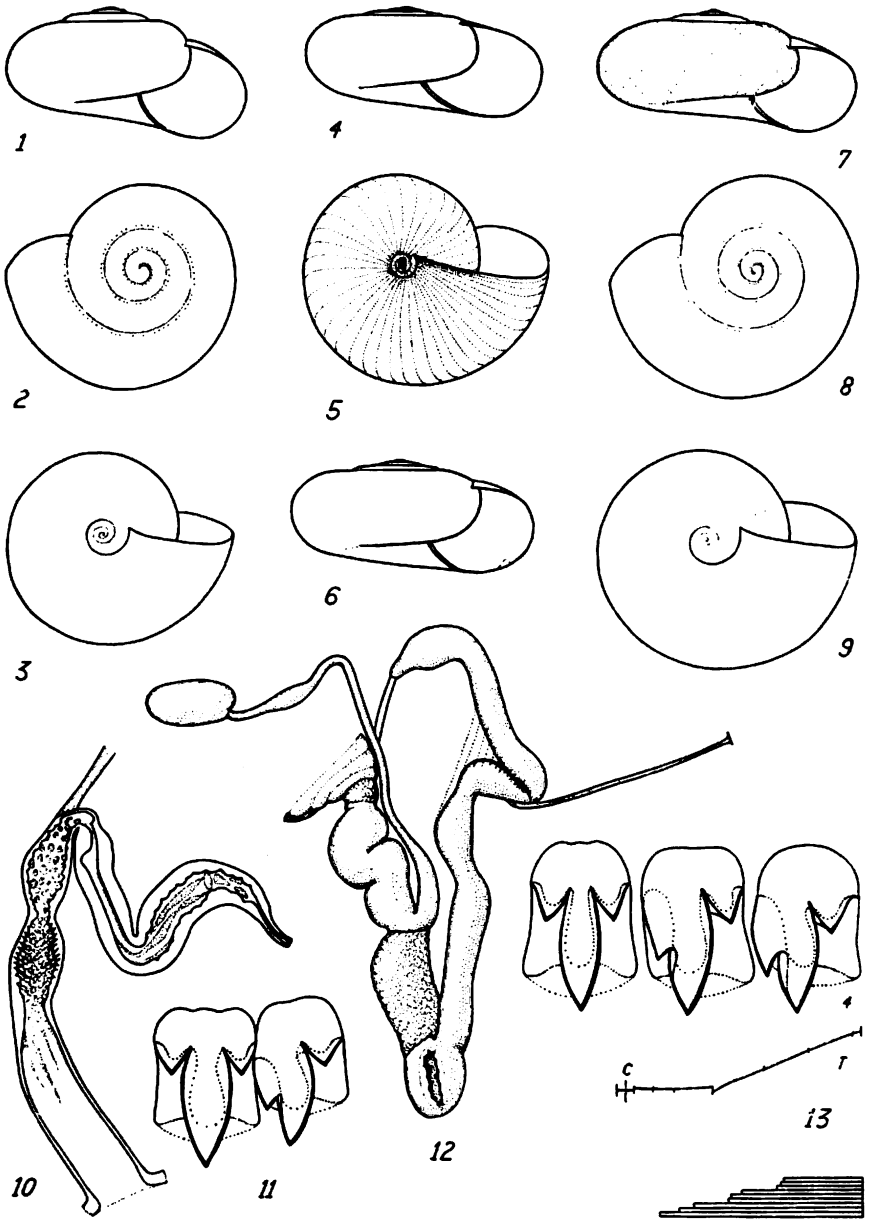

Fig. 128. 1-3, *Retinella binneyana occidentalis,* King Co., Wash., type shell. 4, 5, *R. rhoadsi austrina,* Washington Co., Tenn. Frontal and umbilical (with major growth-furrows) outlines of type shell. 6, *R. burringtoni,* Rockbridge Co., Va. Outline of type shell. 7-9, *R. cumberlandiana roanensis,* Avery Co., N. C. Frontal (with major growth furrows), apical and umbilical outlines of type shell. 10, *R. cumberlandiana cumberlandiana,* Marion Co., Tenn., penis and accessories. 11, radula: central and first lateral teeth. 12, terminations of dissected genitalia. 13, *R. subhyalina* (Necaxa, Puebla, Mexico), radula (after H. B. Baker).

Acad. Nat. Sci. Phila., p. 83, pl. 3, figs. 9-11.
Vitrea dalliana Pilsbry and Ferriss, 1906, Proc. Acad. Nat. Sci. Phila., 58: 152, fig. 9.

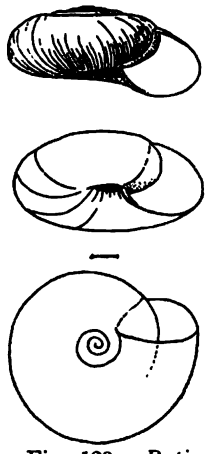

Fig. 129. *Retinella dalliana*, Osprey, Manatee Co. Scale line = actual diameter.

"Shell minute, depressed, narrowly umbilicated, fragile, pale straw-colored, somewhat shining; under a lens seen to be marked with delicate growth-lines above, smoother beneath. Spire a little convex; apex subacute; sutures scarcely impressed. Whorls three and one-half, scarcely convex, the last wide. Aperture oblong-lunate, oblique, upper and lower margins subparallel, slightly converging; peristome acute." (Pilsbry.)

Height 1.36 mm., diameters 2.66 and 2.45 mm., umbilicus 4 times in diameter; 4 whorls.

FLORIDA: Seen from 47 localities in the following counties: Wakulla, Clay, Levy, Alachua, Citrus, Hernando, Lake, St. Lucie, Pinellas, Manatee, Palm Beach, Lee, Collier, Broward, Dade, Monroe. On most of the Keys west to Stock Island. Type 60056 A.N.S.P. from Shaw's Point, near Palma Sola, Manatee Co.

It is sculptured with close but irregularly spaced radial grooves and no spiral striation. It reaches a size of 3.2 mm. diameter with 4½ whorls. Anatomy unknown.

(Named in honor of William H. Dall.)

Subgenus GLYPHYALUS H. B. Baker

The following key has been composed by Dr. H. B. Baker to assist in the identification of the species and subspecies of *Glyphyalus:*

A. Shell with dull sheen (minor growth-wrinkles relatively prominent); sculptural characters approaching *Perpolita* (see key to sub-genera); umbilicus more nearly circular; typical group.
  B. Shell with more depressed whorls and lower spire.
    C. Shell usually larger (diam. about 4 mm.) and with coarser, more distinct spiral striae; light horn-colored; Virginia to New York...*R. burringtoni*
    CC. Shell usually smaller (diam. 3 mm.) and with finer, less prominent spiral striae; typically darker horn-colored.....*R. cumberlandiana*
    CCC. Shell more depressed than the preceding, height about ⅓ the diameter of 4-5 mm.....*R. virginica*
      D. Shell larger and heavier, dark horn-colored (when fresh); southeastern Tenn. and northern Ala. (highlands)..*R. c. cumberlandiana*
      DD. Shell smaller and much more fragile, light horn-colored; Roan Mt. region.....*R. c. roanensis*
  BB. Shell with more rounded whorls; last whorl more descending so as to produce a higher spire; horn-colored with an olive tinge; lowlands of Alabama *R. circumstriata*
AA. Shell more polished (minor growth-wrinkles relatively weak); sculptural characters approaching *Glyphyalops;* umbilicus more elliptical; *R. wheatleyi* group.

E. Umbilicus about 5 or 6 times in major diameter of adult shell (relatively smaller in immature ones).

F. Whorls higher and more evenly rounded; color honey-yellow (typical) to light chestnut (Roan Mt.); Blue Ridge in Tenn. and N. C..... .....*R. vanattai*

FF. Whorls markedly depressed.

G. Shell smaller, brownish horn (when fresh); near Knoxville, Tenn. (to Mich. and Ark.?).*R. wheatleyi*

GG. Shell larger, yellow to reddish, sometimes tinged with green; animal black; Black Mts., N. C. *R. clingmani*

EE. Umbilicus more than 8 times in major diameter; color greenish horn, tinged with pink above; Mt. Mitchell, N. C. *R. approxima*

"The specific status of the seven species which are included in *Glyphyalus* is very perplexing. Until larger series of fresh shells from a wider range of localities can be obtained, I can only indicate the close relationship between all of these forms and their obviously more distant affinities with the traditionally all-inclusive *R. hammonis auct.* (= *electrina*). Exact demarcation of the actual species must await future investigation." (H. B. Baker.)

Retinella virginica Morrison Fig. 130.

Retinella (*Glyphyalus*) *virginica* Morrison, 1937, Proc. Biol. Soc. Washington, 50: 55, pl. 4, figs. 14-16.

"Shell markedly depressed, somewhat flattened above and below, umbilicate, vitreous, pinkish-horn colored. The radial grooves (major growth wrinkles) are rather closely, but irregularly spaced; minor growth wrinkles less prominent; with minute spiral striae above and below, less distinct than in *R. burringtoni*. The spire is lower than that of any of the related

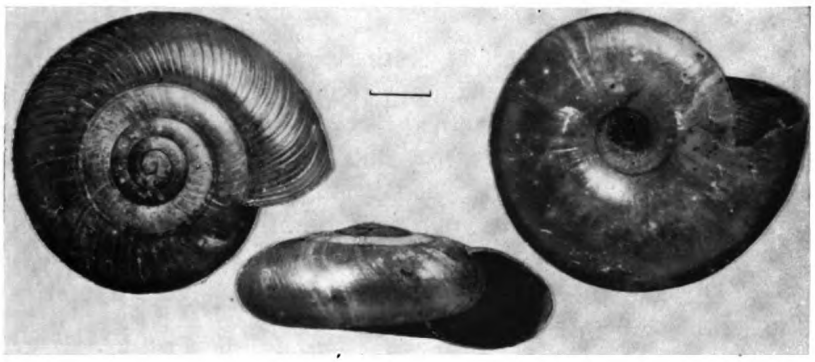

Fig. 130. *Retinella virginica* × about 7 (after Morrison). Scale line = 1 mm.

species, in some examples approaching a plane; whorls 5 to 6 in adult shells. The earlier whorls seen from above slowly increasing and closely wound;

the last whorl not rapidly expanding as in *R. wheatleyi*. Umbilicus funicular, rapidly widening by the slight centrifugal growth of the body whorl, in immature shells contained about 5 times in the major diameter of the shell; in adult shells about 3¾ times in the major diameter of the shell. Aperture transverse, wider than high; upper end of peristome meeting the penultimate whorl horizontally well above its periphery. Height 2.1 mm.; major diameter 5.3 mm.; minor diameter 4.6 mm.; aperture height 1.7 mm.; ap. diam. 2.1 mm.; umb. diam. 1.4 mm.; whorls 5.2" (Morrison).

VIRGINIA: The type (U.S.N.M. 421081) was collected on the west slope of the Blue Ridge, in Clarke Co., some 3 miles west of Trapp, Loudoun Co., by Paul Bartsch and J. P. E. Morrison.

"Four paratypes (U.S.N.M. Cat. No. 421082), from the same lot measure:

Height	Maj. diam.	Min. diam.	Ap. height	Ap. diam.	Umb. diam.	Whorls
1.9 mm.	4.4 mm.	4.0 mm.	1.6 mm.	1.9 mm.	0.9 mm.	5.0
1.8 mm.	4.1 mm.	3.7 mm.	1.5 mm.	1.8 mm.	0.8 mm.	5.0
1.3 mm.	2.7 mm.	2.4 mm.	1.1 mm.	1.2 mm.	0.6 mm.	4.0
1.1 mm.	2.5 mm.	2.3 mm.	1.0 mm.	1.1 mm.	0.5 mm.	3.6

"This newly discovered form may be distinguished by its larger size; by the proportionately wider umbilicus of adults; by the greater number of more slowly increasing whorls, with a lower spire and proportionately smaller aperture.

"Other colonies of this species have been found by the writer on the top of the Blue Ridge, 1 mile south of Snicker's Gap, Clarke County, Virginia; on the north end of Loudoun Heights, Loudoun County, Virginia; and on the west slope of this portion of the Blue Ridge, across the Shenandoah River from Harper's Ferry, in Jefferson County, West Virginia. A single specimen from Lexington, Virginia, is also in the National Museum collections. Some individuals among those collected in a rock-slide on Loudoun Heights, Virginia, have hyaline shells, lacking the pinkish horn-color; in other respects they are typical.

"The radula is typical of the section *Glyphyalus*, s. s.; an immature specimen from the Loudoun County, Virginia, colony having the formula: 17 to 19-3-1-3-17 to 19. The individual teeth are similar to H. B. Baker's figures of the radula of *R. burringtoni* Pilsbry.

"According to the sizes of live and dead shells collected in July, August, and October, this species is probably mature in the spring (with a one-year life history) as has been indicated by H. B. Baker for *R. burringtoni*, *R. cumberlandiana*, *R. roemeri*, and *R. cryptomphala*." (Morrison.)

Retinella burringtoni (Pilsbry) Fig. 128: 6.

Glyphyalinia burringtoni Pilsbry, 1928, Nautilus, 41: 83.—H. B. Baker, 1928, Proc. Acad. Nat. Sci. Phila., 80: 22, pl. 4, figs. 1-3, anatomy of paratypes.

Retinella (*Glyphyalus*) *burringtoni* (Pilsbry) H. B. Baker, 1930, Proc. Acad. Nat. Sci. Phila., 82: 200, pl. 9, fig. 6.

"The shell is depressed, umbilicate, glossy, somewhat translucent, of a warm buff tint. It resembles *G. rhoadsi* but differs by having the retractively radial grooves less widely spaced, minor grooves and wrinkles between them more strongly developed; on the latter part of the last whorl the grooves become closely though somewhat irregularly spaced. Under the compound microscope the surface is seen to be covered with fine, distinct, weakly beaded spiral striae, not seen in *G. rhoadsi*. The umbilicus is contained about 4.4 times in the diameter. The spire is slightly convex; four rapidly widening whorls. The aperture is lunate, shaped much as in *G. rhoadsi*." (Pilsbry.)

Height 1.82 mm., diameters 3.92 and 3.39 mm., umbilicus 4.6 times in diameter; 4¾ whorls (H. B. B., type).

CONNECTICUT: Hartford Co. NEW YORK: Ithaca. NEW JERSEY: Morris, Warren, Cumberland, Burlington, Gloucester and Camden counties. PENNSYLVANIA: Philadelphia, Montgomery, Delaware, Chester, Berks, Bucks, Northampton, Monroe, Susquehanna, Beaver and Allegheny counties. DELAWARE: Kent and New Castle counties. MARYLAND: Washington, Baltimore, Harford, Cecil and Allegany counties. DISTRICT OF COLUMBIA: Washington. VIRGINIA: Natural Bridge, Rockbridge Co., Type 144764 A.N.S.P. Shenandoah Co. WEST VIRGINIA: Greenbrier, Kanawha, Pendleton and Pocahontas counties.

"My anatomical description is based on three individuals from the type lot. The structure is very similar to that of *G. rhoadsi*, and the comparative expressions in the following notes refer to that species.

"Animal: mainly white, but pearly gray above. Foot: as in *G. rhoadsi*. Mantle collar: both neck-lappets heavy, as in *G. indentata*. Ovotestis: consisting of 5 compact groups of alveoli arranged linearly in the liver; duct more swollen (i. e., more actively functioning as a seminal reservoir in my specimens); talon with shorter stalk. Free oviduct (Fig. 131: 1); relatively more elongate; collar of white glandular tissue somewhat narrower. Spermatheca: sac imbedded just above base of albumen gland; duct strongly swollen at base and longitudinally plicate. Vagina: more slender, covered by whitish, glandular cells. Epiphallus (Fig. 131: 2): relatively shorter and more swollen; longitudinal plicae very heavy; similarly attached along side of penis. Penis: relatively more slender but longer; apex recurved (straightened in one specimen); apical half with heavy longitudinal plications and U-shaped thickenings, which break up into knots near middle of penis; lower half with thinner walls and much finer internal folds. Penial retractor: very stout; insertion on loop of penis (i. e. some distance below penial apex); intimate sheath closely investing penis and terminal end of epiphallus.

"Jaw: much thinner and colorless; cutting edge more concave and with much weaker scallops. Radular formula (Fig. 131: 3): 30 to 32-3-1-33 to 35. Transverse rows: 61 counted; distinctly separate from each other in central and lateral fields. Central: about size of first lateral; mesocone long and slender; ectocones small. Laterals: entocone well-developed; third tooth transitional. Marginals: well-formed out to edge of radula.

"In anatomy, this species does not differ greatly from *G. rhoadsi*, although the penial apex, the low attachment of the penial retractor and the heavy base of the spermatheca are peculiar. In radula, on the other hand,

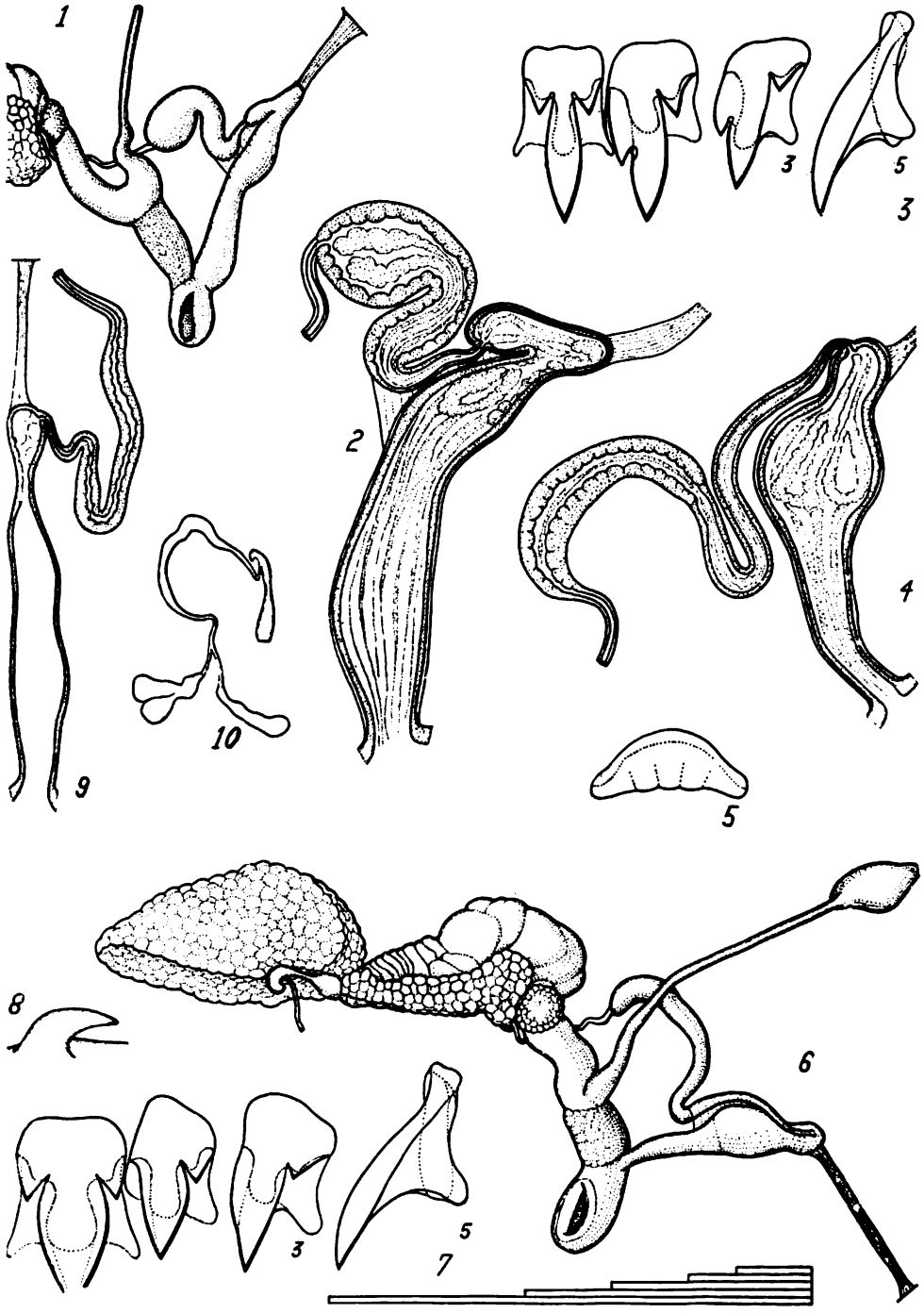

Fig. 131. 1-3, *Retinella burringtoni,* Virginia. 4-7, *R. rhoadsi,* Michigan. 8, left neck lappet of same. 9, 10. *Paravitrea multidentata* form *lamellata,* Virginia, penis and accessories, ovotestis, duct, talon and carrefour (after H. B. Baker).

it seems closer to *Retinella*, or even *Oxychilus*, than to any of the three other species of *Glyphyalinia* examined. This great radular divergence seems to require its subgeneric separation.

" This species has been extensively confused with *R. electrina*, but fresh shells of *R. burringtoni* show, under magnification, distinct spiral striae (stronger than in any North American *Perpolita*) and the widely spaced, radial lines (major series) of *Glyphyalus*. Under lower magnification, the shell of *R. burringtoni* has a dull sheen, produced by the more sharply cut sculpture, while that of *R. electrina* looks like it had been varnished. In addition, *R. burringtoni* has more depressed whorls and usually develops a lower spire. Although the ranges of the two species overlap, few lots contain both of them; *R. electrina*, near the southern edge of its range (*e. g.*, around Philadelphia) seems to be almost as hydrophilous as *Zonitoides nitidus; R. burringtoni* is usually found in the oak-tulip-beech woods of the drier hillsides. Both at its type locality and around Philadelphia, *R. burringtoni* is sexually mature in the early spring.

" The type of *R. burringtoni* is a shell which apparently has not attained its maximum development; specimens with 4½ whorls develop a major diameter of over 4 mm. Despite this, I am a little doubtful in regard to the specific separation of *R. burringtoni* from *R. cumberlandiana*. However, the largest examples of *R. cumberlandiana* (approximating *R. burringtoni* in size) come from southern edge of its range; the northernmost specimens (subspecies *roanensis*) are far smaller, although the most southern point in the known range of *R. burringtoni* (its type locality!) is much farther north and also in the Blue Ridge Mountains.

" Animals from Laurel Springs, Camden Co., New Jersey, have also been examined. These are more darkly pigmented; probably the paratypes were considerably faded. But these northern individuals also show a startling difference in the number of marginals of the radula. Three paratypes possess from 28 to 32; the adult animals from Laurel Springs have only 16 to 18, which agrees closely with the numbers in all of the other species of *Glyphyalus* that I have examined. A larger series of shells from the type locality of *R. burringtoni* might throw light on this radular divergence." (H. B. Baker.)

(Named in honor of Horace Burrington Baker; to his anatomic skill and insight we owe most of our systematic knowledge of the smaller Zonitidae.)

Retinella cumberlandiana (Clapp) Fig. 132.

Polita cumberlandiana Clapp, 1919, Nautilus, 33: 8, text-figs. (Immature.)
Retinella (Glyphyalus) cumberlandiana cumberlandiana (Clapp), H. B. Baker, 1930, Proc. Acad. Nat. Sci. Phila., 82: 202, pl. 9, figs. 10-12.

"Shell widely umbilicated, flattened, very slightly convex above and below, glossy, thin and translucent, light horn color, regularly but lightly sculptured across the whorls by curved, closely set radiating impressed lines parallel with the lines of growth which are very faint; spire flattened;

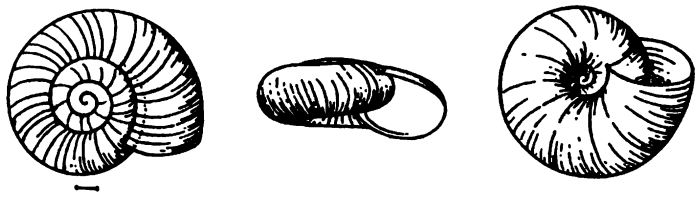

Fig. 132. *Retinella cumberlandiana;* scale line = actual diameter (after Clapp).

stature shallow; whorls about 4, rapidly increasing, the last descending at the aperture which is elongate-oval flattened above, lip very slightly reflected at the columellar insertion; umbilicus wide, displaying all the whorls and contained about 4 times in the diameter of the shell. Greater diameter 3 mm., lesser 2.5 mm., altitude 1.25 mm.

ALABAMA: Cumberland Plateau near Stevenson, Jackson Co. (H. H. Smith). Type 9157 Clapp Coll.; paratypes in A.N.S.P. and Bryant Walker coll. TENNESSEE: near Anderson and near Sherwood, Franklin Co., near Cove and Prior Cove, Marion Co., Skillen Cove, Bledsoe Co., Tellico Gorge, Marion Co.

"At first glance this species may be taken for immature *V. radiatula* [*electrina*] as the general shape and the sculpture of impressed radiating lines are the same, but it is uniformly small with the same number of whorls, the sculpture is weaker and the shell more flattened. Under high magnification there is merely the faintest trace of impressed spiral sculpture. It is much smaller than *Polita rhoadsi.*" (Clapp.)

"In the southern Appalachians, some species appear to have a seasonal as well as an ecologic range. Thus, during the summer of 1928, I only obtained dead shells of *R. cumberlandiana,* but found living, sexually mature animals fairly frequent in the early spring (1929). The apparent rarity of *Retinella* in southern United States may be partially due to summer collecting.

"In the Cumberland Plateau, *R. cumberlandiana* seems to be rather definitely restricted to the noncalcareous caps of the flat-topped hills, although I found one specimen near the upper limit of the limestone at Dove and a good series near the head of Prior Cove. Around Tellico Plains, Monroe Co., Tenn., dead shells were obtained over the slates and older rocks of the southern Blue Ridge. It prefers damp places and usually inhabits the deeper layers of humus.

"I have animals of this species from the summit of the Cumberland Plateau north of Dove and from the head of Prior Cove; the following notes, based on the latter series, include only salient divergences from the anatomy of *R. burringtoni:*

"Animal more lightly pigmented (than Laurel Springs material), but dorsum of head and edge of mantle bluish. Free oviduct (Fig. 128: 12): more elongate (when extended), with longitudinal folds internally. Epiphallus: less attenuate towards penial end. Penis (Fig. 128: 10): apical $\frac{2}{5}$ with two, thick-walled, fusiform enlargements, internal surface of upper one with large, quite widely spaced, elliptic bosses, that of second with closely packed, higher and more conical projections; lower $\frac{3}{5}$ relatively thin-walled with few, very weak longitudinal folds. Penial retractor: insertion near end of penis (much nearer than in *burringtoni*). Radular formula (Fig. 128: 11) 18-3-1-3-17; 38 rows counted. Form of teeth: similar to *burringtoni*, but centrals and laterals much less elongate." (H. B. Baker.)

Retinella cumberlandiana roanensis H. B. Baker Fig. 128: 7-9.

Retinella (Glyphyalus) cumberlandiana roanensis H. B. Baker, 1930, Proc. Acad. Nat. Sci. Phila., 82: 203, pl. 9, figs. 7-9.

"Shell much smaller than typical *cumberlandiana*, lighter horn-colored; exceedingly thin and fragile; spiral striae quite distinct (as in fresh shells of typical form); adults with $4\frac{1}{4}$ whorls."

Height 1.31 mm., diameters 2.74 and 2.32 mm., aperture 0.93 × 1.13 mm., umbilicus in diam. 4.7 times.

North Carolina: (E. 81° 58′. N. 36° 08′) flats of Cranberry Creek, about one mile south of Cranberry, Avery Co. alt. 3300 ft.. Type A.N.S.P. 150610, near Asheville, Buncombe Co. Range: Roan Mt. region, altitudes 2300-3500 ft. Tennessee: Carter and Unicoi counties (H. B. Baker).

"Although evidently similar, the several lots from the Roan Mt. region do not intergrade with typical *cumberlandiana*, although the latter occurs on the same mountain front in southern Tennessee. My only animals come from near Marbleton, Unicoi Co., and were collected in the first week of April, 1929; it lives in the deeper humus of oak and chestnut woods and is quite rare." (H. B. Baker.)

Retinella circumstriata (Taylor) Fig. 133.

Vitrea radiatula electrina race *circumstriata* Taylor, 1908, Land and F. W. Moll. Brit. Is., Zonitidae, p. 98, figs. 140, 141 (Wetumpka, Ala.).

Vitrea radiatula circumstriata Taylor, Walker, 1928, Terr. Moll. Ala., p. 78. fig. 108.

Retinella (Glyphyalus ?) circumstriata ("Taylor" Walker), H. B. Baker, 1930, Proc. Acad. Nat. Sci. Phila., 82: 203.

Fig. 133. *Retinella circumstriata*. After Taylor, drawn by G. H. Clapp.

The shell is rather strongly depressed, narrowly umbilicate, umbilicus contained 6 times in diameter, pale yellow, subtranslucent. Sculpture of many unequally spaced radial grooves which are much weaker on the base.

and a very close distinct microscopic spiral striation. The whorls increase regularly to the last which is about twice as wide as the preceding. The aperture is wide, lunate. Height 2.25 mm., diameter 4.6 mm.; 4¼ whorls.

ALABAMA: Wetumpka, Topotypes from original lot, 86340 A.N.S.P. Also in Clarke, Elmore, Jackson, Madison, Marion, Mobile and Randolph counties.

Formerly considered a form of "*hammonis*" or "*radiatula*" (*electrina*), but quite distinct from typical *electrina* by the minute spiral striation and the more depressed last whorl. The micro-sculpture is much as in *R. wheatleyi*, a shell with wider umbilicus.

Because a quadrinomial name has no status in nomenclature, Dr. Baker considers that *R. circumstriata* should date from Dr. Walker's paper, which seems to be the first use of a trinomial that is accompanied by a description, which Walker quoted from Taylor. It was first recognized as distinct from *electrina* by E. G. Vanatta and George H. Clapp, whose findings were communicated to others verbally and by letter. The anatomy of *R. circumstriata* is unknown.

Retinella wheatleyi (Bland) Figs. 134; 141: 1-3.

Zonites wheatleyi Bland, 1883, Ann. N. Y. Acad. Sci., 2: 368, fig. 1 (very poor).—W. G. Binney, 1885, Man. Amer. Land Sh., p. 222, fig. 237.

Vitrea wheatleyi Bland, Walker, 1899, Ill. Cat. Moll. Michigan, p. 478.

Retinella (*Glyphyalus*) *wheatleyi* (Bland), H. B. Baker, 1930, Proc. Acad. Nat. Sci. Phila., 82: 204, pl. 10, figs. 1-8.

"Shell umbilicated, depressed, thin, shining, pellucid, brownish, horn-colored, finely striated. Spire subplanulate, suture slightly impressed. Whorls little convex, the last more convex at the base, rapidly increasing at the aperture, scarcely descending. Umbilicus pervious. Aperture obliquely lunate; peristome simple, acute, the margins approximating, joined by a thin callus. Alt. 2, diam. major 5, minor 3½ mm." (Bland.)

Height 1.9, diam. 5.5 mm.; width of umbilicus 1 mm.; 5 whorls.

Fig. 134. *Retinella wheatleyi*, Tennessee specimen from Bland. Scale line = 1 mm.

"Height 2.25 mm., diameters 5.05 and 4.3 mm.; 5¼ whorls; umbilicus 5 times in diameter." (H. B. B.)

TENNESSEE: Knoxville (Mrs. Andrews) and near Fountain City, Knox Co., Blount Co. NORTH CAROLINA: Mitchell Co. PENNSYLVANIA: Allegheny Co. OHIO: Adams, Belmont, Clark, Hocking, Licking, Miami and Ross counties. MICHIGAN: Tuscola, Kalamazoo, Kent, Benzie and Grand Traverse counties. INDIANA: Reported from Posey, Franklin, Marion and Dubois counties. MISSOURI: Barry and Christian counties. ARKANSAS: Ashley, Benton, Jefferson, Logan and Washington counties. Has been reported also from Tiverton, R. I., Buffalo, New York, Indiana and northern Alabama.

This species is not found over much of the territory within the peripheral records noted above. It appears to be rare and local. The sculpture consists of unevenly spaced shallow radial grooves, which are closer near the aperture; no spiral striation, or the merest traces. Width of umbilicus contained between 5 and 6 times in the diameter of shell.

"The single shell from Michigan seems close to this species. Those from the Ozarks are more hyaline (possibly somewhat faded) and attain a larger size; probably they represent a distinct subspecies or species but its accurate description would require a large series of fresh specimens. The shell from Bland, for which dimensions are given, is badly faded. I did not find this species at Cherokee Cliffs either during the summer of 1928 or the spring of 1929. But, at Black Oak Ridge, one mile north of Fountain City, Knox Co., I secured one dead shell in July and next spring (April 5,1929) collected over one hundred living and fresh specimens in one day. Even in the spring, it was rare except in a shallow valley on the west-facing (more humid) slope of the ridge, where one or two individuals per square meter were obtained under the decaying leaves in the oak-chestnut woods. Fresh shells are bright, coppery horn-colored and develop distinct spiral striae; mine are slightly smaller than the largest one from Bland.

"The anatomy of this species is also similar to that of *R. burringtoni* and the following notes mainly detail the more important differences:

"Animal more darkly pigmented, foot almost black. Mantle edge (Fig. 141: 8) right lappet large; left one thin but extensive; left accessory lappet very small, tongue-shaped. Lung about twice as long as its base or length of kidney. Kidney slightly longer than broad and about 1½ times length of pericardium. Talon relatively small, ellipsoid, almost completely buried in large albumen gland. Free oviduct (Fig. 141: 7) similar in length but more swollen (in my material, usually containing an egg). Spermatheca stalk arising near middle of sac. Epiphallus sausage-shaped. Penis (Fig. 141: 6) internal surface of upper ⅜ with few, heavy pilasters, that of next ⅜ with progressively smaller, circular bosses; lower ¼ relatively thin-walled and simple. Penial retractor insertion on side of penis (but not as low as in *burringtoni*). Jaw (Fig. 141: 4) thin and transparent. Radular formula (Fig. 141: 5) 18-3-1-3-17; 46 rows counted. Teeth similar to those in *burringtoni* but central and laterals with deeper backs and shorter mesocones." (H. B. Baker.)

Retinella vanattai (Pilsbry & Walker) Fig. 135.

Vitrea vanattai Pilsbry & Walker, 1902, Proc. Acad. Nat. Sci. Phila., p. 432, pl. 23, figs. 4-6.

Retinella (*Glyphyalus*) *vanattai* (P. & W.). H. B. Baker, 1930, Proc. Acad. Nat. Sci. Phila., 82: 205, pl. 10, figs. 9, 10.

"Shell rather narrowly umbilicate (the umbilicus about one-sixth the diameter of the shell), depressed, thin, honey-yellow and translucent. Sculpture of many deeply impressed, irregularly spaced radial grooves, much less conspicuous beneath, and very fine, rather faint, close spiral lines. Whorls

5, slowly increasing, the last much wider. Aperture oblique, broadly lunate, the peristome simple and thin as usual. Alt. hardly 2, diam. 4.5 mm." (P. & W.).

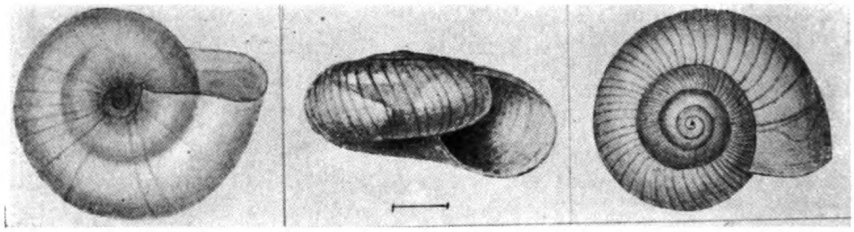

Fig. 135. *Retinella vanattai,* type. Mt. Mitchell, N. C. Scale line = 1 mm.

NORTH CAROLINA: Mt. Mitchell, Yancey Co., Type 83261 A.N.S.P. Cranberry, Avery Co. Black Mountains. Magnetic City, Mitchell Co. TENNESSEE: Valley Forge and northern outliers of Roan Mt., Carter Co. Limestone Cove, Unicoi Co.

This species belongs to the same group as *R. approxima* and *R. clingmani* of the same region. From the first it differs in color, the more depressed body-whorl, less crowded and deeper radial grooves, which are more distinct beneath, in having a half-whorl more and a wider umbilicus. In *R. electrina* the sculpture is much closer, the grooves of *R. vanattai* resembling those of shells of the section *Glyphyalinia*. It resembles *R. clingmani*, but with the same number of whorls the shell is much smaller, and the shape of the aperture differs.

"The Roan Mountain examples of this species approach *R. wheatleyi* in coloration and size. During the last two weeks in August, 1928, I mainly found dead shells but also obtained four quite mature animals. It is more frequent and widely distributed than *R. cumberlandiana roanensis*. Its anatomy is compared to that of *R. wheatleyi:*

"Animal more lightly pigmented, but foot grayish and dorsum of head and mantle edge still darker. Talon subovoid, weakly curved. Free oviduct similar in proportions but narrow apical neck (with glandular collar) more sharply demarcated from swollen body (internally with longitudinal folds). Penis (Fig. 141: 9) internal surface of apical ¼ with elliptic bosses, which become confluent in next ¼, until, just above middle, simple and progressively weaker, longitudinal folds are developed; basal ⅔ relatively thin-walled and simple. Penial retractor insertion on apex of penis. Radular formula (Fig. 141: 10) 22-3-1-3-22; 52 rows counted. Central teeth even more elongate than in *burringtoni;* laterals equally so." (H. B. Baker.)

(It is named for Mr. Edward G. Vanatta, in recognition of his long and careful work upon the Zonitidae and other small land shells of the Academy's collection.)

Retinella clingmani (Dall) Figs. 136, 136 a.

Zonites wheatleyi W. G. Binney, 1885, specimens from Clingman's Peak, Man. Amer. Land Sh., p. 223.

V[*itrea*] *clingmani* Dall, 1890, Nautilus, 11: 101. Nude name.

Vitrea clingmani Dall, 1900, Proc. Acad. Nat. Sci. Phila., p. 150, fig. 2.—Walker & Pilsbry, 1902, Proc. Acad. Nat. Sci. Phila., p. 431, pl. 23, figs. 1-3.

Fig. 136
(after Dall)

"Shell extremely thin and fragile, of a translucent greenish color, polished, with five rather inflated whorls; suture well marked, the enveloping whorl rising slightly above it and not suturally appressed; sculpture in harmony with the incremental lines, consisting of at first rather close-set regular wrinkles which are obsolete on the base and more distant in the adult near the last part of the last whorl; spire and base somewhat flattened, periphery rounded, peristome acute, the upper lip but little produced beyond the basal part; umbilicus narrow, deep; nucleus very small, smooth; major diam. 6.5, minor diam. 5, alt. 2.5 mm." (Dall.)

Height 2.9 mm., diameters 6.5 and 5.6 mm.; 5½ whorls. Umbilicus in diameter 6.2 times.

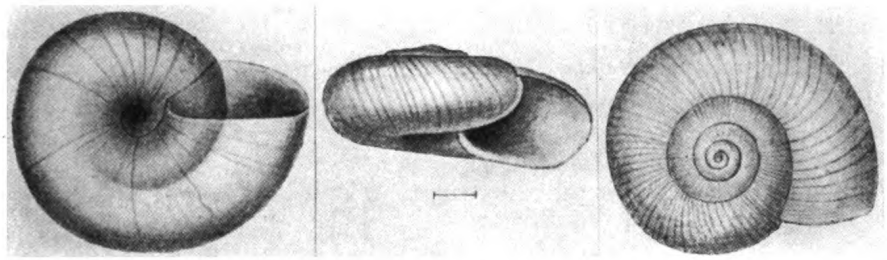

Fig. 136a. *Retinella clingmani,* Potato Top, N. C. Scale line = 1 mm.

North Carolina: "Black Mountains near Clingman's Peak" (Hemphill). Type 38910 U.S.N.M. Mt. Clingman, north of the summit; Mt. Mitchell, a short distance below the summit on the northeast side. Wilson's Cove and Cat-tail (Walker & Ferriss); Potato Top (Ferriss).

"As stated in Dall's description cited above, the type [Fig. 136, original figure] of this rare species was taken by Hemphill at or near Clingman's Peak, or Mt. Gibbs according to the map of the Topographical Survey. The first specimens in 1901 were found on Mt. Clingman, beside the trail just north of the summit. Four specimens were found under one log a short distance below the summit of Mt. Mitchell on the northeast side. It is evidently rare on Mitchell, as most careful search failed to bring any more to light. A single specimen was taken in Wilson's Cove and another on Cat-tail. Ferriss found it in some greater quantity on Potato Top, but it appears to be rare even there.

"*V. clingmani* is peculiar to Black Mountain range. It is one of the largest of the Vitreas and, once seen, is easily recognized. The animal is dark bluish-black, and when alive the whole shell appears black; in this respect it reminds one of *Zonitoides nitidus* Müll. When cleaned, the shell varies from a yellow to reddish horn-color, but occasional specimens are tinged with green as stated in Dr. Dall's description." (Walker.)

"Black Mountain Station is on the railroad east or northeast of Asheville. From this station I walked into the mountains (north) about ten or twelve miles and stopped at a house near the foot of Mt. Mitchell, and also near the Pinnacle of the Blue Ridge. In company with two other persons, I went to the summit of Mt. Mitchell and 'Clingman's Peak,' as they called it, and remained all night. We carried our provisions and blankets. It took nearly all day to get to the summit, and I had but a few hours for collecting the next morning. If my memory serves me faithfully, I got but little material on that trip, but judging by the name, I suppose the shell called *Z. clingmani* was collected at that place and time." (H. Hemphill, in letter.)

The specific name is to honor Thomas L. Clingman, who made valuable observations on the geology and topography of North Carolina, and served that State with distinction in the U. S. Senate, before the civil war. The anatomy of this species is unknown.

Retinella approxima (Walker & Pilsbry) Fig. 137.

Vitrea approxima Walker & Pilsbry, 1902, Proc. Acad. Nat. Sci. Phila., p. 431, pl. 23, figs. 7-9.

"Shell about the size and shape of *V. hammonis;* glossy, smoky greenish horn-color, tinged with pink above; umbilicus round and deep; slightly convex above, whorls 4½, regularly increasing, surface sculptured above with irregularly spaced radial grooves similar to those of *V. hammonis*, but less crowded and with microscopic revolving impressed lines; aperture transversely rounded-lunate. Alt. 2, greater diam. 4½ mm." (W. & P.)

Fig. 137. *Retinella approxima,* type, Mt. Mitchell, N. C. Scale line = 1 mm.

North Carolina: Mt. Mitchell, Yancey Co. (Walker), Type 82360 A.N.S.P.

"Two specimens only of this species, which cannot be satisfactorily assimilated with any of the described species, were taken in Wilson's Cove,

Mt. Mitchell. It is closely related to *V. hammonis* in shape, and in the regularly increasing whorls, but differs in color, in the less crowded sculpture of radial grooves, the presence of microscopic revolving sculpture, which is absent in *hammonis*, and in having nearly a whorl additional. In the examination of these forms for the revolving sculpture a compound lens of at least 100 diameters is necessary for satisfactory results. *V. wheatleyi* and *V. pentadelphia*, which have similar sculpture, differ in having a more open umbilicus and in the rapid enlargement of the last whorl. It differs from *V. rhoadsi* by the smooth base (*V. rhoadsi* being radially grooved beneath), the closer radial grooves, wider umbilicus, and in color." (W. & P.) Umbilicus 8.3 times in diameter.

RETINELLA ROEMERI GROUP (Section *Glyphyaloides* H. B. Baker).

The following key to the species of this section, by Dr. H. B. Baker, may assist in their identification; it does not include *R. floridana*.

A. Shell with umbilicus about 4 times in major diameter and with steeply rounded walls.
  B. Shell larger and higher, with more prominent spiral striae; penis with epiphallar opening near middle of its length; central Texas.....*R. roemeri*
  BB. Shell smaller and more depressed, with spiral striae very weak; penis with epiphallar opening much above middle of its length; Wetumpka, Ala., to Knoxville, Tenn.....*R. lewisiana*
AA. Shell with umbilicus about 3 times in major diameter and with obliquely flattened walls; only known as subfossil; Cumberland, Maryland.....*R. raderi*

Retinella roemeri (Pilsbry & Ferriss) Fig. 138.

Vitrea dalliana roemeri Pilsbry & Ferriss, 1906, Proc. Acad. Nat. Sci. Phila., p. 151, fig. 8.

Retinella (*Glyphyaloides*) *roemeri* (Pilsbry & Ferriss) H. B. Baker, 1930, Proc. Acad. Nat. Sci. Phila., 82: 205, pl. 11, figs. 1-3.

"Shell openly umbilicate, the width of umbilicus contained about 4¾ times in the diameter of the shell, pale whitish-corneous, in general shape resembling *V. dalliana, V. wheatleyi* and *V. petrophila*. Sculpture of *very close and regular radial grooves*, on the last whorl of large specimens be-

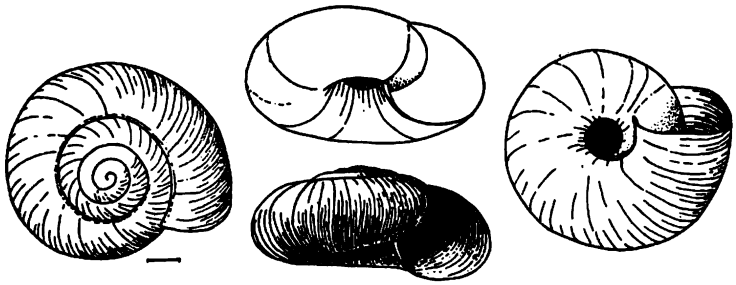

Fig. 138. *Retinella roemeri*, type. Scale line = actual diameter.

coming crowded and less regular, giving a striate appearance. The flat intervals between the grooves show no spiral striae. The base is nearly smooth. Whorls 4½, but slightly convex, slowly widening, the last about double the width of the preceding. Suture scarcely impressed, translucent-margined below. Base convex. Aperture lunate, slightly oblique; the insertions of the peristome are distant. Alt. 2, diam. 4 mm.; umbilicus .85 mm.; aperture 1.7 × 1.65 mm." (P. & F.)

TEXAS: Sinking Spring Creek, near San Marcos, Hays county, Pilsbry and Ferriss. Types 91318, A.N.S.P. Also taken in several places around New Braunfels, Comal County; in the drift debris of the Hondo river, two miles north of Hondo, Medina County; in drift of the Rio San Filipe near Del Rio, and of the Devil's River, Val Verde County. It has about the distribution of *Holospira goldfussi* and *Helicodiscus eigenmanni*.

This very pretty little species has a slightly more ample umbilicus than *R. wheatleyi* or *petrophila*, and the sculpture is closer and more regular than in either. The last whorl, in dorsal view, is wider than in *R. wheatleyi*. It is much smaller than *R. circumstriata*.

R. roemeri attains a larger size than the Floridan *R. dalliana* and the shells have somewhat more regular and crowded grooves on the last whorl; it is less depressed, and the aperture is perceptibly less broad, more roundly lunate.

"A week's collecting at New Braunfels netted a small series of fresh shells and a few animals (mainly immature) of this species, which was previously known only from drift material. The preponderance of freshly dead shells makes me suspect that by June it had considerably passed the climax of its adult abundance. It lives in the deeper layers of the debris and dirt near the chalk ledges, which outcrop from the wooded hillside above the large springs that form most of Comal Creek. Its shell, when fresh, is hyaline (whitish with brown-stained suture), has almost the gloss of a *Paravitrea* and shows, on its umbilical side, fairly distinct and continuous spiral striae, although these are obscured and broken, on the apical surface, by the more prominent radiating lines.

"The following description is based on preserved material: Animal white, but ommatophores sparsely pigmented and eyes black. Foot elongate; sides with prominent, coarse tessellation; pedal grooves deep; peripodial angle forming a short conical projection over pedal orifice; sole apparently undivided, pointed posteriad. Mantle collar lappets similar to those of *R. wheatleyi*. Lung more elongate, 3 times as long as its base or 2½ times length of kidney. Kidney 1½ times as long as its width or length of pericardium. Ovotestis consisting of two large groups of ovoid alveoli, imbedded near base of apical mass of liver; duct swollen and convoluted in third quarter of its length; talon recurved; carrefour elongate. Uterus (Fig. 139: 1) much as in *Glyphyalus*. Free oviduct: slender and of medium length. Spermatheca stalk of long type, basal ⅓ heavy and with longitudinal folds internally. Vagina with glandular collar. Prostate, long type.

Vas deferens short (as in genus). Epiphallus well developed, more slender towards base; opening at apex of basal half of penis. Penis (Fig. 139: 2) apical half a slender diverticulum with internal surface weakly plicate longitudinally; basal half sharply swollen, internal surface with heavy oblique folds which die out near middle of its length. Penial retractor insertion on apex of penis. Cloaca as in *Glyphyalus*. Columellar muscle similar to that of *R. electrina*, but giving off right and left free retractors near its origin. Salivary glands lanceolate, about as long as buccal mass; ducts $\frac{2}{3}$ as long. Radular formula (Fig. 139: 3) 15-3-1-3-15; 59 rows counted. Teeth similar to those in *burringtoni*, but laterals more asymmetric and with broader bases; marginals more widely spaced.

" In my scanty series of *R. roemeri* (and the single animal of *R. lewisiana*), the sole of the foot appears to be undivided, but I have observed, in other species, that the tripartite condition in the living animal may become invisible in dead specimens, especially if the foot swells during asphyxiation. Until living animals can be studied, I am retaining *Glyphyaloides* in the genus *Retinella*." (H. B. Baker.)

Retinella lewisiana (Clapp) Fig. 140.

Vitrea lewisiana Clapp, 1908, Nautilus, 21: 129, upper text-figs.—Walker, 1928, Terr. Moll. Alabama, p. 75, fig. 104.

Retinella (*Glyphyaloides*) *lewisiana* (Clapp), H. B. Baker, 1930, Proc. Acad. Nat Sci. Phila., 82: 207, pl. 11, figs. 4, 5. Anatomy.

" Shell small, depressed widely, perspectively umbilicate, all whorls showing to the apex, umbilicus contained about five times in the diameter of the shell; yellowish-white, translucent, the inner whorls showing through

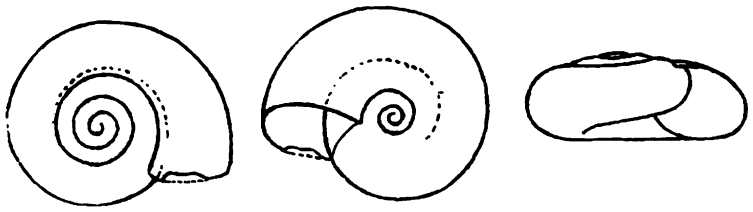

Fig. 140. *Retinella lewisiana* Type × 8 (after Clapp).

the body of the shell, highly polished; the delicate growth lines are very regularly spaced and close together, smooth below. Spire much flattened; sutures well impressed, margined; whorls $3\frac{1}{2}$, slightly convex, the last wide. Aperture oblong-lunate, depressed above, lower margin parallel with the base, lip simple.

" Gr. diam. $3\frac{1}{2}$ mm., lesser 2.8 mm., alt. $1\frac{1}{2}$ mm." (Clapp.)

ALABAMA: Type from Monte Sano, near Huntsville, Madison Co. Type in Clapp Coll., Carnegie Mus. Also found at Wetumpka and Gurley. Reported by Walker from Blount, Elmore, Conecuh, Lauderdale, Madison, Mobile, Randolph and Chambers counties (H. H. Smith). TENNESSEE: near Fountain City, Knox Co. (H. B. Baker.)

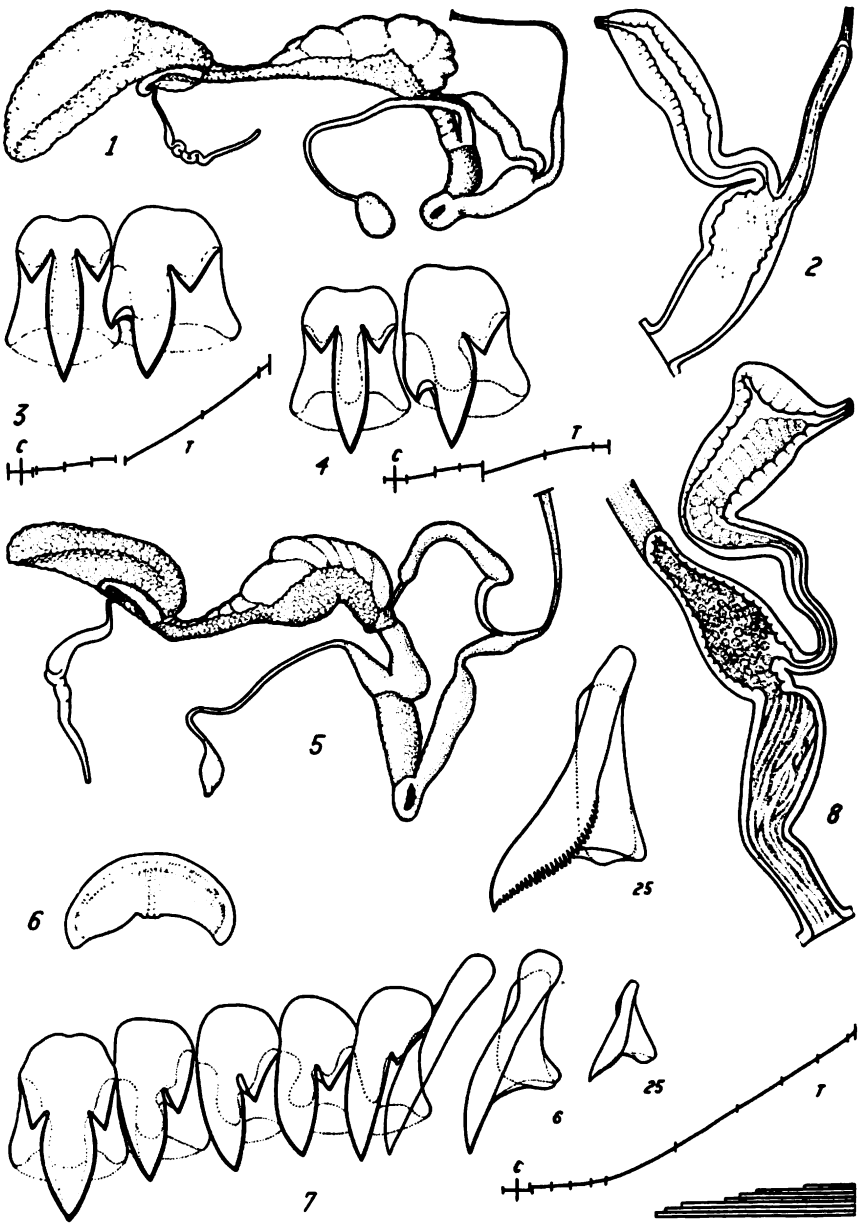

Fig. 139. 1, *Retinella roemeri,* Comal Co., Tex., dissected genitalia (ovotestis omitted); 2, penis and accessories; 3, radula: central and first lateral. 4, *R. lewisiana,* Madison Co., Ala., radula of paratype; 5. dissected genitalia (ovotestis omitted), Knox Co., Tenn. 6, *R. indentata paucilirata,* Madison Co., Ala., jaw; 7, Radula: central, all four laterals and blade of first marginal, also second marginal (6th tooth) and 21st marginal (25th tooth); upper fig. of 25th tooth is more highly magnified than others; diagram of transverse row is also shown; 8, penis and accessories. (After H. B. Baker.)

"The color, and particularly the *very regular, close* lines of growth at once distinguish this shell from all other species. It is perhaps nearest to *V. dalliana,* but differs in color, shape and sculpture. In *dalliana* there is a very minute spiral sculpture, not mentioned in the original description, and only visible under a magnification of about 60 diameters." (Clapp.)

"One adult and one immature animal of this species were collected April 5, 1929, on Black Oak Ridge, about 1 mile north of Fountain City, Knox Co., Tenn. I have also been able to examine the radula of a paratype in the Academy of Natural Sciences of Philadelphia. As the anatomy is similar to that of *R. roemeri,* only salient differences will be noted:

"Free oviduct (Fig. 139: 5) more swollen basally. Spermatheca sac smaller; stalk longer, with a very heavy, pear-shaped base. Penis more elongate; apical half fusiform, with epiphallar opening a little above its middle, internal surface with weak, longitudinal folds; basal half less abruptly swollen, internal surface with a subapical ring of circular bosses and vague longitudinal plicae, which die out before reaching base. Penial retractor insertion apical. Radular formula of paratype (Fig. 139: 4) 16-3-1-3-16 with 53 rows; of Knox Co. animal 15-3-1-3-15 with 55 rows. Teeth as in *roemeri,* but marginals relatively smaller." (H. B. Baker.)

Regarding *R. lewisiana,* H. H. Smith wrote: "With one or two exceptions our specimens were found on the lower sides of sandstone slabs or stones generally beneath other stones in damp forests near the top of Monte Sano. One or two were found among leaves at the base of cliffs near the same locality. Evidently this species, in the Huntsville district, is a rock shell, and it is almost the only rare one which we have obtained by 'quarrying!' The shell, when found, is conspicuous owing to its pale color and shining surface. The animal is pale."

(Named in memory of Dr. James Lewis, eminent New York conchologist, b. Schuyler's Lake, N. Y., July 1822, d. Mohawk, February 23, 1881.)

Retinella raderi (Dall) Fig. 142.

Vitrea raderi Dall, 1898, Nautilus, 11: 100; 1902, Proc. U. S. Nat. Mus., 24: 500, pl. 27, figs. 4-6.

"Shell depressed, four-whorled, smooth except for faint rather regularly spaced incremental lines above, of a pale waxen whitish color; spire hardly raised above the last whorl, which is much the largest; periphery evenly rounded, suture appressed, base moderately rounded, the umbilical slope of the last whorl somewhat flattish; umbilicus very wide, exhibiting all the volutions; aperture wider than high, the upper margin slightly in advance of the lower lip, the two connected by a thin wash of callus over the body. Alt. 1.5, max. diam. 4.0, min. diam. 3.0 mm." (Dall.)

Height 1.74 mm., diameters 3.98 and 3.54 mm., umbilicus 3.3 times in diameter; 4½ whorls. (Topotype, H. B. B.).

MARYLAND: Cumberland (Howard Shriver), Type 107758 U.S.N.M.

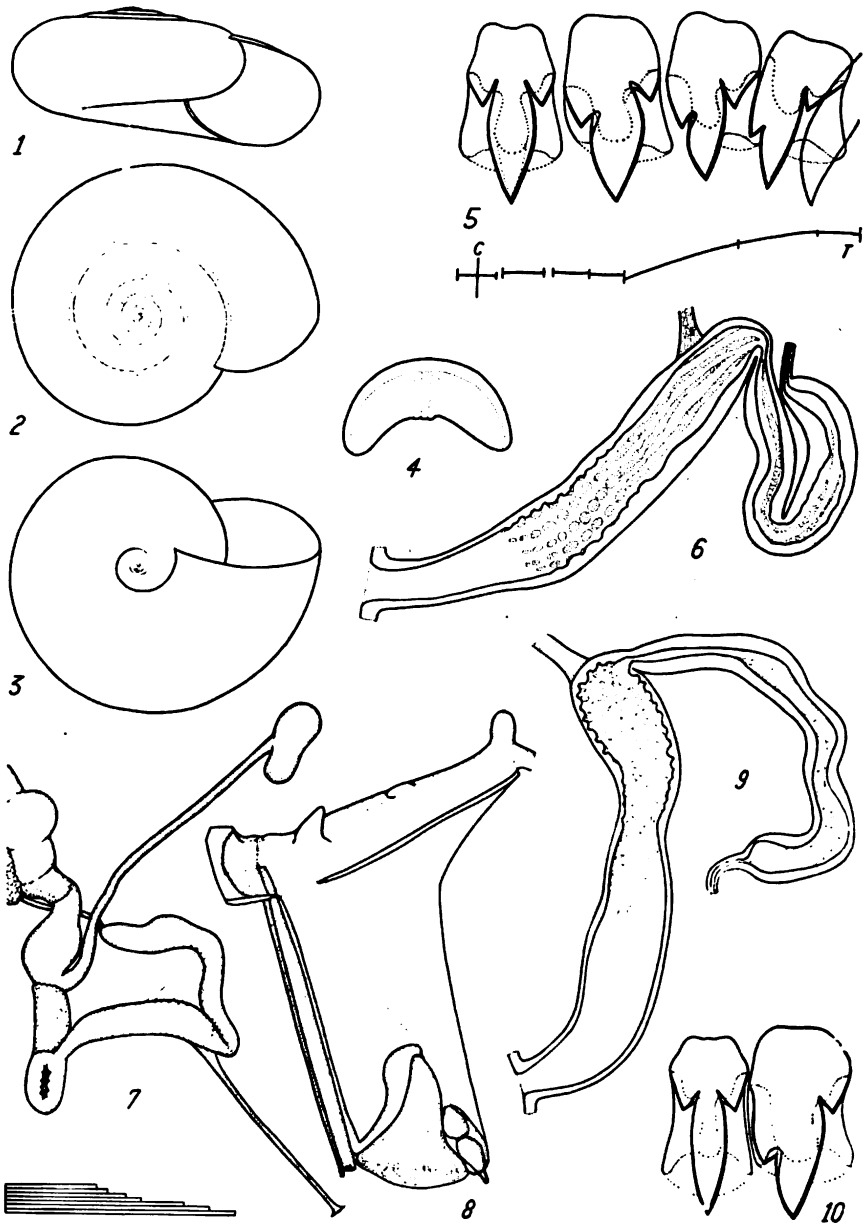

Fig. 141. 1-3. *Retinella wheatleyi,* Tennessee, outlines of shell from Thomas Bland: 4, Knox Co., Tenn., jaw; 5, radula: central, all three laterals and tip of first marginal, with diagram of transverse row; 6, penis and accessories; 7, terminations of dissected genitalia; 8, internal view of pallial complex (left edge of lung considerably stretched). 9, *R. vanattai,* Carter Co., Tenn., penis and accessories; 10, radula: central and first lateral. (After H. B. Baker.)

Fig. 142. *Retinella raderi,* type × 6 (after Dall).

This species is more widely umbilicate than any other *Retinella* of the region. Only "subfossil" specimens have been found. "The type (U.S.N.M.) and five topotypes (A.N.S.P. 73888) have been examined; although chalky, they still retain the characteristic sculpture of *Glyphyaloides.*" (H. B. Baker.)

(Named for a Mr. Rader about whom we know only that in 1897 he was interested in the mollusks of Cumberland.)

Retinella floridana (Morrison) Fig. 143.

Retinella (*Glyphyaloides ?*) *floridana* Morrison, 1937, Proc. Biol. Soc. Wash., 50: 56, pl. 4, figs. 11-13.

"Shell of five whorls, possessing the characteristic sculpture of the subgenus, with regularly and closely spaced major growth wrinkles, of about the size of *R. roemeri,* but with the base of the body whorl more deeply rounded near the umbilicus, which has consequently steeper walls. The spire is regularly depressed-conic, but constantly higher, as is the body whorl, than in the specimens of *roemeri* seen. The aperture is roundly lunate, widest below the middle; peristome more sharply rounded at the periphery and in the columellar region. Umbilicus deep, steep-walled; contained about four times in the major diameter of the shell. Height 2.6 mm.; major diameter 4.5 mm.; minor diameter 4.0 mm.; aperture height 1.7 mm.; ap. diameter 1.8 mm.; umb. diameter 1.1 mm.; whorls 5.2." (Morrison.)

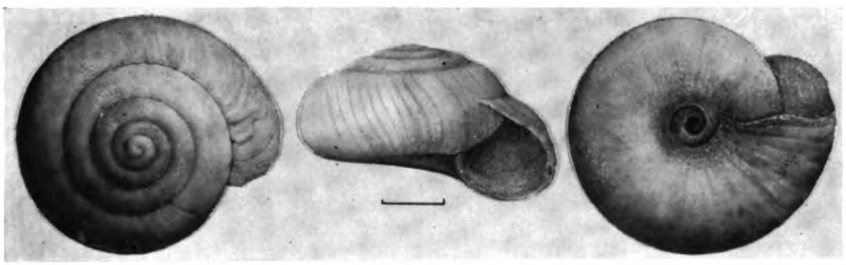

Fig. 143. *Retinella floridana* (after Morrison). Scale line = 1 mm.

FLORIDA: The type, U.S.N.M. 421084, was collected by E. H. Sellards near Ocala, Marion County, "from crevices and caverns in limestone. Pleistocene?"

Nine paratypes (U.S.N.M. 421085) were measured. Average of the ten measured types: height 2.37 mm., maj. diam. 4.11 mm., min. diam. 3.69 mm., height apert. 1.6 mm., diam. apert. 1.66 mm., umbilicus 1.01 mm.; whorls 5.02.

"The many specimens in the original lot (U.S.N.M. 219003) are all dead shells, weathered to a chalky appearance. It appears unlikely that this species is Pleistocene as doubtfully noted by the collector. It may, however, be extinct at the present time. It should be found in the Ocala (Eocene) Limestone area, wherever surface soil conditions are (or were) favorable." (Morrison.)

Subgenus GLYPHYALOPS H. B. Baker

H. B. Baker has given the following:

Key to Species of Subgenus Glyphyalops

A. Penis much more slender, with shortly bifid apex; central and laterals of radula more elongate, with reduced ectocones; shell more corneous, with less prominent major growth-striae (approaching *Glyphyalus*); umbilicus over ¼ major diameter; southern end of Appalachians proper.....*R. pentadelphia*

AA. Penis swollen apically, not bifid; central and laterals of radula broader, with more prominent ectocones; shell more hyaline with relatively distinct major striae; umbilicus not ¼ major diameter.....*R. rhoadsi*

B. Shell with higher spire, relatively larger umbilicus and stronger growth-striae; Maine to Michigan and south to West Virginia.....*R. rhoadsi rhoadsi*

BB. Shell with more depressed spire, relatively smaller umbilicus and weaker growth-striae; Virginia, eastern Tennessee and western North Carolina *R. rhoadsi austrina*

Retinella pentadelphia (Pilsbry) Fig. 144.

Vitrea petrophila pentadelphia Pilsbry, 1900, Proc. Acad. Nat. Sci. Phila., p. 138.

Retinella (Glyphyalops) pentadelphia Pils., H. B. Baker, 1931, Proc. Acad. Nat. Sci. Phila., 83: 113, pl. 19, figs. 14-16; pl. 20, fig. 6.

"Shell about the size of *V. indentata;* glossy, pink-brown, openly umbilicated, convex above, composed of 4½ whorls, those of the spire slowly widening, the last much wider; surfaces sculptured with many unevenly spaced radiating grooves similar in character to those of *V. indentata,* but more numerous; and there are some striæ intermingled, the spire being more closely striate. No mentionable spiral striæ seen with an enlargement of fifty diameters. The grooves continue upon the base, but are weaker there. Aperture broadly lunate. Alt. 2½, greatest diam. 5 mm." (Pilsbry.)

TENNESSEE: Cade's Cove and neighborhood, at western foot of Thunderhead, Blount Co., from about 1800 to 2200 ft. elevation (Ferriss, Walker, Clapp, Sargent and Pilsbry), Type 76856 A.N.S.P. Also Monroe and Polk counties. NORTH CAROLINA: Graham, Cherokee, Clay and Macon counties. GEORGIA: Towns Co., near Hiawassee.

"This *Vitrea* may be briefly characterized as similar to *V. petrophila,* but with only 4½ instead of 5-5½ whorls in shells of the same size. slightly wider umbilicus, less embracing and therefore less deeply lunate aperture and usually pinkish instead of whitish-corneous color. *V. rhoadsi* is a smaller shell with decidedly narrower umbilicus." (H. A. P.)

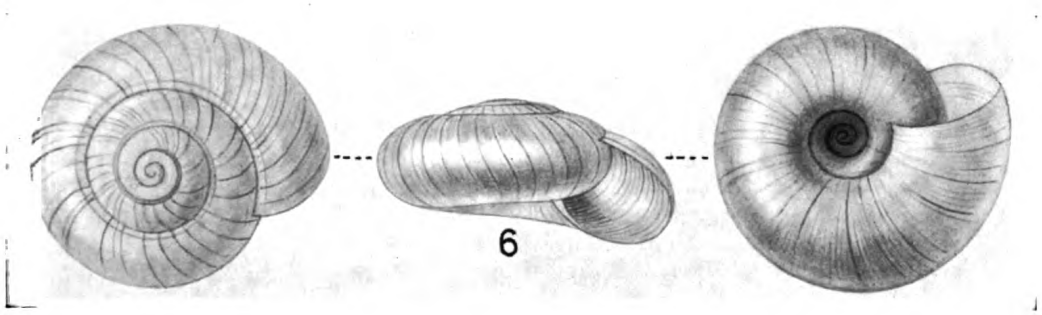

Fig. 144. *Retinella pentadelphia,* type × 8. After H. B. Baker.

Dr. Baker has dissected it. "Animals from Tellico Gorge, Monroe Co. (Aug. 10) are quite mature although the uterus is still rather slender. *R. pentadelphia* (Fig. 144) actually belongs near *R. rhoadsi* (Pilsbry), with which it is compared in the following anatomical notes.

"Foot whitish; top of head bluish gray; tentacles still darker; dorsum of mantle edge light grayish; sole broad, indistinctly tripartite (in my preserved material) and abruptly pointed posteriad. Lung about 3½ times as long as its base or 3 times length of kidney.

"Ovotestis consisting of 4 or 5 trigonal groups of alveoli; talon (Fig. 207: 15) not recurved. Uterus still slender. Free oviduct relatively shorter and vagina longer. Epiphallus relatively shorter and less developed, without penial papilla. Penis (Fig. 207: 16) elongate; apex shortly bifid to receive attachment of retractor and epiphallar entrance; internally with oblique folds in its apical ¼, rows of low papillae in next ¼ and low, longitudinal ridges in basal half. Penial retractor short; origin near middle of diaphragm. Atrium very short.

"Radular formula (Fig. 207: 14) of a dried-in specimen from Rowan Creek, Cade Cove (A.N.S.P. 78935) is 12 + 2 + 1 + 14, with 43 rows; of a preserved animal from Tellico Gorge, 11 + 3 + 1 + 14, with 44 rows. Centrals and laterals very elongate, with heavy mesocones and weak ectocones; third tooth aculeate, sometimes (Monroe Co.) with minute ectocone. Aperture of type shell measures: altitude 69 (1.81 mm.); diameter 123 (2.22 mm.).

"The bicuspid laterals of *R. pentadelphia* evidently place it in the subgenus *Glyphyalops* with *R. rhoadsi,* but its more corneous shell, weaker sculpture and more elongate penis also approach the group of *R. (Glyphyalus) wheatleyi.* Its elongate centrals and laterals are quite peculiar." (H. B. Baker.)

(Named for the party of five who in 1899 camped, in high spirits and usually hard rain, in the Great Smoky Mountains.)

Retinella rhoadsi (Pilsbry) Fig. 145.

Vitrea rhoadsi Pilsbry, 1899, Nautilus, 12: 101; 1906, Nautilus, 19: 109, fig. 1.— Bryant Walker, 1900, Nautilus, 14: 8; 1906, Ill. Cat. Moll. Mich., p. 480, fig. 49.

Glyphyalinia (*Glyphyalops*) *rhoadsi* (Pils.) H. B. Baker, 1928, Proc. Acad. Nat. Sci. Phila., 80: 21, pl. 4, figs. 4-8.

Retinella (*Glyphyalops*) *rhoadsi rhoadsi* (Pils.), H. B. Baker, 1930, Proc. Acad. Nat. Sci. Phila., 82: 207.

"Similar to *V. indentata*, but differing from that species in the distinct umbilicus, about one-half mm. wide, showing the penultimate whorl within; radial grooves more numerous, and therefore closer. The same characters, and the smaller size, separate *rhoadsi* from *carolinensis*. Alt. 2.5, diameter 4.7 mm." (Pilsbry.)

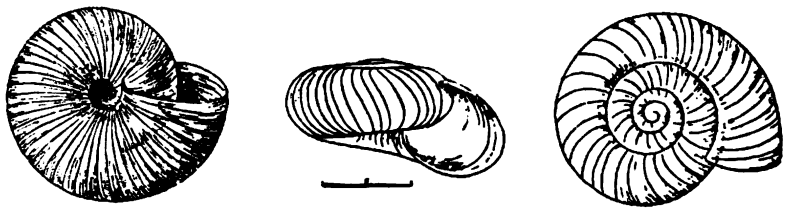

Fig. 145. *Retinella rhoadsi* × 5½; type, White Pond, N. J. (after Walker). Scale line = 2 mm.

The radial grooves are similar to those of *R. indentata*, continuing over the base. They become more or less crowded and irregular behind the aperture, so that the count is rather variable: I find 38 to 45 in several apparently adult specimens. In a few examples (including one of the type lot), some extremely weak spiral striæ can be made out near suture and umbilicus, but none could see seen in other apparently fresh shells. The largest shell in the type lot has a diameter of 4.7 mm., 4 whorls. Umbilicus 7 times in diameter.

ONTARIO: near Toronto (Oughton). MAINE: Oxford Co. VERMONT: Windham and Orange counties. MASSACHUSETTS: Middlesex and Norfolk counties. CONNECTICUT: Hartford Co. NEW YORK: Fulton, Onondaga, Madison, Tompkins and Dutchess counties. NEW JERSEY: Sussex, Mercer and Gloucester counties; Type 68213 A.N.S.P. from White Pond, Warren Co. PENNSYLVANIA: Pike, Northampton, Monroe, Montgomery, Bucks, Berks, Philadelphia, Delaware, Adams, Fulton and Beaver counties. MICHIGAN: Cheboygan Co.; Emmet Co. DELAWARE: New Castle Co. MARYLAND: Cecil and Allegany Co. VIRGINIA: Orange Co. (Walker). WEST VIRGINIA: Pendleton, Braxton and Wirt counties. NORTH CAROLINA: Crowders Mt., Gaston Co.

(Named for Samuel N. Rhoads, chiefly known as a mammalogist, but also a collector of shells in Mexico and the United States. He was the writer's companion when the type lot of this snail was collected.)

Dr. Baker writes: "My specimens come from Cheboygan County, Michigan; three were examined. The anatomy has many points in common with that of *G. indentata* and only distinctive features will be discussed.

"Animal: still lighter in color. Foot: sole acuminate posteriad and projecting some distance beyond abruptly pointed peripodial angle; mucous

pore without swelling. Mantle collar: much wider and more glandular dorsally; left neck-lappet (Fig. 131: 8) much longer and more acuminate; umbilical lobe scarcely more prominent than in *Retinella*. Pallial complex: similar in proportions to that of *G. indentata*, but secondary ureter stouter.

"Talon (Fig. 131: 6): with stouter caecoid portion; carrefour relatively smaller. Uterus: of same short type and with chocolate stain. Free oviduct; relatively shorter and stouter; glandular collar developed, on dorsal side, into a conspicuous mass of small, white alveoli (distinctly reminiscent of *Plekocheilus* and *Auris*). Spermatheca: sac large, lanceolate in shape and imbedded near base of albumen gland above loop of aorta; stalk basally swollen. Vagina: short and stout, with heavy investment of yellow, glandular tissue. Epiphallus (Fig. 131: 4): exceptionally long; apical $\frac{2}{5}$ swollen, with heavy glandular walls; basal $\frac{3}{5}$ with thinner walls and low plicae, tapering towards apex of penis; no distinct penial papilla. Penis: apical chamber small and knob-shaped, without prominent papillae; remainder similar in structure to that of *G. indentata*, but relatively much stouter. Penial retractor: stout but long; insertion just below apex of penis; intimate sheath investing penis and basal $\frac{1}{3}$ of epiphallus.

"Jaw (Fig. 131: 5): bright fulvous in color and concentrically striate; crescentic in shape but deep at center; cutting edge almost straight, with 3 shallow notches, which are continued by impressed lines. Radular formula (Fig. 131: 7): 37-3-1-40; 51 transverse rows counted. Central: larger than first lateral, with remarkably broad mesocone (approaching that of *Striatura* in appearance). Laterals: elongate, with deep backs; bicuspid with large mesocone and small ectocone; base extending mesiad of mesocone so that, under low magnifications, an entocone appears to be present (Cf. Morse for *G. indentata*).

"The many differences between this species and *G. indentata* seem to demand subgeneric recognition. The relatively more simple penis slightly approaches the condition in *Retinella*, but the remainder of the anatomy is much closer to that of *Glyphyalinia* s.s." (H. B. Baker.)

Retinella rhoadsi austrina H. B. Baker Fig. 128: 4, 5.

Vitrea rhoadsi Walker & Pilsbry, 1902, Proc. Acad. Nat. Sci. Phila., p. 402.

Retinella (Glyphyalops) rhoadsi austrina H. B. Baker, 1930, Proc. Acad. Nat. Sci. Phila., 82: 208, pl. 9, figs. 4, 5.

"Shell quite small, hyaline, thin and transparent; spire more depressed than *rhoadsi;* umbilicus smaller (8 to 9 times in major diameter); spiral sculpture quite weak; radiating lines rather closely spaced (41 on last whorl of type)." (H. B. B.)

Height 2.45 mm., diameters 5.27 and 4.49 mm.; $4\frac{3}{4}$ whorls. Umbilicus 8.3 times in diameter.

TENNESSEE: sink-holes about 3 miles northwest of Johnson City, Washington Co. (H. B. Baker), Type 150606 A.N.S.P. Also in Carter, Unicoi, Knox and Blount counties. NORTH CAROLINA: Avery and Mitchell counties. VIRGINIA: Rockbridge Co. and near Snowden, Amherst Co.

"This subspecies has a flatter spire, a more polished surface and a relatively smaller umbilicus than typical *rhoadsi*. At its type locality, it occurs

with *R. indentata paucilirata,* from which it is rather difficult to separate, although *austrina* is more depressed, has more closely spaced radial furrows and develops stronger interstitial ones (minor series) especially near the suture on its apical side. Around Roan Mt., *austrina* usually occurs in drier situations than *R. carolinensis wetherbyi* and is much rarer. In addition to the foregoing, the A.N.S.P. collection contains a single specimen from Williamsburg or Berkeley Co., South Carolina, which has a higher spire (like *rhoadsi*) but a small umbilicus (like *austrina*) and is a larger and heavier shell than either subspecies.

"Paratype (Aug. 26) and Roan Mountain (Aug. 15-25) animals have been dissected. The anatomy of *austrina* is very similar to that of typical *rhoadsi,* but the glandular part of its epiphallus is relatively shorter and the internal folds in the apical swelling of its penis are more oblique. The radular formula of a paratype is 32-3-1-3-32 with 51 transverse rows." (H. B. Baker.)

Subgenus GLYPHYALINIA Von Martens

The following key to the species of *Glyphyalinia,* taken from H. B. Baker, may assist in their identification.

A. Shell rimate to narrowly umbilicate
- B. Shell with more rounded whorls and less conspicuous spiral sculpture; epidermis thin and hyaline (except in Florida and "C" forms); epiphallar opening near base of apical penial chamber..... .....*R. indentata*
  - C. Shell with narrowly rimate umbilicus; apical chamber of penis short; northeastern United States.....*R. indentata indentata*
  - CC. Shell usually perforate to narrowly umbilicate; apical chamber of penis relatively longer and larger; central and southern United States to Guatemala (and Porto Rico?).....*R. indentata paucilirata*
- BB. Shell with more depressed whorls and conspicuous spirals; epidermis markedly corneous; epiphallar opening near middle of apical penial chamber; umbilicus rimate; western edges of Appalachians proper, from Natural Bridge, Va., to Mt. Guyot, Tennessee.....*R. carolinensis*
  - D. Shell thinner; major diameter 7 or 8 mm.....form *wetherbyi*
  - DD. Shell heavier; major diameter 8-13 mm... .....typical form

AA. Shell with umbilicus closed by tongue-shaped callus; central of radula more elongate ....*R. cryptomphala*
- E. Shell thinner, with hyaline epidermis; usually smaller; Knox Co., Tennessee.....*R. cryptomphala cryptomphala*
- EE. Shell heavier with corneous epidermis; typically larger; northern Florida to Kentucky (and Arkansas?) *R. cryptomphala solida*

Retinella indentata (Say) Fig. 146 a.

Helix indentata Say, 1823, Jour. Acad. Nat. Sci. Phila., 2: 372 (Harrigate and New Jersey).

Zonites indentatus Say, W. G. Binney, 1885, Man. Amer. L. Sh., p. 62, fig. 15.

Vitrea indentata (Say) of American authors, 1900 to 1930.

Glyphyalinia indentata Say, H. B. Baker, 1928, Proc. Acad. Nat. Sci. Phila., 80: 20, pl. 3, figs. 6-8, anatomy.

Retinella (*Glyphyalinia*) *indentata* (Say), H. B. Baker, 1930, Proc. Acad. Nat. Sci. Phila., 82: 209.

"Shell depressed, pellucid, highly polished; whorls four, with regular, distant, subequidistant, impressed lines across, of which there are about twenty-eight to the body whorl, all extending to the base; suture not deeply indented; aperture rather large; labrum simple, terminating at its inferior extremity at the centre of the base of the shell; umbilicus none, but the umbilical region is deeply indented. Greatest breadth one-fifth of an inch. Animal: Blued-black, immaculate." (Say.)

Height 3 mm., diameter 5.7 mm., 4¾ whorls (Philadelphia).

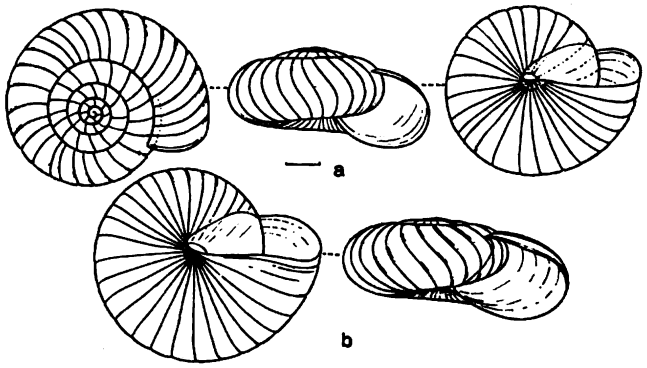

Fig. 146. a, *Retinella indentata,* Douglas Lake, Michigan. b, *Retinella indentata paucilirata,* Rucker Canyon, Chiricahua Mts Scale line = 1 mm.

The minute umbilical perforation, contained 25-30 times in the diameter, is not closed, as Say thought, but minutely open, the columellar reflection usually about half to three-fourths covering it.

Under the binocular, microscopic spiral striae can usually be seen on some part of the last whorl, either rather weakly developed or only as traces; but they are not well developed as in *R. carolinensis.* A New Jersey shell 4.7 mm. diameter has 4¼ whorls. A Cheboygan Co., Michigan specimen of 5.4 mm. diameter has 4¾ whorls, about 28 radial grooves on the last whorl. Most others of the same lot are not over 4.7 mm. diameter. Dr. Baker counted 4¾ whorls in a Philadelphia specimen of 5.72 mm. diameter.

CANADA: southern Ontario north to the Muskoka District, Manitoulin Is. and Ottawa (Oughton). UNITED STATES: Oxford, York, Hancock and Somerset counties, Maine. Generally distributed in all of the New England and Middle States. Virginia, West Virginia; Ohio and Michigan, west to Shawnee Co., Kansas. Eastern and northern Missouri; south to Sevier Co., Tennessee. Jackson Co., northern Alabama. Say gave localities in northern Philadelphia ("Harrigate") and New Jersey.

Along the western and southern borders of the range of *indentata* there is some intergradation with the small northern and eastern forms

of *paucilirata*. It has been said that "Nature never draws a line without smudging it," and those who attempt to name every specimen seen of the *indentata-paucilirata* complex will probably agree that the boundaries occasionally appear smudged, although typical examples are distinct enough. Dr. Baker found some small anatomical differences between the specimens of *indentata* and *paucilirata* he dissected, but whether these prove to be any more constant than the shell characters seems doubtful. His observations on *indentata* follow.

"My material comes from Cheboygan County, Michigan; two animals were dissected. The anatomy is fundamentally similar to that of *R. hammonis* [*R. electrina*] and only points of difference will be noted.

"Animal: mainly white, but shading into pearl-gray on tail and towards mantle collar; exposed epidermis very heavy, with prominent tesselloid bosses. Foot: not quite so large in proportion to shell; sole slender, with less deeply impressed longitudinal furrows. Tail: peripodial angle slightly notched but with a little triangular shelf; mucous groove in an arrow-shaped swelling, which may extend slightly beyond tip of sole. Mantle collar (Fig. 127: 8): large right and left neck-lappets and a small but distinct umbilical shell-lobe (considerably more prominent than in *Oxychilus* or *Retinella*). Lung: about twice as long as its base or length of kidney; principal pulmonary vein large, minor venation indistinct. Kidney: about 1½ times as long as its base and almost 1½ times length of pericardium.

"Ovotestis (Fig. 127: 7): four groups of very few, ovoid lobules with large connecting tubes; duct long, swollen and slightly convoluted beyond middle half of length; talon the shape of a question-mark with caecal portion small; carrefour ellipsoid. Uterus: relatively very short, sacculate, with a dark, chocolate-brown stain on its basal third (present in all species of genus examined). Free oviduct: long and quite stout, with a narrow collar of white glandular tissue around its apex. Spermatheca: sac subspherical and large; stalk short. Vagina: practically absent, but apex of cloaca with zone of yellow, glandular tissue. Prostate: long type. Vas deferens: passing directly to apex of epiphallus. Epiphallus (Fig. 127: 6): parallel to penis; stout but quite short, slightly tapered at both ends; wall thick and glandular, with heavy, longitudinal plicae; penial papilla not developed. Penis: apical compartment small and conical, with numerous, closely-crowded papillae and lateral penial pore; apical half of basal portion with very heavy pilasters and two, large U-shaped thickenings; basal half with low, longitudinal plicae. Penial retractor: very stout and short (another peculiarity of the genus); insertion at apex of penis; intimate sheath complete. Cloaca: short but stout; opening lateral and large, situated considerably behind middle of visceral stalk and high on its side.

"Columellar muscles: much as in *R. hammonis*. Salivary glands: right one larger than left; otherwise similar but more ellipsoid in shape. Radula: similar to that of *G. rhoadsi*, but outer marginals with serrate blades, as first noted by Dr. Pilsbry, who will publish figures of the teeth." (H B. Baker.)

Retinella indentata paucilirata (Morelet) Fig. 146 b.

Helix paucilirata Morelet, 1851, Testac. Nov., 2: 8. Salama, Guatemala.

Hyalinia paucilirata Morelet. Von Martens, 1892, Biol. Centr. Amer., Moll., p. 118, pl. 6, fig. 12.

(?) *Helix indentata* var. *umbilicata* W. G. Binney, 1858, Proc. Acad. Nat. Sci. Phila., p. 202 (name only; may be *rhoadsi*).

Zonites indentatus var. *umbilicatus* Singley, Cockerell, 1893, Brit. Nat., 3: 81, Lee Co., Texas; not the figure cited; 1899, Nautilus, 12: 120.

Vitrea indentata umbilicata (Ckll.) Pilsbry, 1906, Proc. Acad. Nat. Sci. Phila., p. 150; 1910, p. 131 (Arizona).

Retinella (*Glyphyalinia*) *indentata paucilirata* (Morelet) H. B. Baker, 1930, Proc. Acad. Nat. Sci. Phila., 82: 210, pl. 11, figs. 6-8, anatomy, distribution.

Differs from *R. indentata* by the larger umbilicus and by attaining a greater size. The largest specimen noticed, from near New Braunfels, Texas, measures: height 3.2 mm., diameter 7.1 mm.; but it is usually smaller, about 6 mm. diameter, or in many lots not larger than: height 2.3 mm., diameter 5 mm., with $3\frac{3}{4}$ to $3\frac{1}{4}$ whorls. Morelet's type was said to measure 2×6 mm.

The type, according to Von Martens, has about 30 indented lines on the last whorl, 10 of them in the last 2 mm. The type locality was around the town of Salama, Guatemala. It is the only *Glyphyalinia* known in Arizona, New Mexico and Texas. Dr. Baker, who has examined the Academy series, gave the following range of A.N.S.P. material.

INDIANA: Henry and Hendricks Co. KENTUCKY: Edmondson, Warren, Breathitt and Pulaski Co. TENNESSEE: Washington, Knox, Bledsoe, Marion, Hardin, Davidson and Shelby Co. ALABAMA: 10 counties. MISSISSIPPI. LOUISIANA. MISSOURI: Pettis, St. Clair, Christian and Barry Co. ARKANSAS: 9 counties. OKLAHOMA. TEXAS. NEW MEXICO. ARIZONA. UTAH: Tooele and Salt Lake Counties.

MEXICO: states of Durango, Jalisco, Moreles and Michoacán, also found in Mexico and Puebla.

The Florida form is always small, up to 5 mm. diameter, but it has a somewhat larger perforation than northern *indentata*. It is at hand from the following counties: Alachua, Citrus, Collier, Dade, Duval, Gadsden, Hernando, Jackson, Lake, Lee, Leon, Manatee, Marion, Monroe, Palm Beach, Pinellas, Sarasota, St. Lucie, Seminole and Volusia. Also Georgia: Glynn and McIntosh counties. South Carolina: Beaufort Co. and Richland Co. North Carolina: Haywood and Clay counties.

R. indentata has been reported from the Sierra Laguna, Lower California, by Cooper (Proc. Cal. Acad. Sci., 1892, 3: 216), and from the Tres Marias by Dall (same Proc., 1926, 15: 483). Probably both are *paucilirata*.

" Unlike most of the species of *Glyphyalus*, *paucilirata* seems to become mature during the summer. None of several hundred individuals, collected near New Braunfels, Comal Co., Texas (June 17-25) are sexually mature, although some of them are very large. On the other hand, animals with ripe genitalia are present in the lots collected from the southern Cumberlands (July 23-Aug. 7). The following anatomical notes on large specimens

from near Gurley, Madison Co., Alabama, emphasize only the differences from the structure of typical *indentata*.

"Spermatheca stalk more swollen basally (stouter than free oviduct). Epiphallus (Fig. 139: 8) lumen weakly T-shaped; base more attenuate. Penis apical, papillate chamber teat-shaped, almost half as long as entire organ; basal chamber relatively stouter (than in *indentata*), internal surface with anastomosing, longitudinal wrinkles. [Examples from San Juan Teotihuacán, Mexico, are similar but all of the parts are smaller (younger) and the papillate chamber is broader at its apex.] Penial retractor origin dorsal to and near apex of spermoviduct; body passing to left of uterus; insertion on apex of penis (as usual in *Glyphyalinia*). Jaw (Fig. 139: 6): crescentic; imbedded border hyaline; exposed region dark reddish; center with 3 to 5 vague plaits, which resist corrosion as a weak point near middle of cutting edge (as usual in *Glyphyalinia*). Radular formula (Fig. 139: 7) 18-18-4-1-4-36; 63 rows counted. Outer 18 marginals small, with extremely minute serrations on inner border. [Radular formula of San Juan Teotihuacán individual 16-18-5-1-5-34; 66 rows counted.]" (H. B. Baker.)

Retinella carolinensis (Cockerell) Fig. 151 b.

Zonites carolinensis Cockerell, 1890, Science-Gossip, 26: 114.

Zonites caroliniensis Cockerell, W. G. Binney, 4th Suppl. Bull. Mus. Comp. Zool., 22: 167, pl. 3, fig. 7.

Vitrea carolinensis (Ckll.), Cockerell, 1899, Nautilus, 12: 120.—Walker, 1902, Proc. Acad. Nat. Sci. Phila., p. 430: 1928, Terr. Moll. Ala., p. 80, fig. 111.—Clapp, 1915, Nautilus, 29: 26.

Glyphyalinia carolinensis (Ckll.), H. B. Baker, 1928, Proc. Acad. Nat. Sci. Phila., 80: 22.

Retinella (*Glyphyalinia*) *carolinensis* (Cockerell) H. B. Baker, 1930, Proc. Acad. Nat. Sci. Phila., 82: 211, pl. 12, figs. 4, 10, 11. Also form *wetherbyi*, ibid., pl. 12, figs. 1-3, neotype.

Vitrea carolinensis var. *wetherbyi* Cockerell, 1900, Nautilus, 14: 45; 1903, Nautilus, 16: 108 (name only).—Walker & Pilsbry, 1902, Proc. Acad. Nat. Sci. Phila., p. 430.

"Allied to *Z. sculptilis*, but differs in its fewer whorls, its straighter columellar margin, its fewer sculptured lines and its less lunar aperture." (Cockerell, 1890).

"The original type was thus described: Max. diam. 10, alt. 5 mm., whorls 5. Pale horn, shiny, semitransparent, umbilical region somewhat whitened. Surface of shell with strong transverse growth lines and distinct transverse grooved lines. The grooved lines are about 26 on body whorl. Umbilicus small, narrow. Aperture obliquely large-lunate, the upper angle much smaller than the lower. Peristome not sinuate." (Cockerell, 1899.)

Height 5 mm., diameter 11 mm., 5½ whorls; 36 grooves on the last whorl. Natural Bridge, Va.

Height 5.5 mm., diameter 12 mm., 5½ whorls; 46 grooves on last whorl. Limestone Cove, Unicoi Co., Tenn.

Height 4.4 mm., diameter 8.5 mm., 5½ whorls; 50 grooves on last whorl. Paint Rock, N. C.

Height 3.4 mm., diameter 8 mm., 5.2 whorls; near Magnetic City, N. C.

VIRGINIA: Natural Bridge, Rockbridge Co. (H. B. Baker). NORTH CAROLINA: Paintrock, Madison Co. (Ferriss); Walnut Cove, Stokes Co. (A. P. Jacot); near Magnetic City, Mitchell Co. (Wetherby); Roan Mt. (W. G. Binney). TENNESSEE: Gatlinburg and Mt. LeConte, Sevier Co. (Clench & Archer).

The large, typical form of *carolinensis* is rather scarce, but smaller forms of 5 to 7 mm. diameter appear to be rather widely spread, far south into Alabama. There appears to be no point where the series can be divided on size, "*wetherbyi*" being the widely spread form which, in some places from southwestern Virginia to Alabama, becomes the large *carolinensis*. It is easily separable from *R. sculptilis* by the smaller number of radial grooves. This number is rather variable as noted above. Dr. Clapp states that, "my three largest Cranberry shells have 38, 34 and 32 respectively, while a 6½ mm. diameter shell from Mitchell Co., N. C. (labeled *carolinensis* by A. G. Wetherby) has 35, and a 6¼ mm. shell from Paint Rock, N. C. has 32 lines."

R. carolinensis when examined with a very strong hand-lens or under the binocular "shows a minute sculpture of *very even, close, clear-cut spiral engraved lines*. In *R. indentata* the same magnification only brings out an extremely weak striation or none; only rarely does it approach the condition of *R. carolinensis*." This micro-sculpture is so minute that an ordinary pocket lens rarely reveals it. But I have seen very few specimens which could not be definitely referred either to *carolinensis* or *indentata* when examined under the microscope. This sculpture is visible only in the highlight.

Dr. Baker has noted that the *carolinensis* from Natural Bridge when fresh were a translucent hazel color, some specimens more pinkish, fading towards the umbilicus. Like other tinted retinellas, the color soon fades in the collection.

R. carolinensis has been reported from Westmoreland Co., Pennsylvania (Nautilus, 53:98). I have not seen it from that state.

The form *wetherbyi* was originally (1900) noticed as "*V. carolinensis* of a small type (var. *wetherbyi* Ckll. ined.) intermediate between *indentata* and *carolinensis* proper" and referring to shells of the Great Smoky Mountains. In 1902 Walker reported *V. c. wetherbyi* from Paint Rock, Bluff mountain, Tyson's, Wilson's Mt. Mitchell, Cat-tail, Pinnacle of the Blue Ridge, Toe River and Potato Top; adding "In the report of the expedition of 1899 [Great Smoky Mountains] the specimens of *V. carolinensis* were found to belong to a small race, ranging from 5½ to 7 mm. in diameter. Cockerell has since distinguished it under the above varietal name." In 1903 Cockerell added that it had been sent from Roan Mt. by Wetherby.

Notes published up to that time are quite inadequate for recognition in this difficult group; moreover, they applied primarily to a Great Smoky Mountain form. H. B. Baker writes: "as neotype (A.N.S.P. 150607), a

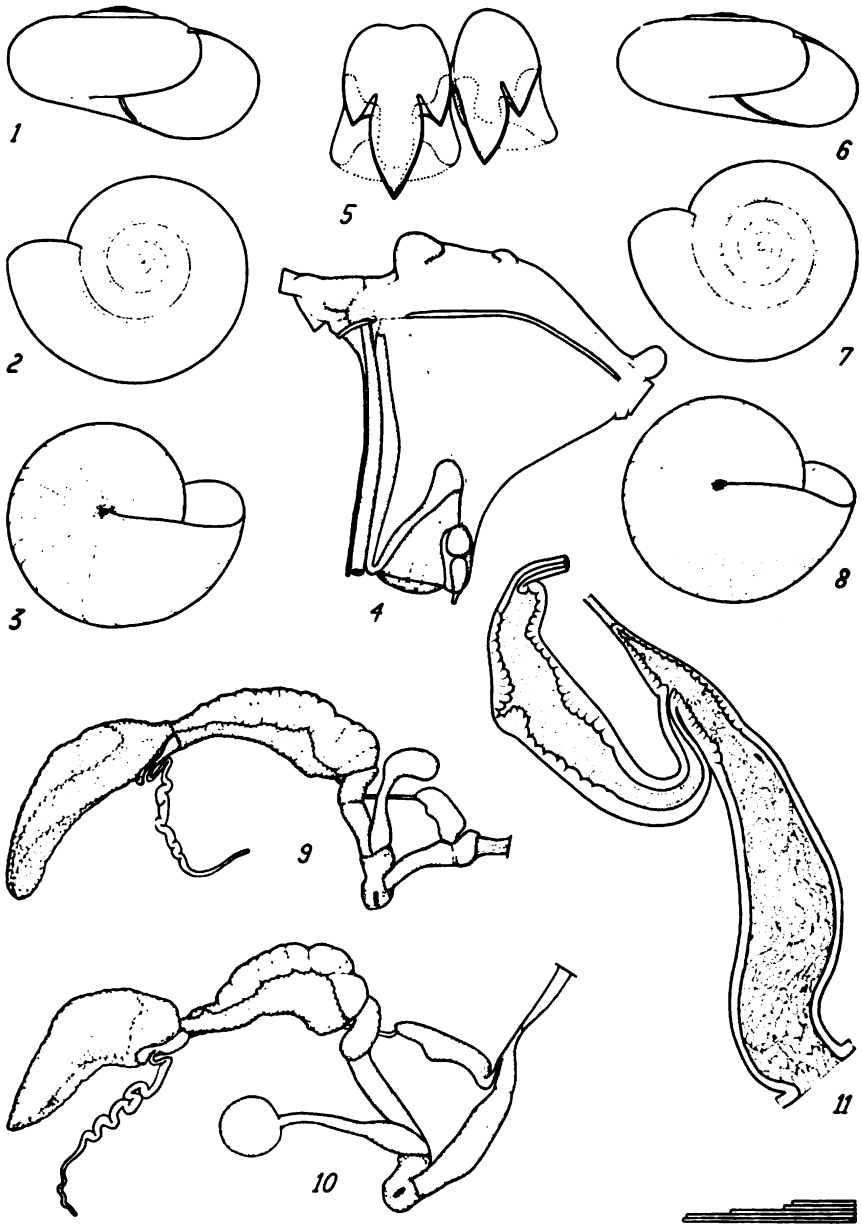

Fig. 147. 1-3, *Retinella carolinensis* form *wetherbyi*, Carter Co., Tenn., frontal, apical and umbilical (showing major growth-furrows) outlines of shell chosen as neotype. 4, *R. carolinensis*, typical form, Unicoi Co., Tenn., internal view of pallial complex. 5, *R. sculptilis subdola*, Carter Co., Tenn., radula: central and first lateral; 6-8, frontal, apical and umbilical (showing major growth-furrows) outlines of type shell; 9, dissected genitalia (ovotestis omitted) 10, *R. carolinensis* form *wetherbyi*, dissected genitalia (ovotestis omitted); 11, penis and accessories (after H. B. Baker).

shell (Figs. 147: 1-3) from the lower, northern slopes of Roan Mt. (alt. 3600 ft.) is now chosen; the animal (Aug. 24) was not quite mature. This example is probably a topotype, and Prof. Cockerell assures me that *wetherbyi* is the small form of *carolinensis*.

"The confusion in its inception seems to have influenced its subsequent identification. Actually, it appears to be limited to the northern end of the mountains which form the Tennessee-North Carolina boundary, but it (or *carolinensis*) has evidently been used for any shell that looks vaguely like an overgrown *R. indentata*. As used here, *wetherbyi* is simply an edaphic, paedogenetic form of *carolinensis*, that occurs within a few feet of the typical variation and intergrades perfectly with it. Other of the related species (e. g., *sculptilis*) show a similar tendency to produce giant individuals in especially favorable situations. My own field studies (Natural Bridge, Va., and Limestone Cove, Tenn.) seem to indicate that typical *carolinensis* is usually developed in talus from the slopes of steep-sided, protected valleys. Most of my specimens from the slopes of Roan Mountain are rather small, although one has a diameter of 8.5 mm. Form *wetherbyi*, like immature individuals of true *carolinensis*, has a smaller number of whorls, a relatively higher spire and more widely spaced radiating lines than adults of the typical form. Height 3.64 mm., diameters 6.94 and 6.01 mm.; 4½ whorls."

Dr. H. B. Baker's notes on the anatomy follow.

As compared with *R. indentata* the animal of both *carolinensis* and *wetherbyi* is "much darker; dorsum of head and tail and mantle edge deeply pigmented; sides of foot lighter. Lung (Fig. 147: 4, typical form): 2¼ times as long as its base or about twice length of kidney, which is 1½ times as long as its width or length of pericardium; left mantle lappet cleaver-shaped, accessory left one small (as usual in *Glyphyalinia*). Talon (Fig. 147: 10) wedge-shaped. Uterus chocolate-brown. [The uterus in most species of *Glyphyalinia* and *Glyphognomon* show some of this pigmentation, but it appears more complete in those with darker foot.] Free oviduct longer; apical glandular collar much larger. Epiphallus (Fig. 147: 11) lumen weakly T-shaped; wall with heavy pilaster of glandular columns; opening near middle of apical penial chamber. Penis apical chamber attenuate, about ⅓ of length of entire organ, internal wall with comparatively few, large papillae; basal region stout, internal surface with short, fine, anastomosing wrinkles. Radular formula (typical form, Limestone Cove) 33-21-6-1-6-54; 67 rows counted." See also Fig. 127: 9, teeth of immature *R. carolinensis*.

Retinella cryptomphala (Clapp) Fig. 148.

Vitrea cryptomphala Clapp, 1915, Nautilus, 29: 25, fig. 1.

Retinella (*Glyphyalinia*) *cryptomphala cryptomphala* (Clapp) H. B. Baker, 1930, Proc. Acad. Nat. Sci. Phila., 82: 213, pl. 13. figs. 9, 10.

"Shell thin, polished, very light horn-color to white, generally white, translucent; whorls 5 to 5½, those of the spire regularly increasing, the last

widening very rapidly and doubling the diameter of the shell. Aperture broadly lunate, sutures well impressed, all whorls showing through the shell. Surface sculptured with rather evenly spaced, radiating grooves continued to the base as in *V. indentata* and *carolinensis*, there being from 23 to 34 on the body whorl. Micro-sculpture of even, close, clear-cut spiral en-

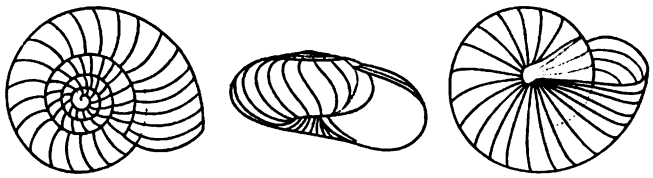

Fig. 148. *Retinella cryptomphala*, type × 5 (after Clapp).

graved lines like those of *carolinensis*, best seen with a magnification of 25 diameters or over. Spire much depressed, almost flat, the termination of the last whorl slightly raised at the lip which is straight on the lower edge and well curved forward above, projecting about 1 mm. beyond the lower lip; at the columellar end the lip is thickened and joined to a *tongue-like callus which completely covers the umbilicus at all stages of growth.* There is a thin, microscopically granular parietal callus, as in *V. indentata.* Base of shell well rounded and less impressed in the umbilical region than *indentata* or *carolinensis.*

"Shell figured (Knox Co.,) 5.1 × 4.2 × 2.1 mm., whorls 5; 23 grooves on body whorl.

"Largest, Knox Co., 5.7 × 4.8 × 2.7 mm., whorls 5; 26 grooves on body whorl. (Clapp.)

"Largest, Knoxville, 5.9 × 5.0 × 2.8 mm., whorls 5; 34 grooves on body whorl.

"Smallest, Knox Co., 2.1 × 1.9 × 1.1 mm., whorls 3, umbilicus completely covered." (Clapp.)

TENNESSEE: Knoxville (Mrs. Geo. Andrews), Type 7365 Clapp Collection, cotypes 112421 A.N.S.P.; also in U.S.N.M. and Bryant Walker Coll.

"At first I was inclined to consider this a variety of *V. carolinensis*, but the flatter spire, the umbilicus covered *at all stages of growth*, the less excavated umbilical region and the wider aperture indicate a good species. I examined 250 *V. indentata* from 41 localities and 110 *carolinensis* and var. *wetherbyi* from 15 localities and found no intermediates." (Clapp.)

Dr. Baker writes: "In its type region, *R. cryptomphala* is readily separable from *R. praecox* because fresh shells of the former are much more hyaline. In the Cumberlands and apparently elsewhere, fresh specimens of *cryptomphala* are corneous and quite heavy; typical *solida* (see below) represents the edaphic culmination of this tendency.

"My spring animals of this species (April 4, 5) are fully developed; those collected in the summer (July 11-13) are mainly juvenile, but two

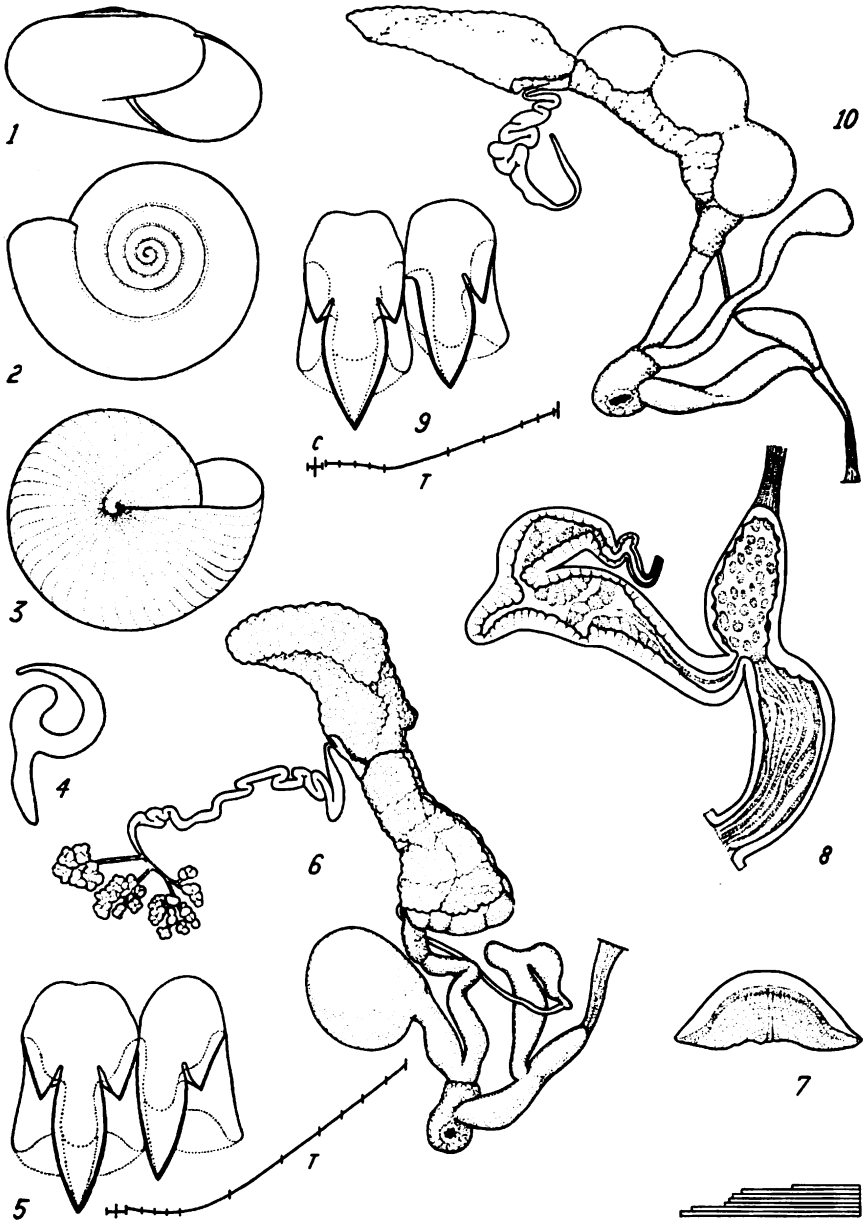

Fig. 149. 1-3, *Retinella cryptomphala solida* Marion Co., Tenn., frontal, apical and umbilical (showing major growth-furrows) outlines of type shell; 4, spermatophore (spring animal); 5, radula, central and first lateral, also diagram of transverse row; 6, dissected genitalia (spring animal); 7, jaw; 8, penis and accessories. 9, *Retinella cryptomphala,* Knox Co., Tenn., radula, central and first lateral, also diagram of transverse now; 10, dissected genitalia of animal past climax of sexual activity (July); ovotestis is omitted. (After H. B. Baker.)

individuals are in late maturity. Each of these gerontic specimens (Fig. 149: 10) contains three, large spherical eggs with calcareous shells, but the spermathecae are small (empty) and, in one, the albumen gland is greatly reduced. The following anatomical notes only emphasize salient difference from the animal of *indentata*.

"Animal with more widespread and better developed bluish pigmentation; pedal pore a transverse slit in a larger, circular boss. Talon (Fig. 149: 10): with a longitudinal groove which marks off knobby halves. Uterus (July animal), contents of egg apparently cellular but without signs of advanced development. Free oviduct, glandular collar longer. Epiphallus, lumen weakly T-shaped (past maturity). Penis, apical compartment more elongate, with larger and fewer, internal papillae; basal chamber with anastomosing, longitudinal plicae internally. Radular formula (Fig. 149: 9) 28-16-5-1-5-44; 50 rows counted. Central with deeper back and more elongate base (than in *indentata*)." (H. B. Baker.)

(Κρύπτω, ομφαλός, concealed umbilicus.)

Retinella cryptomphala solida H. B. Baker Fig. 149: 1-3.

R. (*Glyphyalinia*) *cryptomphala solida,* H. B. Baker, 1930, Proc. Acad. Nat. Sci. Phila., 82: 213, pl. 13, figs. 1-8.

"Shell color corneous through fulvous to almost chestnut; typically larger, heavier and with stronger sculpture than *cryptomphala*. Height 4.05 mm., diameters 7.5 and 6.48 mm.; 5¼ whorls." (H. B. Baker.)

TENNESSEE: along calcareous ledges, south side of Prior Cove, near Jasper, Marion Co., Type A.N.S.P. 150603. Typical form also from coves in east side of Cumberlands, Marion and Bledsoe counties. KENTUCKY: Pulaski Co. ALABAMA: Wetumpka, Elmore Co. Range of corneous but smaller shells: KENTUCKY: Edmonson and Barren counties. TENNESSEE: Bledsoe, Marion, Franklin, Hardin and Davidson counties. ALABAMA: Jackson, Madison, Cullman, Dekalb, Cherokee, Blount, Shelby, Bibb and Mobile counties. GEORGIA: Fulton and McIntosh counties. FLORIDA: Alachua Co. Also (?) ARKANSAS: Polk and Logan counties.

"The large form of this subspecies is developed in talus near rock ledges; its heavy radiating furrows give it somewhat the appearance of *R. sculptilis*. The Arkansas specimens are few and in poor condition. My summer animals from the type locality (July 23-26) are immature but a very few of the small form from near Dove in the same county (same dates) and around Gurley, Madison and Jackson Co., Ala., (July 30–Aug. 7) are somewhat more mature. Spring animals from the type locality (April 2, 3) and smaller ones from around Dove (Mar. 29-31) are fully mature. The anatomical description is based on a spring topotype; its spermatheca contained a large, T-shaped spermatophore (Fig. 149: 4).

"Animal slightly darker than typical *cryptomphala;* pedal pore a transverse slit under a projection shaped like the end of a canoe. Pallial complex like that of *carolinensis;* umbilical shell-lappet heavier but not longer. Free oviduct (Fig. 149: 6) longer and more slender (than in typical subspecies). Prostate very broad. Epiphallus (Fig. 149: 8) markedly T-shaped, with a short apical caecum. Penis, apical compartment large,

internally with big, spaced, ovoid bosses; basal chamber with irregularly longitudinal, internal plicae. Jaw (Fig. 149: 7) exposed surface dark reddish; central plaits distinct. Radular formula (Fig. 149: 5) 27-21-4-1-4-48; 67 rows counted. Centrals and laterals: mesocones more slender than in typical *cryptomphala*." (H. B. Baker.)

GROUP OF RETINELLA SCULPTILIS (Section *Glyphognomon* H. B. Baker)

This section differs from *Glyphyalinia* by having a slender continuation of the penis beyond the insertion of the epiphallus and the penial retractor, entirely comparable to that of *Mesomphix*, and not known in any other *Retinellae*.

The following key by H. B. Baker to the species and subspecies of *Glyphognomon* is presented:

A. Penial flagellum a long, attenuate continuation of apical chamber; epiphallus attenuate basally; shell similar to *wetherbyi* but with flatter spire, smaller and more gradually increasing apical whorls, brilliant, bronze-tinged epidermis, more widely spaced spirals and less capacious last whorl; southern end of Appalachians proper to Knoxville and southern Cumberlands.....*R. praecox*

AA. Penial flagellum short and lateral to broad apical chamber; epiphallus sessile; shell with much more gradually increasing whorls and much less expanded last whorl than *wetherbyi* (or *carolinensis*); suture impressed.....*R. sculptilis*

B. Penial flagellum distinct; central of radula more elongate; shell heavier and typically larger with closely spaced major growth-furrows preceded by definite thickenings; southern end of Appalachians proper..*R. sculptilis sculptilis*

BB. Penial flagellum vestigial; central of radula broad and short; shell small and relatively thin with more widely spaced major growth furrows preceded by much weaker thickenings; vicinity of Roan and Black Mts., Tenn.-N. C. (and western Maryland?).....*R. sculptilis subdola*

BBB. Thickenings along furrows distinctly beaded; western N. C. *R. sculptilis junaluskana*

Retinella praecox H. B. Baker Fig. 150: 1-3.

Retinella (*Glyphognomon*) *praecox* H. B. Baker, 1930, Proc. Acad. Nat. Sci. Phila., 82: 214, pl. 14. figs. 1-7.

"Shell medium in size, brilliant bronze-colored, quite thin and translucent; spire almost flat; apical whorls small and quite gradually increasing; last whorls rapidly increasing; apical spiral relatively large; major growth-furrows widely spaced (28 on last whorl of type); spiral sculpture distinct and quite widely spaced. Umbilicus rimate. Aperture subcircular (less expanded than in *wetherbyi*)." (H. B. Baker.)

Height 2.81 mm., diameters 6.27 and 5.51 mm.; $4\frac{1}{8}$ whorls.

TENNESSEE: Slate talus near mouth of Laurel Creek, gorge of Tellico River, near Tellico Plains, Monroe Co., Type A.N.S.P. 150608. Monroe, Blount, Knox, Marion, Franklin, Bledsoe, Roane and Morgan counties. NORTH CAROLINA: Haywood, Swain, Graham and Jackson counties. KENTUCKY: Pulaski and Edmonson counties. ALABAMA: Jackson, Madison, Lauderdale, Blount and Shelby counties; also (?) Wetumpka, Elmore Co. GEORGIA: Murray Co.

"This species is easily confused with *wetherbyi* and its range will require anatomical verification. The large and greenish shells from Wetumpka are especially peculiar, although they are approached by specimens from

swampy woods along the Tennessee River near the Tennessee-Alabama border (H. H. Smith!). I have dissected animals from the counties followed by an exclamation point (!). Summer specimens from the type locality (Aug. 9-12), Knoxville (July 11-13) and Bledsoe Co. (July 16-20) are sexually mature; a single animal from Kelly Cove, Marion Co. (July 26) is slightly immature although its penial flagellum is well developed. Spring individuals from Knoxville (Apr. 4) are immature, but one from near Fountain City (Apr. 5) is quite well-developed.

"The following notes on the anatomy of *R. praecox* are mainly founded on paratypes: Animal body yellowish-white; dorsum of head and towards tip of tail grayish; ommatophores black; tail much as in *indentata;* mucous pore large, guarded by thick lips which form a lanceolate protuberance; tripartite division of sole very sharp. Talon (Fig. 150: 5) cleaver-shaped. Uterus less markedly conoid than in *Glyphyalinia;* dark brown stain widespread. Free oviduct short and slender; glandular collar present. Spermatheca, short type; sac relatively small (as usual in *Glyphognomon*); stalk stout. Vagina very short. Prostate broad. Epiphallus (Fig. 150: 4) apical end with small caecum; wall thick, internal surface divided into transverse-polygonal areas; basal third simpler and more slender. Penis fusiform with long, attenuate apical flagellum; lumen almost continuous (apical chamber not sharply demarcated); wall throughout length with closely spaced papillae. Penial retractor short and stout; origin on right side near base of spermoviduct (as usual in *Glyphognomon*); insertion on side of penis between apical and middle thirds. Cloaca, glandular investment and external opening much as in *Glyphyalinia*. Jaw (Fig. 150: 7): heavy, exposed region dark chestnut-colored; vestigial plaits near its center even more distinct than in *Glyphyalinia*. Radular formula (Fig. 150: 6) (24-26)-21-4-1-4-(45-47); 61 transverse rows counted. Teeth, central broad with stout mesocone; first lateral shorter, with squarish base; outer and smaller marginals (26th to 51st teeth) serrate as in *Glyphyalinia*.

"As indicated in the foregoing, the low insertion of the penial retractor and consequent demarcation of a free flagellum in *Glyphognomon* appears to be correlated with its shortness and low origin on the diaphragm. In *Glyphyalinia*, the origin of the retractor is always higher and the muscle itself usually passes to the left of the spermoviduct instead of the right; usually, it is relatively longer than in *Glyphognomon* and invariably the total distance from the origin of the retractor to the base of the penis is proportionately greater." (H. B. Baker.)

(*Praecox*, precocious.)

Retinella sculptilis (Bland) **Fig. 151 a.**

Helix sculptilis Bland, 1858, Ann. Lyc. Nat. Hist. of N. Y., 6: 279, pl. 9, figs. 11-13.

Zonites sculptilis Bld., W. G. Binney, 1878, Terr. Moll., 5: 110, pl. 2, fig. P, teeth; 1885, Man. Amer. L. Sh., p. 218, fig. 231.

Vitrea sculptilis Bld., Walker, 1928, Terr. Moll. Ala., p. 83.

Retinella (*Glyphognomon*) *sculptilis sculptilis* (Bland), H. B. Baker, 1930, Proc. Acad. Nat. Sci. Phila., 82: 216, pl. 14, figs. 8-10. Anatomy.

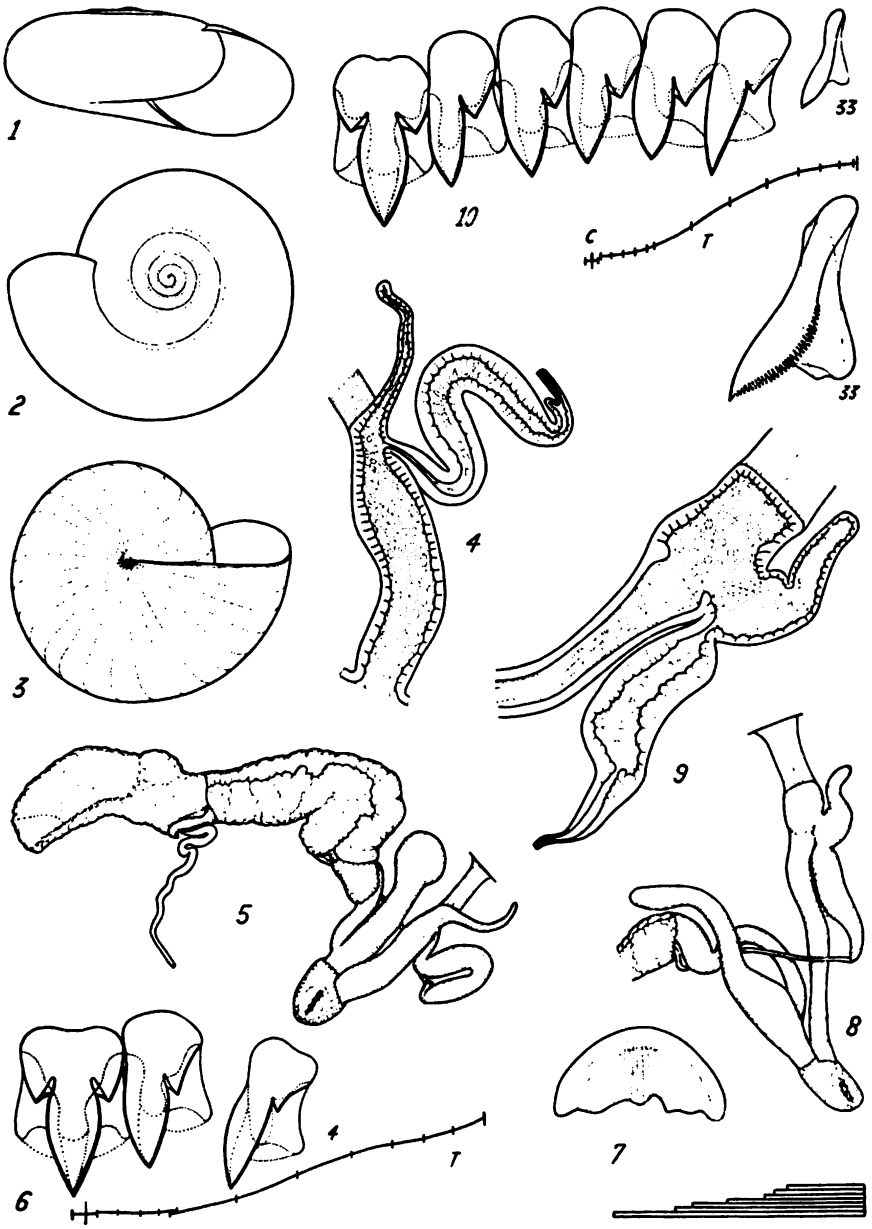

Fig. 150. 1-3, *Retinella praecox* Monroe Co., Tenn., outlines of type shell showing major growth-furrows; 4, penis and accessories. 5, *R. praecox*, dissected genitalia of paratype, ovotestis omitted; 6. radula; 7, jaw. 8, *R. sculptilis*, Monroe Co., Tenn., terminations of genitalia from nearly mature animal; 9, penis (basal half omitted) and accessories; 10, radula: central and all 5 laterals; also 28th marginal (33rd tooth). at same and at greater magnification, and diagram of transverse row. (After H. B. Baker.)

"Shell scarcely perforate, suborbicular, depressed, subpellucid, pale horn color above, of lighter shade beneath, shining, with regular, subequidistant, impressed transverse lines, those on the last whorl extending over the per-

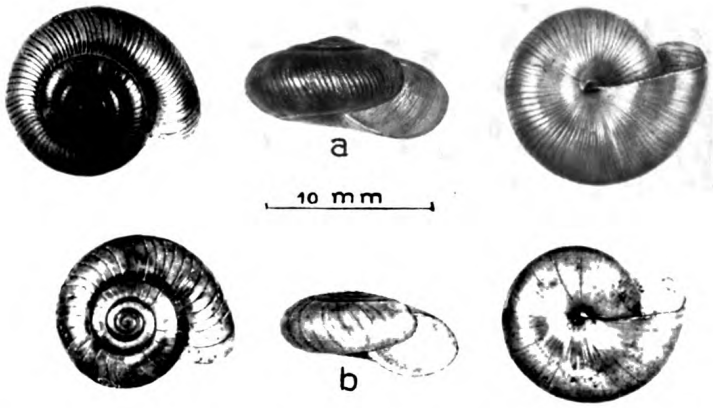

Fig. 151. a, *Retinella sculptilis,* Clay Co. line, North Carolina, 5 miles from Murphy, center figure; near Hiawassee, Towns Co., Georgia, side figures. b, *Retinella carolinensis,* Natural Bridge, Virginia.

iphery, and converging in the umbilical excavation; spire very little elevated, scarcely convex; whorls 7, planulate, the last rapidly increasing, equal at the aperture to ⅓ the diameter of the shell, beneath flattened, and little excavated in the umbilical region; suture lightly impressed; aperture scarcely oblique, depressed, transverse, lunate; peristome simple, acute, sinuate, the columellar margin very rapidly and narrowly reflected over, and almost entirely covering the very small perforation. Diameter maj. 12½, min. 11, alt. 5 mill." (Bland.)

North Carolina: Cherokee, Clay, Graham and Swain counties; Type locality Anantahely (Nantahala) Mountains. Tennessee: Blount, Monroe, Sevier, Polk and Hamilton counties. Georgia: Hiawassee, Towns Co. Alabama: Chambers, Cleburne, Dekalb, Franklin, Jackson, Jefferson, Madison, Randolph, Shelby, Talladega and Tuscaloosa counties.

The typical large form of *sculptilis* is characterized by the crowded radial grooves of which I count 82 on the last whorl of a specimen 12.7 mm. diameter. Usually each groove is preceded and sometimes followed by a slight thickening. On the intermediate whorls weak, close, microscopic spiral striation can usually be seen, but it is generally very weak or wanting on the last whorl. However, some small forms, such as *R. s. subdola,* have close microscopic spirals over the last whorl and base. A shell of this kind from Jennings, Garrett Co., Md., has diameter of 7 mm., 59 grooves on last whorl.

The minute umbilicus is usually about two-thirds covered by the expansion of the columellar lip at its insertion. Dr. Baker writes:

"As in *R. carolinensis*, the giant (typical) form of *R. sculptilis* seems to be developed in the coves at the edge of the mountains and a dwarfed variety in the ranges themselves. Near Tellico Plains, *R. sculptilis* is rarer and more sporadic than *R. praecox*. My one animal, collected during the second week in August in the gorge of the Tellico River, is not quite ripe sexually; its genitalia are still relatively small and slender, although well formed. In the following description, its anatomy is compared with that of *R. praecox* and only salient differences will be noted.

"Animal much larger, with more extensive although similarly located bluish black pigmentation. Ovotestis with more alveoli in each group. Albumen gland still rudimentary. Uterus still slender. Free oviduct (Fig. 150: 8) long and slender. Spermatheca stalk very stout, sac scarcely swollen as yet. Epiphallus (Fig. 150: 9): opening into appendiculate side of penis. Penis consisting of a bipartite apical chamber and a long, slender basal portion; apical chamber bearing a horn-shaped flagellum, internal surface with large, closely packed papillae; basal portion with very thick walls and irregular, longitudinal and oblique, internal folds. Penial retractor short and stout, insertion on apex of main body of apical chamber. Jaw large and heavy. Radular formula (Fig. 150: 10) 30-24-5-1-5-54; 69 rows counted. Central and laterals relatively elongate, with more slender mesocones." (H. B. Baker.)

Retinella sculptilis subdola H. B. Baker Fig. 147: 6-8.

R. (*Glyphognomon*) *sculptilis subdola* H. B. Baker, 1930, Proc. Acad. Nat. Sci. Phila., 82: 217, pl. 12, figs. 5-9.

"Shell brass colored (considerably darker than *wetherbyi*); thinner and more depressed than the small form of *sculptilis*, with more widely spaced radial lines (40 on last whorl of type), which are preceded by much lower growth-thickenings; umbilicus rimate.

"Height 3.32 mm., diameters 6.95 and 6.03 mm.; $5\frac{3}{8}$ whorls." (H. B. Baker.)

TENNESSEE: north slope of Roan Mountain (alt. 3500 ft.) about one mile south of Burbank, Carter Co., Type A.N.S.P. 150604. Also Unicoi Co. (H. B. Baker). NORTH CAROLINA: Avery, Mitchell and Yancey counties. Also (?) MARYLAND: Garrett Co.

"Once noticed, the much more gradual whorl-increase and less voluminous last whorl of this subspecies immediately separate it from *R. carolinensis wetherbyi*, which also occurs around Roan Mountain. Nevertheless, I must confess that my sketch of the type of *subdola* was originally prepared in order to figure an especially fine topotype of *wetherbyi!* The single Maryland specimen resembles *subdola* quite closely, but more and fresher material may show significant differences. My Roan Mt. animals (Aug. 15-25) are still sexually immature but two examples from Limestone Cove (April 6-8) are fully ripe, although one of them is quite small.

"Animal tinged with bluish on top of head; tip of tail quite dark; pedal pore under a short, thimble-shaped projection. Talon (Fig. 147: 9)

clavate. Uterus almost black, relatively long and not markedly attenuate apically. Free oviduct short. Spermatheca sac reniform, relatively small. Epiphallus short and almost sessile; lumen T-shaped. Penis: apical chamber short and broad with very short and inconspicuous flagellum, internally with closely packed papillae; interior of basal portion with weak oblique and stronger longitudinal folds. Penial retractor short and stout. Radular formula (Fig. 147: 5) **43-5-1-5-22-31**; **63** rows counted. Central and laterals broader (bases nearly as broad as long) and with heavier mesocones than typical *sculptilis*." (H. B. Baker.)

Retinella sculptilis junaluskana Clench & Banks Fig. 152.

Retinella (*Glyphognomon*) *junaluskana* Clench & Banks, 1932, Nautilus, 46: 15, pl. 2, fig. 4.

Retinella (*Glyphognomon?*) *sculptilis junaluskana* C. & B., H. B. Baker, 1933, Occas. Pap. Mus. Zool. Univ. Mich. No. 269, p. 6.

Fig. 152. *R. sculptilis junaluskana* (after C. & B.).

"Shell minutely umbilicated, possessing the same general outline and thinness of *R. sculptilis* but only a little more than half the size of that species. Whorls 6, upper half of the shell light amber, basal area shading into yellowish horn. Sculpture consisting of axial grooves, with a beaded riblet on each side. The area in between the riblets is faintly and spirally beaded. Incised spiral lines are present on the earliest whorls. the beaded sculpture only well developed on the last two whorls. On the basal area, the grooves and beaded riblets are as equally well developed and continue into the umbilicus. Height 4.0 mm. maj. diam. 7.5 mm., less diam. 6.7 mm., ap. width 4.6 mm. Holotype" (Clench & Banks).

Paratypes measure: 3.6 mm., 6.5 mm., 6.0 mm., 4.0 mm.; 3.9 mm., 7.3 mm., 6.6 mm., 4.2 mm.; and 3.7 mm., 6.6 mm., 6.0 mm., 3.8 mm.

North Carolina: Wooded slopes of small hill 2½ mi. east of Andrews, Cherokee Co. (G. S. Banks, 1930; Clench, Archer & Rehder, 1931), Type 86429 M. C. Z. Paratypes 157215 A.N.S.P., Univ. Mich. and Banks Coll.

"This new subspecies differs from *R. sculptilis subdola* Baker in possessing a darker color and having an entirely different sculpture. In *R. s. subdola* there is no trace of beading, the axial grooves are wider, and the spiral sculpture is very strong on the last whorl." (Clench & Banks.)

The beading along the thickenings bordering the radial grooves, though too minute to show in the figure, is much coarser and more spaced than in others of the *sculptilis* group, readily distinguishing it. Not yet dissected.

(Named for the Indian chief, Junaluska, who exercised control over the Cherokee Indians of this region.)

MESOMPHIX Rafinesque

Mesomphix Rafinesque, 1819, Jour. de Physique etc., 88: 425, no species mentioned by name.—Férussac, 1821, Tabl. Syst. Limaçons, p. 41, two undefined species mentioned, no. 211, *Helix planorboides* "Raf." and no. 221, *Helix laevigata* "Raf."; both validated by Férussac, 1832.[76]—Herrmannsen, July 1847, Ind. Gen. Malac., 2: 40, *Helix laevigata* designated type.—Beck, 1837, Index Moll., p. 7. —Pilsbry, Proc. Acad. Nat. Sci. Phila., 1911, p. 478.—H. B. Baker, 1930, Occ. Pap. Mus. Zool. Univ. Mich., 220: 24.

Omphix Pilsbry, 1911, Proc. Acad. Nat. Sci. Phila., p. 479. Type *M. inornatus.*

Micromphix Pilsbry, 1911, Proc. Acad. Nat. Sci. Phila., p. 479. Type *M. subplanus.*

The shell of medium to large size is perforate or umbilicate, heliciform, with flat to low-conoidal spire, of 4½ to 5 whorls, the last ample; opaque, of green, yellow or brown color; 1½ embryonic whorls either smooth or radially striate. Aperture lunate, peristome thin and simple.

Pedal grooves single or double; tail rounded, with a caudal pore; dorsal surface from head to mantle without longitudinal grooves; the mantle has small right and left body-lobes. Sole tripartite, in motion showing direct waves in the middle area.

The triangular kidney is about 1½ times the length of the pericardium; secondary ureter closed throughout; the pulmonary vein branches rather freely on both sides.

Jaw strong, yellow to black, vertically striate, having a strong median projection on the cutting edge.

Radula has a tricuspid central tooth, the mesocone projecting well beyond the basal plate; laterals similar to the central but without entocone, or replaced by teeth transitional to marginals. Marginal teeth with long basal plates, with simple cusps of the usual thorn-like shape.

Genitalia opening below the visceral stalk, with penis having terminal retractor or with a continuation beyond it, internally without verge or distinctly developed papilla. Epiphallus usually well differentiated from vas deferens, its entrance into penis from submedian to subapical. Duct of spermatheca of medium length.

Distribution. — Eastern North America from Ontario to Guatemala, in regions of moderate or high humidity, with deciduous forest.

Mesomphix proper is an Appalachian group, though some species (*inornatus, vulgatus*) spread beyond the mountains. It is more specialized anatomically than *Omphalina*, and probably the group arose in the region it still inhabits. The subgenus *Omphalina* extends from Canada to Guatemala, with about 15 species, of which only four plain colored and nearly related forms occur within our limits. Mexican species are much more varied both anatomically and in color, some being conspicuously banded.[77]

---

[76] A. S. Kennard (Proc. Malac. Soc. Lond., 25: 117) gives the generic name as "*Mesomphyx*," probably quoting the folio edition of the Prodrome. In the quarto edition, which alone I have consulted, the name is spelled *Mesomphix.*

[77] Related Mexican forms in which there is no differentiated epiphallus, and a high transverse ridge makes the penial cavity quasi-bicameral, may perhaps better be treated as forming a distinct genus, *Patulopsis* Strebel & Pfeffer. The apical insertion of the penial retractor argues against the view which has been advanced that the upper penial cavity in these forms is epiphallic, since no nearly related snail has the retractor inserted on the epiphallus.

As *Mesomphix* is widely deployed geographically and in climate, and diversified in structure, it is evidently an old group, but fossil forms which have been referred here are so poorly preserved that their generic assignment is mere guesswork.

Omphalina (?) *laminarum* Cockerell. Miocene, Florissant, Colorado.

Omphalina oredontis Cockerell & Henderson. Oreodon beds, Pawnee Buttes, Colorado. May be helicid.

(Μέσος, ομφαλός, middle umbilicus.)

Subgenera and Sections of Mesomphix

A. Penis with terminal retractor; vagina usually with glandular collar, often pigmented. Teeth of a transverse row usually exceeding 100; cusps of central and lateral teeth arising normally, in front of the middle of basal plates. Jaw yellow. Subgenus *Omphalina*

AA. Penis continued beyond insertion of retractor and epiphallus. No dark glandular ring on vagina. Teeth in a transverse row fewer than 100; cusps of central and lateral teeth mainly back of the middle of basal plates. Jaw reddish brown or black, opaque.....Subgenus *Mesomphix*

B. Central tooth of radula with normally proportioned mesocone and ectocones; 2 to 4 laterals with ectocones Flagelliform extension of penis rather long.

C. Whorls of spire and embryo smooth; epiphallus entering penis near insertion of retractor.....Section *Omphix*

CC. Whorls of spire, including last embryonic whorl, striate; epiphallus entering penis well anterior to insertion of retractor....Section *Micromphix*

BB. Central tooth of radula with very narrow mesocone, the ectocones vestigeal; inner side teeth transitional in form to marginal type. Spire, including last embryonic whorl, striate.....Section *Mesomphix, s. s.*

Key to species by shell characters

NOTE.—" Width of spire " is measured from termination of suture across apex to last suture on the other (left) side.

A. Umbilicus a mere perforation or very small, contained more than 12 times in the diameter.

B. Shell very thin and fragile, as in *Vitrina*. Tennessee.....*M. perfragilis*

BB. Shell moderately strong though often thin.

C. Embryonic shell and whorls of the spire nearly smooth.

D. Width of spire distinctly more than half the total diameter. Quebec and Indiana to Kentucky.....*M. inornatus*

DD. Width of spire about half diameter of shell. Southwestern Va. to mountains of East Tennessee and Western N. C.....*M. andrewsae*

CC. Last embryonic turn and whorls of spire strongly striate.

D. Height about half the diameter or less.

E. Width of spire little more than half of the diameter of shell; microscopic papillose spirals present.....*M. latior*

EE. Width of spire much exceeding half of diameter; no fine spirals.....*M. subplanus*

DD. Height decidedly more than half of the diameter.

E. Aperture nearly as high as wide.

F. Smooth between the striae.....*M. rugeli*

FF. Minutely papillose.....*M. r. oxycoccus*

EE. Aperture distinctly wider than high.
F. Closely papillose in spiral lines.....*M. vulgatus*
FF. Weakly or not papillose, more glossy.....*M. perlaevis*
AA. Umbilicus larger, contained from 5 to 12 times in diameter; large, rather globose shells.
B. With microscopic sculpture of papillae in spiral lines.
C. With fine, close growth striae.....*M. pilsbryi*
CC. With low growth wrinkles.....*M. capnodes*
BB. Microscopic sculpture rather indistinct, not of regularly papillose spirals.
C. Umbilicus usually contained 5 or 6 times in diameter; apex worn *M. cupreus*
CC. Umbilicus smaller; apex smooth, polished, whitish and unworn *M. friabilis*

Subgenus MESOMPHIX Rafinesque

The shell form varies from discoidal to moderately elevated, and the umbilicus is always very small or nearly closed.

MESOMPHIX INORNATUS GROUP (Section *Omphix* Pilsbry)

Mesomphix inornatus (Say) Fig. 153.

Helix inornata Say, 1821, Jour. Acad. Nat Sci. Phila., 2: 371 (Pennsylvania).—Binney, 1811, Boston Jour. Nat. Hist., 3: 419, pl. 21, fig. 3; 1851, Terr. Moll., 2: 227, pl. 34.—W. G. Binney, Terr. Moll., 4: 109.—Bland, 1858, Ann. Lyc. Nat. Hist. of N. Y. 6: 352, and 1860, 7: 120.

Zonites inornatus Say, W. G. Binney, Terr. Moll., 5: 108, pl. ii, fig. H, teeth, pl. xi, fig. c, genitalia.—Call, 1900, 24th Ann. Rep. Indiana Dept. Geol. and Nat. Res., p. 375.

Omphalina inornata Say, Walker, 1906, Ill. Cat. Moll. Mich., p. 475.—Sterki, 1907, Proc. Ohio State Acad. Sci., 4: 374.

Mesomphix inornata (Say), Pilsbry, 1911, Proc. Acad. Nat. Sci. Phila., p. 485, pl. 39, fig. 5, teeth.—Brooks, 1935, Ann. Carnegie Mus., 24: 65.—Winslow, 1926, Occas. Pap. Mus. Zool. Univ. Mich., 181: 2.

The shell is perforate, depressed, with low, convex spire; in color ecru-olive, shading into colonial buff on the latter part of last whorl. The surface has a bright gloss, is weakly sculptured with low, inconspicuous growth-wrinkles, and under the microscope shows very minute papillae arranged

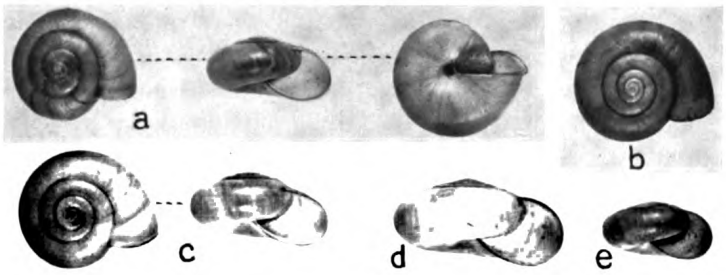

Fig. 153. *Mesomphix inornatus.* a, Neotype, Stoups Ferry, Allegheny Co., Pa.; b, Pine Creek, Indiana Co., Pa.; c, Rock Pt., Lawrence Co., Pa.; d. Burnside, Kentucky; e, Cazenovia, N. Y.

in close spiral series or along faint spiral striae. Whorls about 5, slowly increasing, the last whorl double the width of the preceding, convex below, excavated around the perforation. About $1\frac{3}{4}$ embryonic whorls are often more or less worn, but when perfect are nearly smooth. Aperture rotund-lunate, lined with a white calllus. Lip thin, the columellar termination abruptly dilated close to the perforation.

Height 8.8 mm., diameter 16.6 mm.; 5 whorls. Allegheny Co., Pa.
Height 8.4 mm., diameter 17 mm., Glenwood, Allegheny Co., Pa.
Height 9.5 mm., diameter 17 mm., Glenwood, Allegheny Co., Pa.
Height 8.8 mm., diameter 18.7 mm., Lee Co., Va.
Height 9.8 mm., diameter 20 mm., Pine Mt., Ky.
Height 11 mm., diameter 21 mm., Quicksand, Ky.

QUEBEC: near Hull (Latchford). ONTARIO. VERMONT: Middlebury, according to C. B. Adams. MASSACHUSETTS: Berkshire Co., according to W. G. B.; North Adams and Chester, according to C. W. Johnson. NEW YORK: Allegany, Erie, Hamilton, Herkimer, Livingston, Madison, Monroe, Oneida, Onondaga, Ontario, Orange, Otsego, Rockland, Schuyler, Tompkins, Ulster and Washington counties. NEW JERSEY: Trenton Falls (A. D. Brown). PENNSYLVANIA: Allegheny,[78] Beaver, Cambria, Cameron, Clinton, Fayette, Greene, Indiana, Lawrence, McKean, Mifflin, Potter, Somerset, Sullivan, Warren and Westmoreland counties. MARYLAND: Jennings (W. Stone), and near Bittinger (J. B. Clark), Garrett Co. VIRGINIA: Healing Spring Gap, Bath Co. (P. P. Calvert); Lee Co. (R. W. Jackson); Wytheville, Wythe Co. (Pilsbry). WEST VIRGINIA: Wirt Co. (Clench & Archer). Also recorded by Brooks from Cabell, Greenbrier, Logan, Mercer, Monongalia, Ohio, Pocahontas, Preston, Randolph and Tucker counties. OHIO: Brown and Jefferson counties. Also reported from Cincinnati (Wetherby), Columbus (Moores), Portage and Cuyahoga counties and Akron (Sterki). INDIANA: Lawrenceburg (Billups). Also reported by R. E. Call from Corydon and Madison. KENTUCKY: near Mammoth Cave, Edmonton Co. (C. R. Crosby); Quicksand, Breathitt Co. (W. D. Funkhouser); Burnside, Pulaski Co. (Ferriss); Pine Mt., Harlan Co. (Witmer Stone)

M. inornatus is usually smaller than *M. subplanus* of farther south, and the inner whorls are smooth. It differs from *M. andrewsae* by the spire, which in *inornatus* is decidedly wider in an apical view.

It inhabits wooded country sufficiently hilly to afford moist shaded slopes or ravines, where it lives under leaves and dead wood.

The snail varies in size, this variation being roughly correlated with distribution, the northern form being smaller, diameter 13 to 16 mm. (Madison Co., N. Y.), and those from south of the Ohio River larger, up to 20 mm. or more in some Kentucky lots (Breathitt, Harlan and Pulaski counties); but the transition is gradual, some Pennsylvania lots being intermediate. Otherwise the main variation is in width of the aperture. (1) In what is accepted as typical *inornatus*[79] the last whorl is less expanded, and the aperture narrower, the part falling outside of the preceding whorl (measured on a line from axial termination of lip to periphery) is less than that from outline of preceding whorl to axial insertion of lip (Fig. 153a, neotype, Stoup's Station, Allegheny Co., Pa.). In the other form, (2), the

[78] No definite locality was given by Say, and his type specimen is lost. I am selecting Stoup's Station, Allegheny Co., Pennsylvania as type locality, No. 70219, Fig. 153a, being taken as neotype.

[79] Selected because it is the form figured by Binney 1841, as *inornatus* Say.

last whorl, viewed from above, is wider, and the outer part of the aperture nearly equal to the inner (Fig. 153c, Rock Point, Lawrence Co., Pa.). Further study of both shells and anatomy of these forms seems called for, but as there appears difficulty in assorting some lots by these criteria, the difference observed may not be of racial significance.

Mina L. Winslow, 1926, considered Michigan records of *M. inornatus* erroneous, and its presence in that state " very doubtful ".

There was formerly some difference of opinion about the name of this snail, which may be mentioned briefly here though it is now ancient history. Say's description is somewhat ambiguous. Thomas Bland, 1858, 1860, contended that *Helix glaphyra* Say applied to what we are calling *M. inornatus*, and that *H. inornata* Say was what is now called *M. vulgatus*. However, since *glaphyra* was described from a Philadelphia garden, and *Oxychilus cellarius* is still to be found in the City, while *M. inornatus* is a western Pennsylvanian snail, the identification of *glaphyra* with *cellarius* seems far more reasonable. W. G. Binney wrote: " The testimony of Dr. Griffith is still more conclusive. I have a letter of his to my father in which he says that he *had seen* Say's type of *glaphyra* in the collection of the Academy, and that it was certainly the *cellaria* of Europe. He adds, that when arranging the collection, the shell was broken and thrown aside." If *M. vulgatus* had been before Say when he described *inornatus* he would undoubtedly have noticed the fine striation. Most subsequent authors have followed Dr. Binney's identification of Say's species.

In a snail from Watkins Glen, N. Y., the shell is carried with the axis tilted toward the right about 45°. The back is intensely blue-black, pedal margins gray. The sole is gray, sharply divided into three longitudinal areas, the central paler, the lateral fields closely flecked with white. In movement there are about seven waves, which scarcely extend upon the side areas.

The radula (Fig. 156: 5) has 24, 1, 24 teeth. The tricuspid centrals have an hour-glass-shaped basal-plate and well-developed cusps. There are two lateral teeth, the next two teeth being transitional. Three side teeth have cutting points on the ectocones. The marginal teeth are less crowded than in *M. subplana* or *M. andrewsae*, with shorter cusps than the former.

The number of teeth in a row is much smaller in *M. inornatus* than in any species except *M. vulgatus*. The cusps of the lateral teeth have a bulging outline on the inner side as in *M. andrewsae*, but they are much longer than in that species.

Genitalia (Fig. 154 a-d). The penis is club-shaped with a slender terminal portion or " appendage " nearly as long as the penis proper, the penial retractor inserted at the base of this appendage. Internally the cavity of the penis has transverse and irregular folds near the distal end,

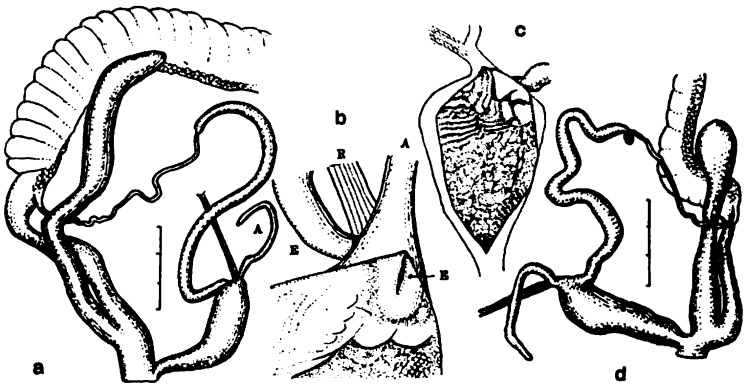

Fig. 154. *Mesomphix inornatus* a, b, Pine Mt., Kentucky. c, d, near Pittsburgh, Pa. Figs. b, c, the penis opened. A, appendage terminating the penis. E, epiphallus and its opening into penis. R, penial retractor. Scale lines = 3 mm.

below which the wall is thinner, with very low, irregular reticulation (Fig. 154 b, c). The long epiphallus enters the penis cavity by a simple orifice not far from that of the terminal appendage. The vagina is very short, free oviduct long but not conspicuously sinuated in those examined. Spermatheca oblong in Pennsylvania specimens examined, short and oval in one from Kentucky. Length of penis exclusive of terminal appendage, 5 mm.; epiphallus 10 mm., diam. of shell 16.7 mm. A specimen from Pine Mountain, Harlan Co., Kentucky (Fig. 154a) has the transverse folds in the distal part of penis cavity rather fleshy.

(*Inornatus*, unadorned, plain.)

Mesomphix andrewsae (Pilsbry) Fig. 155 a, b, c, d, g.

Omphalina andrewsae Pilsbry, 1895, Nautilus, 9: 14; 1900, Proc. Acad. Nat. Sci. Phila., p. 136.—Walker & Pilsbry, 1902, same Proc., p. 430.

Omphalina andrewsae montivaga Pilsbry, 1895, Nautilus, 9: 15.

"Shell allied to *O. inornata* Say in general characters and size. Rich chestnut colored above,[80] opaque buff below [but usually the color is olive lake, somewhat lighter at base], the surface brilliant, polished. Whorls 4½, slightly convex, slowly widening, separated by moderately impressed, margined suture; spire small, very low-convex, its width less than half that of the shell; last whorl very wide, depressed, rounded at periphery, evenly flattened-convex beneath; convex around the deeply indented umbilical perforation. Aperture slightly oblique, elliptical-lunate; interior lined with a heavy white callus which thins out and disappears a few millimeters from the lip-edge; the latter thin, sharp; columellar margin concave, expanded in a minute triangle slightly impinging on umbilicus." (Pilsbry.)

[80] The type lot and some other Thunderhead lots are now naples yellow to buckthorn brown above, naphthaline yellow at base. The darker color before growth-rests which I called "rich chestnut" in the original description, has certainly faded, but I do not know how much. We did not have Ridgway's Color Standards at that time.

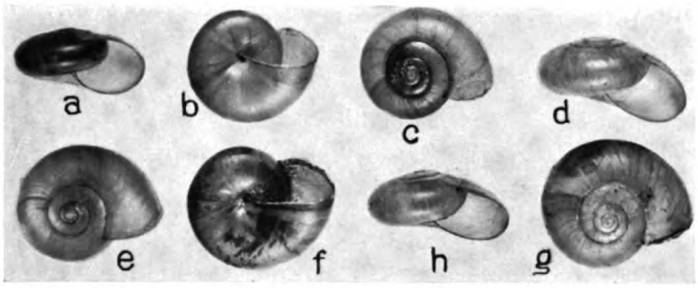

Fig. 155. a, b, c, *Mesomphix andrewsae*, type and topotypes, Thunderhead Mt.; d, g, Jackson Co., N. C.; e, f, *Mesomphix andrewsae montivagus*, Cades Cove; h, type, summit of Thunderhead.

Height 8.5 mm., diameter 16.3 mm. (Type.)
Height 9.1 mm., diameter 17.5 mm.; 5 whorls. Cades Cove, Tenn.
Height 8.7 mm., diameter 17.7 mm.; 5 whorls. Satulah Mt., N. C.
Height 10 mm., diameter 19.3 mm.; Jackson Co., N. C.

VIRGINIA: Spanishburg, Mercer Co. (Clench & Archer). NORTH CAROLINA: Buncombe, Cherokee, Graham, Haywood, Jackson, Macon and Swain counties. Also, according to Walker, "Mt. Mitchell, Wilson's, Potato Top, and Tyson's. Very rare, apparently at about the extreme of its northern range, but quite typical." TENNESSEE: Great Smoky Mountains, generally spread; Type 65733 A.N.S.P. from the summit of Thunderhead. Mt. LeConte Sevier Co.

The umbilical perforation is slightly smaller than in *M. inornatus* and the surface has a higher gloss, but the most conspicuous difference is in the narrower spire. As seen in apical view, the width of the spiral figure is about one-half the diameter of the shell, while in *M. inornatus* the spire is noticeably wider.

At the top of Thunderhead, where the type lot was taken by Mrs. Andrews, and where we found it in 1899, they are a little smaller than in most lower localities. At Nantahala Gorge, Blowing Rock, Swain Co., N. C. large specimens up to 21 mm. diameter were taken by Clench and by Archer. Shells with a dark band above the periphery were occasionally found on Thunderhead, but this band has wholly faded from those collected by us in 1899, though kept in a dark case.

The mantle is not pigmented over the lung. Genitalia (Proc. A.N.S.P. 1900, pl. 37, fig. 11) differs from related forms by the greater length of the spermatheca duct and epiphallus. The penis is strongly swollen near the base and has a rather long terminal appendage. Its retractor muscle is long. The very short vagina is somewhat swollen near the base, but is without glandular area there. Length of penis 3.5; of epiphallus 14 mm.; of of spermatheca and duct 9.5 mm.

The radula (Fig. 156: 4) has 40, 1, 40 teeth, more crowded than in *M. inornatus*. The central and lateral teeth have much shorter, stouter cusps.

There are three lateral teeth, the next two being transitional. The marginal teeth are less slender and graceful than in *M. inornatus*. The radula of *M. andrewsae* most resembles that of *M. inornatus*, but differs by the much shorter cusps and the far greater number of teeth.

Mesomphix andrewsae montivagus (Pilsbry) Fig. 155, e, f, g, h.

Similar in color and bright gloss to *M. andrewsae*, but the aperture is wider and shorter, its height/width index about 66.3 to 74; the basal lip is less arcuate, and the lining of white callus is wanting or reduced to a narrow rim within the lip.

Height 8.8 mm., diameter 17.8 mm.; width of spire 9 mm.; 5 whorls. Type.

Height 9.6 mm., diameter 19.7 mm. Cades Cove.
Height 8.6 mm., diameter 20 mm. Cades Cove.
Height 9.2 mm., diameter 21 mm. Nantahala Gorge.

TENNESSEE: Great Smoky Mountains, Thunderhead at the summit (Mrs. George Andrews and others), Type 65732 A.N.S.P.; also Cade's and other coves, Blount Co. (Ferriss, Pilsbry *et al*); Miry Ridge (G. H. Clapp) Mt. LeConte, Sevier Co. (Clench, Archer). NORTH CAROLINA: Blowing Springs, Nantahala Gap, Swain Co. (Clench). Satulah Mt. near Highlands, 2 mi. southeast of Gneiss, and Black Gap, Macon Co. (Archer).

The different shape of the mouth, much less curved basal lip and lack of white lining differentiate this from *andrewsae*.

In nearly every locality for *montivagus* it was found with *M. andrewsae*. There appears to be no geographic or ecologic separation, but the two usually remain quite distinct by the characters given above. In a lot from Mt. LeConte there are a few somewhat intermediate examples. In *M. inornatus* a somewhat similar diversity has been noted in some districts, but the differences are far less strongly marked. A thorough comparison of the anatomy is needed for an understanding of the relation of *montivagus* to *andrewsae*.

(*Montivagus*, mountain wanderer.)

MESOMPHIX SUBPLANUS GROUP (Section *Micromphix* Pilsbry)

Mesomphix subplanus (Binney) Fig. 157 a, b, c.

Helix sub-plana Binney, 1842, Boston Jour. Nat. Hist., vol. 4, part 1, p. 3 of cover; also 4: 241 (mountainous region of eastern Tennessee); 1851, Terr. Moll. 2: 229. pl. 33.—W. G. Binney, 1857, Proc. Acad. Nat. Sci. Phila., p. 190 (name misspelled "*sulplana*").

Zonites subplanus Binney, 1878, Terr. Moll., 5: 107; 1883, Bull. Mus. Comp. Zool., 11: 139, pl. 2, fig. J, teeth.

Omphalina subplana (Binney), Pilsbry, 1900, Proc. Acad. Nat. Sci. Phila., p. 136.—Walker & Pilsbry, 1902, same Proc., p. 429.—Clench & Banks, 1902, Nautilus, 46: 59.

Mesomphix subplana (Binn.), Pilsbry, 1911, Proc. Acad. Nat. Sci. Phila., p. 483, pl. 37. fig. 9, pl. 39, fig. 1, anatomy.

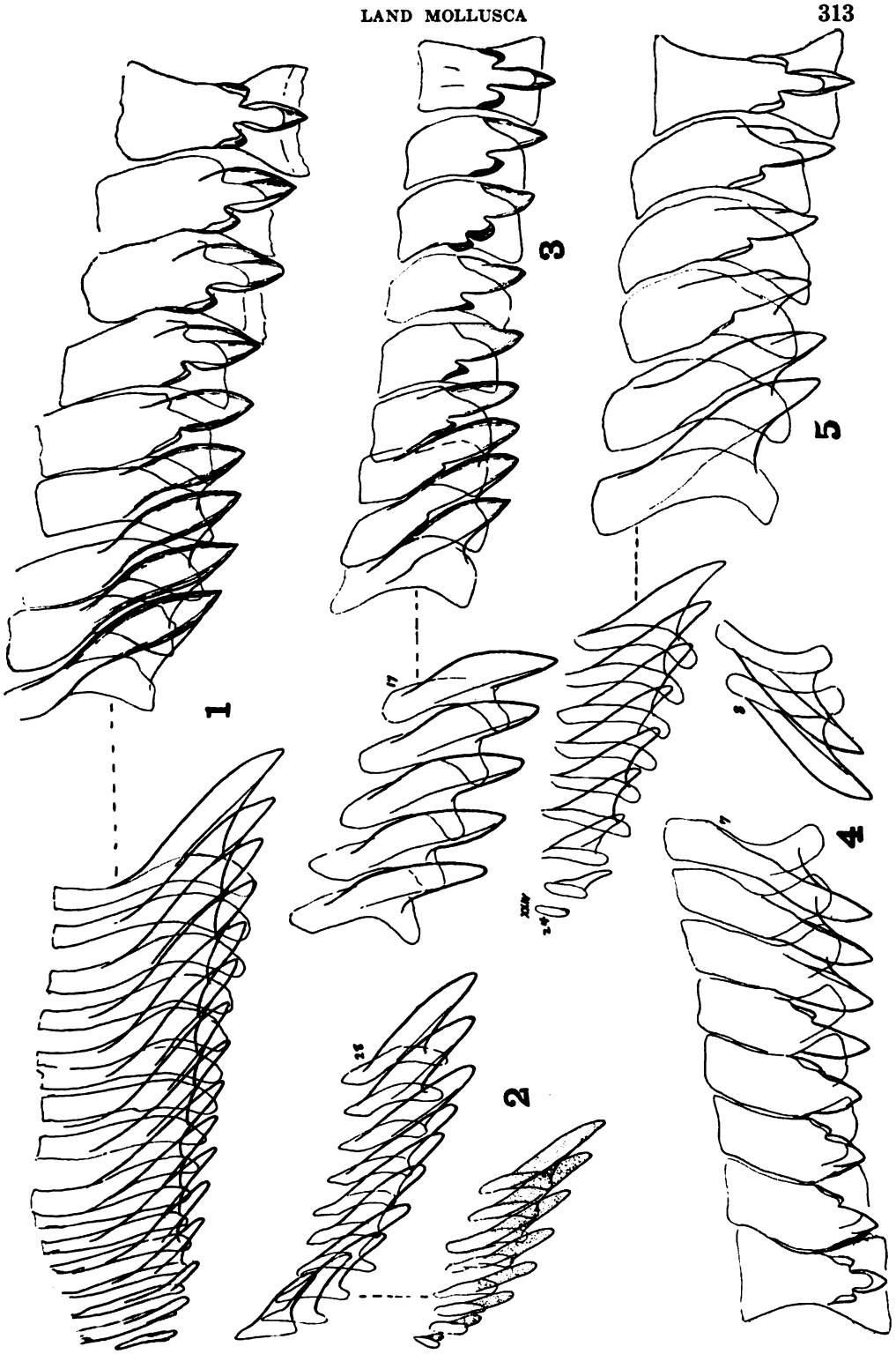

Fig. 156. Teeth of: 1, *Mesomphix subplanus*, Thunderhead Mt. 2, 3, *M. rugeli*, Roan Mt. 4, *M. andrewsae*, Cades Cove 5, *M. inornatus*, Pittsburgh.

"Shell flattened, planulate above and beneath; epidermis brownish or smoky horn-color, shining; whorls five and a half, those nearest the apex striated transversely with very minute and delicate wrinkles; suture distinct, not much impressed; aperture transverse, not expanded, the plane of the aperture making nearly a right angle with the plane of the base of the shell; lip simple, thin, acute; base flattened, umbilical region a little impressed; umbilicus very small, round and deep, not exhibiting the volutions. Greatest transverse diameter less than three-fourths of an inch." (Binney.)

Greater diameter 20, lesser 16, height 6 mill." (W. G. B.)

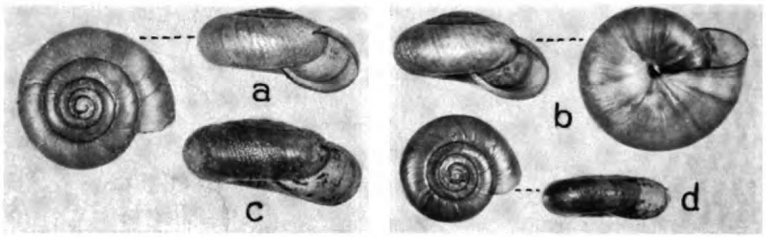

Fig. 157. a, *Mesomphix subplanus,* Thunderhead; b, Cades Cove; c, Limestone Cove; d, *M. subplanus planus,* topotypes

Height 10.6 mm., diameter 22 mm.; 6 whorls. Thunderhead.
Height 9.5 mm., diameter 22.3 mm.; 6 whorls. Unicoi Co.
Height 9.3 mm., diameter 18.7 mm.; 5½ whorls. Bluff Mt., N. C.

TENNESSEE: Limestone Cove, Unicoi Co. (H. B. Baker). Mt. LeConte and the Chimneys, Sevier Co. (Clench & Archer). Clingman Dome, Thunderhead, Cades Cove, and elsewhere in the Great Smoky Mountains (Ferriss & Pilsbry). Valley River Mts. 5 mi. southeast of Andrews, Cherokee Co. (Clench & Banks).

NORTH CAROLINA: Nantahala Mts. and elsewhere in Swain Co. Stratton Bald, Unaka Mts., Graham Co. (H. E. Sargent). Reported by Ferriss from Blockhouse Mt. and Welch Bald, Swain Co., Tuskeegee Creek, Cheoah River, Mt. Hayo, Graham Co. Bluff Mt. and Paint Rock, Madison Co. (Ferriss). Linville Falls, Burke Co. (Maxwell Smith). Mt. Mitchell in Mitchell and Yancey counties. Roan Mt., 2800-3600 ft., Mitchell Co. (A. G. Wetherby). East Fork Pigeon River near mouth, Haywood Co. (S. C. Bishop).

The umbilicus is minute, usually less than 1 mm. wide, but in one lot from Mt. Mitchell it is wider in some specimens, 1.5 mm. in a shell of 19.5 mm. from Mt. Mitchell, others from Mt. LeConte. The shell is glossy, the inner whorls sharply striate, the last two with low wrinkles and no spiral striation. The width of the slightly convex spire decidedly exceeds half of the diameter of the shell.

As in *M. rugeli*, there are two colors, the prevalent coloration being ecru-olive shading into barium yellow on the latter part of the base. The other color is amber brown, usually darker towards the lip, lighter on the spire. Such dark shells are before me from Thunderhead Mt. and Mt. LeConte in Tennessee, Mt. Mitchell and Roan mountain, North Carolina, and, with shells of rather intermediate tint, from some other places. It was an intermediate specimen which Binney described as "brownish or smoky

horn-color" though his colored figure resembles the green form more. He had two specimens collected by Haldeman.

It is generally spread in the Great Smoky Mountains in Tennessee and North Carolina, nearly to the summits. Walker writes that, "This was one of the most abundant species, both at Bluff mountain and Mt. Mitchell. Very large fine specimens were found on the south side of the river at Paint Rock, frequently reaching 22 and 23 mm. in diameter. Both here and at Bluff mountain a peculiar form was found with more convex base, not excavated around the umbilicus, and approaching *O. rugeli* W. G. B. Many of the specimens from these localities were quite green. Found also at Tyson's, Potato Top, Ivy river, Toe river, Wilson's and Cat-tail."

According to Ferriss, the shells were very fragile on the Unaka Mountains; the largest on Mt. Hayo, Graham Co., N. C., measuring 10×24 mm.

This species was reported from "western Pennsylvania, in the mountains" by W. G. Binney, also, on the authority of J. S. Phillips, from northeastern Pennsylvania in Wyoming county, on the Susquehanna River; but this locality appears quite improbable. Its occurrence anywhere in Pennsylvania requires confirmation.

The shells are hard to clean, scarcely ever "pulling" well.

The caudal foss resembles that of *Omphalina pilsbryi*. The penis has a long, slender, flagelliform terminal appendage, 5 mm. in length. Its retractor muscle is long and slender (Proc. A.N.S.P. 1900, pl. 37, fig. 7). Epiphallus 12 mm. long.

The radula examined has 36, 1, 36 teeth (Fig. 156: 1). The basal-plates are very long, the cusps arising far backward, about the middle of the plates, about as in *M. andrewsae* and *M. inornatus*. Two or three teeth on each side may be reckoned laterals, having well-developed side cusps and cutting points; the next is transitional, the rest marginals. The marginal teeth are closely crowded, with long slender cusps, longer than in other species of *Mesomphix*, and more like those of some Omphalinas. Binney found 37, 1, 37 teeth in a Roan Mountain specimen, agreeing in form with my figure except that the basal-plates are a little shorter.

The large number, closely crowded and long cusps of the marginal teeth are characteristic of this species.

Mesomphix subplanus planus Banks Figs. 157 d; 158.

Mesomphix (*Micromphix*) *subplanus planus* G. S. Banks, 1933, Nautilus, 47: 70, pl. 7, figs. 5-7.

"Shell about 18.5 mm. in maj. diam.; discoidal; very thin and translucent; surface shiny, greenish horn color. Whorls 6; quite flat above, but evenly rounded on the body-whorl. Spire completely depressed. Suture slightly indented. Aperture expanding transversely, lunate; peristome simple. The sculpture consists of closely set microscopic radial ridges and

very fine spiral lines, both of which extend, although fading, to the umbilicus. Umbilicus, narrow and deep; showing no whorls, and contained in the shell diam. from 9 to 12 times (the smaller number being for young shells)." (Banks.)

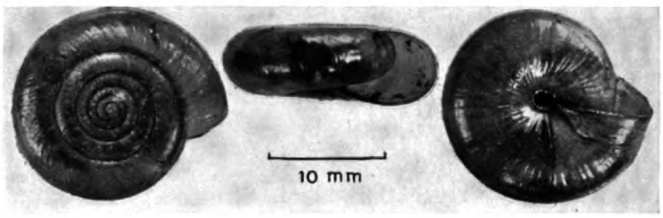

Fig. 158. *Mesomphix subplanus planus,* enlarged (after Banks).

North Carolina: Steps Gap, Mt. Mitchell, Yancey Co., Type 94334 M. C. Z., paratypes 161868 A.N.S.P. (G. S. Banks). Also Black Mountains between Pt. Lookout and Ridgecrest at about 3000 ft. (Banks).

"The main difference between *Mesomphix subplanus* and *M. s. planus* are the discoidal appearance of *planus*, the transversely placed aperture (which is oblique in *subplanus*), and the conspicuous umbilicus (which is even more conspicuous in young specimens). The columella does not tend to cover over the umbilicus in adult specimens, as in *M. subplanus.*

"To further illustrate the difference, I will compare the measurements of the holotype of *M. s. planus*, with a typical specimen (of the same size) of *M. subplanus* from New Found Gap, Great Smoky Mts.

"*M. subplanus*, gr. diam. 18.0, less. diam. 15.9, alt. 8.9, width ap. 8.7, width last wh. at ap. 7.1 mm.

"*M. s. planus,* gr. diam. 18.2, less. diam. 15.7, alt. 6.6, width ap. 8.5, width last wh. at ap. 6.0 mm.

"*Mesomphix s. planus* seems to be confined to high elevations." (Banks.)

It varies from buffy citrine to dresden brown in color, or is sometimes greener, dull citrine. Paratypes measure:

Height 6.5 mm., diameter 17 mm.; 6 whorls.
Height 6 mm., diameter 16.3 mm.; $5\frac{3}{4}$ whorls.

Mesomphix rugeli (W. G. Binney) Fig. 159 a, b.

Zonites rugeli W. G. Binney, 1879, Ann New York Acad. Sci., 1: 357, pl. 15, figs. H (shell), I (teeth), pl. 14, fig. D (genitalia); reprinted in Bull. Mus. Comp. Zool., 11: 138, pl. 2, figs. H, I, pl. 3, fig. D.

Mesomphix rugeli (W. G. Binn.), Pilsbry, 1911, Proc. Acad. Nat. Sci. Phila., p. 484, pl. 37, fig. 9 (genitalia), pl. 39, figs. 2, 3 (teeth).

Zonites inornatus var., W. G. Binney, 1878, Terr. Moll., 5: 109, fig. 27.

"Shell depressed globose, perforated, thin, delicately wrinkled, the apical whorls sometimes striate, greenish horn-colored, dark smoky above;

spire slightly elevated, apex flat; whorls 6, slightly rounded, the last globose, scarcely excavated at the perforation; aperture large, rounded, oblique; peristome simple, thin; ends slightly approaching; the columellar one scarcely broadened. Diam., larger 19; lesser 15; height 9 mill." (W. G. B.)

Height 13 mm., diameter 21 mm., width spire 12 mm.; 5½ whorls. Roan Mt.

Height 12.6 mm., diameter 22.1 mm. Roan Mt.
Height 12 mm., diameter 19.5 mm. Unicoi Co., Tenn.
Height 10.8 mm., diameter 12.4 mm., 5⅓ whorls. Near Pulaski, Va.
Height 9 mm., diameter 16 mm., 5½ whorls. Bluff Mt., N. C.

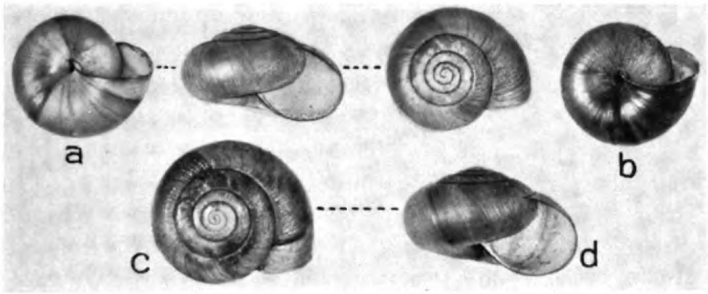

Fig. 159. a, *Mesomphix rugeli*, Roan Mt.; b, top of fir belt, Roan Mt. c, *M. rugeli oxycoccus*, apical view of paratype and d, face of type.

VIRGINIA: 12 mi. s. w. of Pulaski, Wythe Co. (Clench & Archer). NORTH CAROLINA: Roan Mountain (Mrs. George Andrews, A. G. Wetherby *et al.*). Type locality. Bend Creek Exper. Forest, Stokes Co. (A. P. Jacot.). TENNESSEE: North side Roan Mt., Carter Co. and Limestone Cove, Unicoi Co. (H. B. Baker). Road to Cloudland, Roan Mt., 4000 to 5000 ft. (S. N. Rhoads).

M. rugeli is a very distinct species by the shape of the shell, and also by the short form of the central teeth and the comparatively large number of lateral and marginal teeth. It resembles *M. subplanus* by having the inner whorls of the spire heavily striate (or finely costulate), but it differs by being far less depressed, the last whorl much more capacious. After the smooth initial third of a whorl, the apex has fine radial rib-striae on the second whorl, then becoming coarser, regularly placed riblets, after which there is rather strong but irregular wrinkle-striation on the later whorls; the glossy base being less strongly striate. There is no spiral striation. In a lot from Unicoi Co., Tenn. the first third to half of a whorl is smooth, then well-spaced radial grooves appear. These become very short on the first half of the second whorl, then longer and gradually stronger. But the details vary somewhat individually in different lots examined. The summit is usually worn in adult shells.

On Roan Mountain there are two color-forms, the usual tint being ecru-olive or a little greener, shading into olive-ocher on the latter part of the last whorl; this being the usual coloration of *rugeli* throughout its area. There is also on Roan Mt. a dark form, amber brown, shading into nearly black near the aperture, and in many specimens the color fades to tawny-olive or buckthorn brown on the spire and front of the last whorl. One of these dark shells is illustrated in Fig. 159b, from a lot of 14 collected by S. N. Rhoads at " top of the fir belt "; all are dark, diameter up to 19.4 mm.

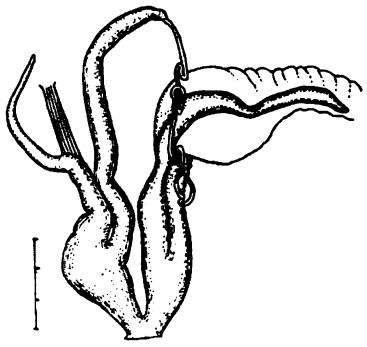

Fig. 160, *Mesomphix rugeli*, Roan Mt., anterior parts of genitalia. Scale line = 3 mm.

In *M. rugeli* (Fig. 160, Roan Mt., shell 20 mm. diameter) the extension of penis beyond retractor is longer than in *monticola*, and as in that, the entrance of epiphallus into penis is remote from the insertion of the penial retractor. The male organs do not differ materially from *M. subplanus*. Length of penis 8, epiphallus 9.5 mm.

The radula examined (Fig. 156: 2, 3) has 41. 1. 41 teeth, of which about 4 or possibly 5 on each side are laterals, with well-developed ectocones. The central tooth has a wider, shorter basal-plate than in allied species, more like that of *Omphalina*. The intermediate marginal teeth are rather stout and ungraceful (fig. 3, left side). The outer ones decrease rapidly to the outer edge of the radula (fig. 2). The radula figured has an abnormal row of teeth on one side, the second lateral having a double ectocone. The teeth are all shorter than in *M. subplanus*. Binney records 38. 1. 38 teeth, with 4 or 5 laterals.

(Named for Ferdinand Rugel, 1806-1878, a country doctor who collected plants and shells, and according to Mrs. Andrews, first found this snail.)

Mesomphix rugeli oxycoccus (Vanatta) Fig. 159 c. d.

Omphalina rugeli oxycoccus Vanatta, 1903, Nautilus, 16: 106.

Mesomphix rugeli oxycoccus (Vanatta), Pilsbry, 1911, Proc. Acad. Nat. Sci. Phila., p. 484.

The shell differs from *rugeli* by having a microscopic sculpture of closely crowded, papillose spirals on the upper surface; base nearly smooth, as in typical *rugeli*.

Height 14.4 mm., diameter 22.5 mm., 6 whorls. Type.
Height 15 mm., diameter 21.7 mm., 5¾ whorls. Cranberry.
Height 12 mm., diameter 20.4 mm., Banners Elk.
Height 12.7 mm., diameter 20 mm., Banners Elk.

North Carolina: Cranberry, Avery Co. (H. W. Wenzel, H. Skinner, Mrs. Geo. Andrews), Type 68743 A.N.S.P. Banners Elk, Watauga Co. (Mrs. Andrews).

(*Oxycoccus*, a cranberry.)

Mesomphix vulgatus Group (Section *Mesomphix* s. str.)

Species which differ rather widely in genitalia are grouped together in this section on account of the similarity of dentition and shells. They differ mainly by the form and position of the appendage or extension of the penis, and the place of entrance of the epiphallus, thus:

I. Extension of penis beyond insertion of retractor extremely short and blunt; entrance of epiphallus subterminal (Fig. 167).....*M. vulgatus*

II. Extension of penis shortly flagelliform; epiphallus entering lower down (Fig. 164) *M. latior monticola*

III. Extension of penis very small, lateral on penis, well anterior to insertion of retractor; epiphallus inserted laterally, still farther forward. (Fig. 162)..*M. perlaevis*

Mesomphix perlaevis (Pilsbry) Fig. 161 a-c.

Omphalina laevigata perlaevis Pilsbry, 1900, Proc. Acad. Nat. Sci. Phila., p. 135.

Mesomphix laevigata perlaevis (Pils.) Pilsbry, 1911, same Proc., p. 482.

Mesomphix perlaevis perlaevis (Pilsbry), H. B. Baker, 1933, Occas. Pap. Mus. Zool. Univ. Mich., 269: 7.

The shell is thin, depressed, height about 55 per cent of the diameter; minutely umbilicate, the umbilicus contained about 17 times in diameter. Of a dilute olive lake tint, fading to near barium yellow at the base. The surface is glossy, with short regular radial grooves after the smooth initial half whorl, the grooves longer, extending across on the second whorl, third

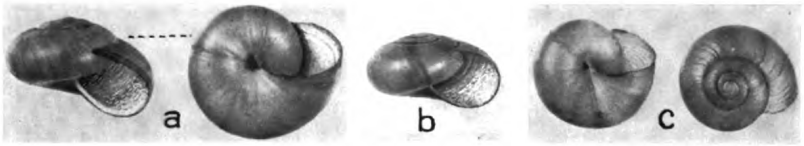

Fig. 161. *Mesomphix perlaevis*. a, Pine Mountain, Kentucky. b, c, type and paratypes, Tallassee Ford, Tennessee.

whorl strongly striate; on the last whorl the striation becomes weaker, passing into low, irregular growth wrinkles, and without distinct spiral sculpture, but under a high power, faint, close, smooth spirals appear in places, but are often wanting. The base is slightly smoother, strongly convex. The aperture is slightly wider than high, lunate, with a thin white lining; the lip is sharp, dilated near columellar insertion, as usual.

Height 9.7 mm., diameter 17.6 mm.; width of spire 9 mm.; $4\frac{1}{2}$ whorls. Type.

Height 12 mm., diameter 18.7 mm. Presly, Ga.

Height 11.8 mm., diameter 20.2 mm. Presly, Ga.

Height 11.8 mm., diameter 20.7 mm.; $4\frac{3}{4}$ whorls. Topton, Macon Co., N. C.

Height 12.2 mm., diameter 20 mm.; $4\frac{3}{4}$ whorls. Burnside, Ky.

TENNESSEE: Tallassee ford of the Little Tennessee River, Monroe Co., Type and paratypes 77737 A.N.S.P. Ten miles north of N. C. line, Blount Co. (Archer). Seven miles east of Smithville, De Kalb Co. (Pilsbry). KENTUCKY: Burnside, Pulaski Co. (Ferriss). Pine Mountain, Harlan Co. (Witmer Stone). NORTH CAROLINA: Black Mountains (Hemphill). Near Topton, Macon Co. (Archer). Murphy, Cherokee Co. (Archer). Cheoah River, Graham Co. (Ferriss).

This species has a more glossy shell than *M. vulgatus*, with much less regular and smoother striae, and typically such spirals as are visible in places are smooth, though in some lots minutely papillose striae (as in *M. latior*) are weakly developed. It is strongly characterized by the structure of the genitalia. The teeth (in a Pine Mountain example) do not differ materially from those of *M. latior monticola;* formula 21.1.21.

Mr. Ferriss, who collected the type lot, unfortunately did not save the soft parts, so that these are known only from other localities. Some lots recorded in the distribution paragraph stand in need of verification by anatomic structure, as there is occasional intergradation with *M. l. monticola* in microscopic sculpture of the shell.

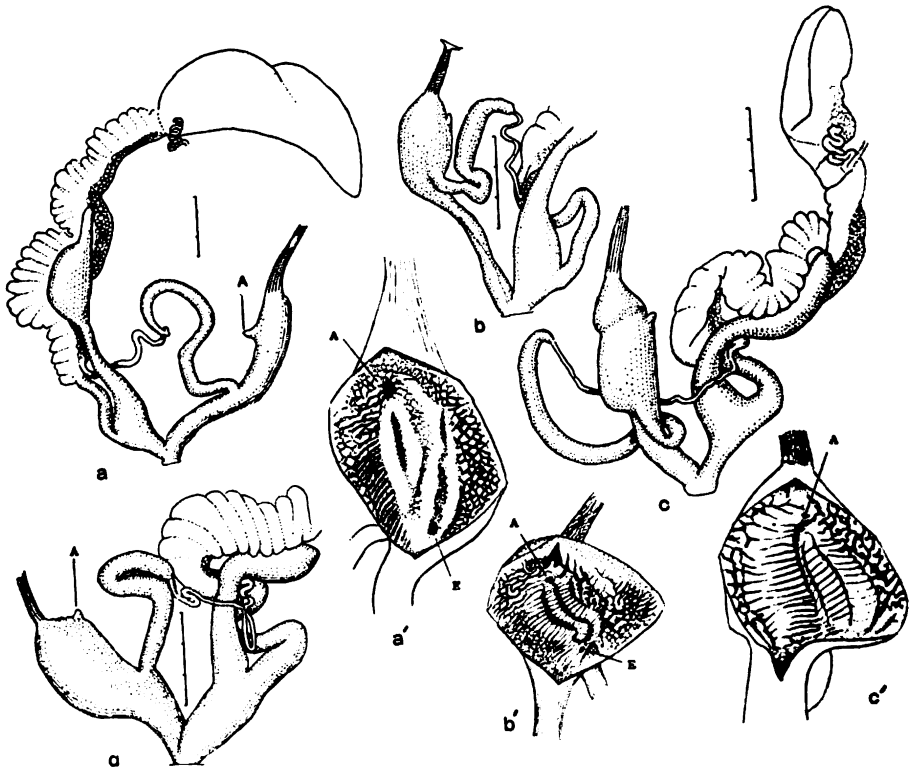

Fig. 162. *Mesomphix perlaevis.* a, a′, Pine Mt., Kentucky. b, b′, d, Tellico Gorge. Tennessee. c, c′, lower 3 miles of Tellico Gorge. A, appendage of penis, and its opening into penis. E, opening of epiphallus. Scale lines = 3 mm.

Genitalia (Fig. 162): The penis is very broad in the distal half, narrower anteriorly, the quite short retractor terminal. The appendage (which in other species is terminal and extends beyond the penial retractor) is reduced to a small lateral spur (marked A in figs. 162 a and d), remote from the insertion of the retractor. The epiphallus enters below the middle of the penis. Inside (Figs. 162 a′, b′, c′) there are several low, transversely grooved ridges between the orifices of the appendage and the epiphallus. The duct of the spermatheca is strongly swollen basally. The free oviduct is rather short.[81]

M. perlaevis was not well named. It may be " very smooth " in comparison with *M. vulgatus*, and it is glossier, but many other mesomphices are smoother.

Mesomphix latior (Pilsbry) Fig. 163 a-c.

Omphalina laevigata latior Pilsbry 1900, Proc. Acad. Nat. Sci. Phila., p. 135.—Ferriss, Nautilus, 14: 56.

Mesomphix laevigata latior Pilsbry, 1912, Proc. Acad. Nat. Sci. Phila., for 1911, p. 482.—Wheeler, 1911, Nautilus, 25: 125.—Walker, 1928, Terr. Moll. Alabama, p. 73.

The shell is perforate, strongly depressed, the height about half of the diameter, the spire narrow, not much exceeding half of the diameter, the last whorl (in apical view) wider than in *M. vulgatus*, base excavated around the perforation. Color ecru-olive with some darker and lighter streaks, usually becoming colonial buff near the aperture. The base is glossy, upper surface slightly duller. First half whorl smooth, next half with radial riblets, at first short, but becoming longer, and somewhere on the following whorl reaching to the lower suture; third whorl with finer close

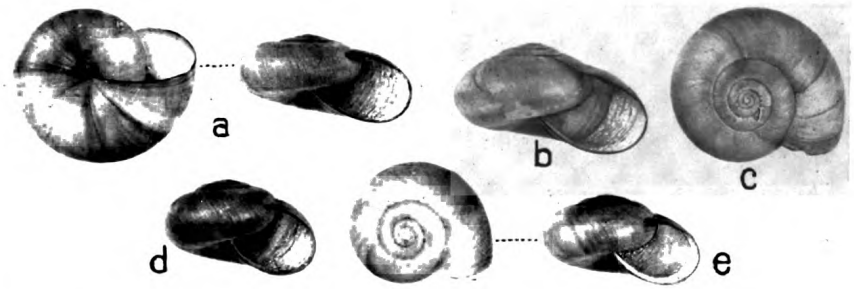

Fig. 163. *Mesomphix latior.* a, type and paratype; b, near Jasper, Tenn.; c, Blowing Spring, N. C. d, e, *Mesomphix latior monticola,* type and paratypes.

radii; on the last 1½ whorls these thread-like striae give place to rather coarse, low, uneven wrinkles of growth, with a microscopic sculpture of

[81] W. G. Binney's description and figures of the genitalia of *"Zonites laevigatus"* (Proc. Acad. Nat. Sci. Phila., 1874, p. 39, pl. 3, fig. 10, apparently the same preparation redrawn in Terr. Moll., 5, pl. xi, fig. E) appear to represent *M. perlaevis.* The organ he marked *d. s.* is the penis; the lower *r* in his figure being the penial retractor and the upper *r* I take to be the appendage which is marked A in my figures. Probably he did not see all of the spermatheca, as it may be more or less covered by the uterus. The locality of the specimen he dissected was not given.

close, papillose spiral lines. The aperture is decidedly wider than high, with a white lining.

Height 12.5 mm., diameter 24 mm.; 5 whorls. Type.
Height 13.2 mm., diameter 25 mm. Paratype.
Height 15.5 mm., diameter 28 mm. Paratype.
Height 12 mm., diameter 24.4 mm. Nantahala Mt., N. C.
Height 10.7 mm., diameter 22.5 mm.; 4¾ whorls. Jasper, Tenn.

TENNESSEE: Tallassee ford of Little Tennessee River, Monroe Co. (Ferriss), Type and paratypes 77736 A.N.S.P. Fullerton Bluff and Prior Cove, near Jasper, Marion Co. (H. B. Baker). NORTH CAROLINA: Chamber's Church, on Little Tennessee River at junction of Chamber's Creek (Ferriss). Blowing Springs, Nantahala Mt. (W. J. Clench). ALABAMA: according to B. Walker, Ft. Payne and Lookout Mt., DeKalb Co.; Monte Sano, Madison Co.

The depressed shape and broad last whorl as well as the wrinkled, rather than thread-striate surface of the last whorl, as in *perlaevis*, distinguish this from *vulgatus;* moreover, the papillose spirals are more minute. It differs from *perlaevis* by the depressed shape, wide aperture and larger basal excavation around the perforation.

The microscopic sculpture is fainter in the specimens from near Jasper, Marion County.

Mesomphix latior monticola Pilsbry Fig. 163 d. e.

Omphalina laevigata (specimens from Great Smoky Mountains) Pilsbry, 1900, Proc A. N. S. Phila., p. 135.

Mesomphix laevigata monticola Pilsbry, 1911, Proc. Acad. Nat. Sci. Phila. for 1910, p. 480, figs. 6, 7; pl. 37, fig. 10, anatomy.—Walker, Terr. Moll. Alabama, p. 73.

The shell is similar to *M. perlaevis* but more depressed, the base less convex around the umbilicus and the aperture wider. The spire is small, but a little more than half of the diameter. Striation of early whorls as described for *perlaevis* and *latior;* on the last whorl the striation becomes lower and less regular than in *vulgatus,* but stronger than in *perlaevis.* Microscopic papillose spiral lines are extremely minute, and weaker than in *latior.* Aperture distinctly wider than high, with a white lining or a wide rim within.

Height 11.4 mm., diameter 20.5 mm.; 4¾ whorls. Type.
Height 10.6 mm., diameter 20.8 mm. Cades Cove.

TENNESSEE: Great Smoky Mountains, Thunderhead; Cades Cove at about 2000 ft., and the adjoining Sugar Cove, Blount Co., Type and paratypes 71367 A.N.S.P. (Ferriss & Pilsbry). On the Little Tennessee near Tallassee Ford (Ferriss). Ridge at Kimball, Marion Co. (Clench & Archer). Dove, Marion Co. (H. B. Baker). NORTH CAROLINA: Macon Co. (W. G. Binney). GEORGIA: Presly, Towns Co. (Jesse White). ALABAMA: Horseblock Mt., Talladega Co., according to Walker.

This shell has the sculpture of the larger *M. latior*, and is therefore believed to be conspecific; and indeed its separation as a subspecies appears doubtful in view of the series of shells now in hand. However, it is still retained since it is this smaller form which has been dissected, the larger typical *latior* remaining unknown anatomically.

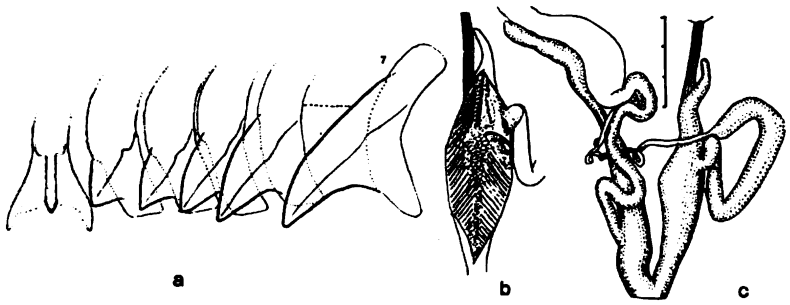

Fig. 164. *Mesomphix latior monticola*, Cades Cove; a, teeth, b, c, opened penis and anterior parts of genitalia. Scale line for fig c = 3 mm.

Anterior parts of genitalia of specimens from Cades Cove, Blount Co., Tenn., July 25, 1899, are drawn in Fig. 164 b, c. The fusiform penis tapers into the short terminal appendage above the insertion of the very short penial retractor. The epiphallus is slightly longer than the penis, and inserted in the latter some distance below the insertion of the retractor, somewhat as in *M. rugeli*. The free oviduct is much longer than in *rugeli*. Length of penis 8 to 8.5 mm., epiphallus 10 mm., vagina 2 or 3 mm., spermatheca and duct 9 to 10 mm.

M. latior and the form *monticola* were formerly thought to be subspecies of *M. laevigatus* (= *vulgatus*), but *monticola* differs by the longer terminal extension of the differently shaped penis, which is less conspicuously rugose within.

The radula of a specimen from Cades Cove has 19.1.19 teeth (Fig. 164a). The central tooth has a very narrow cusp with a minute cutting point. There are only low vestiges of side cusps, without cutting points. The inner side teeth are " transition teeth," with short, wide, obliquely conic cusps, a sinuation marking the place of ectocones. Farther out, the cusps are strictly aculeate, but rather short and stout.

The caudal pit is an irregular curved fissure, partly surrounding a median areole (fig. 165).

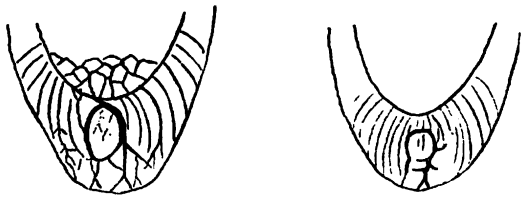

Fig. 165. *Mesomphix latior monticola*. End of foot and tail-pit of two individuals from Cades Cove, Tenn.

Mesomphix vulgatus H. B. Baker Fig. 166, a, b.

Helix laevigata Rafinesque; Mesomphix laevigatus, Férussac, 1821, Tabl. Syst. Limaçons, p. 41, No. 221 (Kentucky), nude name; 1832, Hist. Nat. Moll. terr. fluv., pl. 82, fig. 6 Expl. Pl. p. iv.—Deshayes, 1850, Hist., p. 94. Not *Helix laevigata* Linnaeus, 1766, Syst. Nat., edit. 12, p. 1250.

Zonites laevigatus Pfeiffer, W. G. Binney, 1878, Terr. Moll., 5: 102, (?) pl. ii, fig. F, teeth, not pl. xi, fig. E, genitalia.

Mesomphix laevigata Rafq., Beck, 1847, Index Moll., p. 7, based on Férussac, Hist., pl. 82, f. 6.—Pilsbry, 1911, Proc. Acad. Nat. Sci. Phila., p. 480.—Daniels, 1901, Indiana Dept. Geol. and Nat. Res., 26th Ann. Rep., p. 588.

Helix lucubrata Say, Binney, 1851, Terr. Moll., 2: 225, pl. 32. Not of Say.

Mesomphix perlaevis vulgatus H B. Baker, 1933, Occas. Pap. Mus. Zool. Univ. Mich., 269: 7. New name for *H. laevigata* Fér. and *H. lucubrata* Binney.

The shell is very narrowly umbilicate, depressed, with low spire. Color of base ecru-olive shading into colonial buff streaks, the upper surface tawny olive with indistinct cinnamon-brown streaks, or uniform cinnamon-brown, or similar in color to the base. Surface glossy at base and to a varying degree above; finely and evenly striate, the striae extending over the

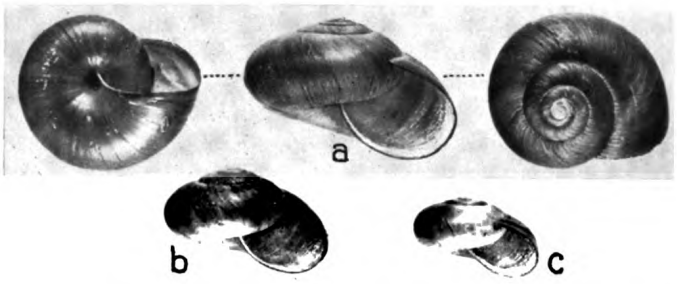

Fig. 166. a, *Mesomphix vulgatus*, Tuscaloosa Co., Alabama. b, Grand Chain, Indiana. c, *M. v. hartwrighti*, type, Marianna, Florida.

periphery but fading out on the base, which has low growth wrinkles only. Over this sculpture on the last whorl there is a micro-sculpture of close, minutely papillose spiral threads, which on the base are weak or wanting.

Height 14 mm., diameter 21.3 mm.; 5 whorls. Posey Co., Ind.
Height 12.5 mm., diameter 20 mm.; $4\frac{2}{3}$ whorls. Charlestown, Ind.
Height 14.4 mm., diameter 23.7 mm. Wyandotte, Ind.
Height 14.5 mm., diameter 21.4 mm.; $5\frac{1}{4}$ whorls. Cross Co., Ark.
Height 17.5 mm., diameter 27.8 mm.; $5\frac{1}{3}$ whorls. Tuscaloosa Co., Ala.

PENNSYLVANIA: Johnston, Cambria Co. (J. B. Clark). Ohiopyle, Fayette Co.; Laurel Ridge and White Creek, Somerset Co. (Stew. Brown). MARYLAND: Cumberland (H. Shriver). OHIO: Cincinnati, and Akron, Summit Co., according to A. G. Wetherby. INDIANA: Clark Co. (A. F. Archer, L. E. Daniels), Crawford Co. (Daniels), Dearborn Co. (Billups), Franklin, Jackson, Posey and Perry counties (Daniels). ILLINOIS: Saline, Gallatin, Pope and Hardin counties, according to F. C. Baker, Fieldbook Ill. L. Sn. p. 68. KENTUCKY: Nicholas Co. (Sterki) Mammoth Cave, Edmonson Co. (Rhoads, Clark). Breathitt Co. (Funkhouser). Franklin Co. (Rhoads). Warren Co. (Sadie F.

Price). High Bridge of the C. S. RR., Pulaski Co., according to Wetherby. TENNESSEE: Bledsoe, Blount, Carter, Davidson, Hamilton, Marion, Monroe, Polk, Roane, Sevier, Shelby, Unicoi and Washington counties. NORTH CAROLINA: Cherokee, Macon, Swain and Watauga counties. SOUTH CAROLINA: McCormick Co. (A. P. Jacot). GEORGIA: Burke, Murray, Muscogee, Rabun and Stewart counties. FLORIDA: Tallahassee, Leon Co. (Van Hyning). St. Augustine (T. Bland). ALABAMA: Baldwin, Bibb, Blount, Chilton, Clark, Cleburne, Colbert, Conecuh, Coosa, DeKalb, Elmore, Etowah, Franklin, Hale, Jackson, Jefferson, Lee, Madison, Marion, Marengo, Montgomery, Randolph St. Clair, Sumter, Talladega, Tuscaloosa and Washington counties. Reported by Bryant Walker also from Barbour, Calhoun, Chambers, Cherokee, Choctaw, Clay, Cullman, Dale, Dallas, Fayette, Geneva, Greene, Lauderdale, Macon, Mobile, Monroe, Pike, Perry, Shelby, Walker and Wilcox counties. ARKANSAS: St. Francis River, Cross Co. (A. W. Clime). Near Forest City, St. Francis Co. (Archer). Near Menard Landing, Arkansas R., Arkansas Co. (C. B. Moore). LOUISIANA: Lake Charles, Calcasieu Parish (Pilsbry, Shimek). Jefferson Island, Iberia Parish (H. G. Richards). Near Jones, Morehouse Parish, and Dailey Landing, Boeuf R., Franklin Parish (C. B. Moore).

Daniels reports finding this species in dry upland woods, under logs.

In typical *M. p. vulgatus* the clear-cut, even striation extends to the lip, the micro-sculpture of minute papillae in spiral lines is close and distinct, upper surface being somewhat dull or semimatt, and the base glossy. The height/diameter index of the shell is about 62 to 66. It is typically developed throughout Alabama, also Georgia, parts of Tennessee, Kentucky and Indiana, and west of the Mississippi in Arkansas. In Louisiana the shells are typical except for their smaller size, diameter 16-17 mm., and weak spirals. In parts of Kentucky, Tennessee and North Carolina there are forms rather intermediate between *vulgatus* and *monticola*. These need further collecting and study before the geographic limits of the typically very distinct *vulgatus* can be assigned.

M. perlaevis vulgatus was a new name for *H. laevigata* Fér. (known by the figures of Férussac and the later works of Deshayes and W. G. Binney), and for *H. lucubrata* of Binney. Whether the types of these authors could be found now is doubtful, but all seem to apply to one form, and the shell figured by Férussac becomes the type of *vulgatus*. The locality of this specimen is Kentucky, collected by Rafinesque. Living examples should be collected, preferably from the neighborhood of Lexington, where Rafinesque lived, and the anatomy investigated. While shells seen from this district do not differ materially from Alabama specimens, the identity should be confirmed by anatomic comparison of topotypes.

The anatomy of examples from anywhere near the type locality is not known. Genitalia and teeth of specimens from Wetumpka, Alabama, are drawn in Fig. 167 a-e. The rather short, club-shaped penis has a very short, blunt, conic extension beyond the insertion of the penial retractor, the epiphallus entering at the base of this conic extension. The epiphallus is more than twice the length of the penis. The free oviduct is moderately long, but shorter than in *M. latior monticola*.

The radula drawn (Fig. 167 e) has 20-1-20 teeth. Centrals have a long very narrow mesocone and vestigeal ectocones without cutting points. There are no true laterals, the inner side teeth being transitional to the marginal

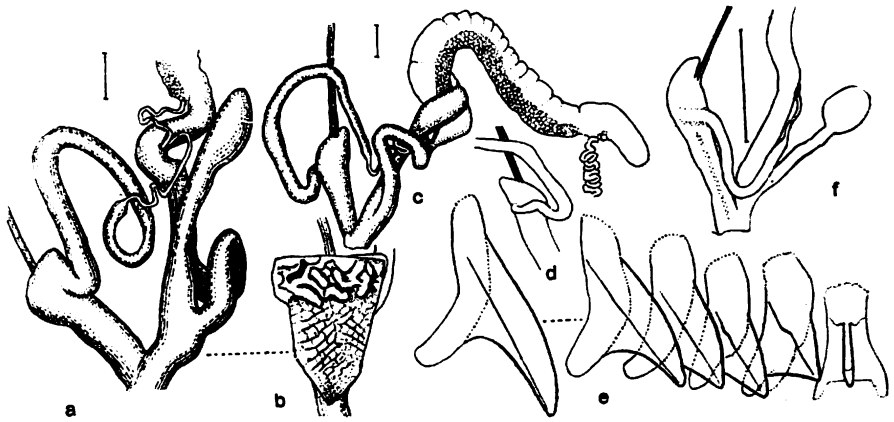

Fig. 167. *Mesomphix vulgatus*, Wetumpka: a, b, c. genitalia of two individuals. b. opened penis. d, upper side of penis of c e, teeth. f, genitalia of half-grown *M. v. hartwrighti*, Tick Island. Scale lines = 1 mm.

type, but with a short, very stout cusp; two teeth show a sinuation in place of the ectocone. Marginals with strong, simple cusps.[82]

Form *hartwrighti* (new form), Fig. 166c, has the shell small, with striation typical of *vulgatus*, but with the microscopic spiral lines weak, either indistinctly papillose or smooth, and often largely obsolete.

Height 9.5 mm., diameter 16.5 mm., 4¾ whorls. Marianna. Type.
Height 9.2 mm., diameter 14.3 mm., 4⅔ whorls. Near Marianna.
Height 10.6 mm., diameter 17 mm., 5 whorls. Tick Island.

FLORIDA: Marianna, Jackson Co. (C. W. Johnson), Type 77943 A.N.S.P. Quincy, Gadsden Co. (Van Hyning). Jackson's Bluff of Ocklocknee R. (C. W. Johnson), and Tallahassee (Van Hyning), Leon Co. Ichatucknee R., Suwannee Co. (Van Hyning). Tick Island in the St. Johns River, Volusia Co. (Johnson & Pilsbry).

This small race (or perhaps the ecologic form of a region of low calcium carbonate supply) occurs in northern Florida and as far south as Volusia County. It was first found by Berlin Hart Wright, and was named but not published by Dr. Wesley Newcomb.

It should be noted that typical *vulgatus* from Tallahassee, Florida, measuring 13.8 x 21 mm., 5½ whorls, has been sent by Van Hyning, and there is an old "St. Augustine" specimen in the collection, from Bland.

A quite young specimen (Fig. 167 f, shell of only 3¾ whorls, Tick Island), has the appendage beyond the insertion of the penial retractor somewhat longer than in Wetumpka *vulgatus*. A larger specimen in the Tick Island lot, preserved without shell, has this appendage at least as long

[82] In Terr. Moll., 5: 104, pl. ii, fig F, W. G. Binney figured teeth of "*Zonites laevigatus*," the locality not stated. The centrals are similar to the radula I examined, but he represents a cutting point on ectocone of the first side tooth, not present in my radula. His figure of the genitalia, pl. xi, fig. E, seems referable to *M. perlaevis*, and cannot be *laevigatus* (= *vulgatus*).

as in *M. l. monticola*. Radula with 23-1-23 teeth. Central teeth as in *vulgatus* but with distinct ectocones, and the inner three lateral teeth have much longer mesocones than in *vulgatus*, and distinct ectocones with short cutting points. I have not figured anatomy of this specimen because I could not certainly connect it with any shell in the collection, but mention it here as requiring further investigation of this Florida form, which approaches *Omphix* in both radula and penis.

Mesomphix(?) perfragilis (Wetherby)

Zonites perfragilis Wetherby, 1881, Jour. Cincin. Soc. Nat. Hist., 4: 326 (not described); 1894, same Jour., 16: 215.

Mesomphix (?) *perfragilis* (Wetherby), Pilsbry, 1911, Proc. Acad. Nat. Sci. Phila., 63: 483.

"As thin and pellucid as *Vitrina limpida*, the shells being extremely fragile and delicate. They were much flattened and the umbilical opening was much larger than in typical *laevigatus*." (Wetherby, 1894).

TENNESSEE: Rutherford County, "in a sink-hole in a cedar glade on the Murphreesboro Pike about two miles out of Nashville" (Wetherby).

I quote from a letter received from Wetherby many years ago: "I tell you about *Zonites perfragilis* W., MS., so that in case you should go into the limestone region of middle Tennessee you may be on the lookout for it. It is a species built much on the plan of *Z. laevigatus* and varies in size as that does. All the specimens yet found have a shell thinner than that of *Vitrina limpida*. I first found it in a sink-hole in a cedar glade on the Murphreesboro Pike about two miles out of Nashville, in August, 1875. Not doubting my ability to clean them, with care, I plunged them into hot water, but the experiment was fatal. I lost them all. I next put some in alcohol, but before we got back to Cincinnati they were reduced to nothing as to the shells. It is not uncommon, I think, in the limestone sink-holes, especially in the damper parts."

Wetherby's description of 1894, given above, was from memory, the specimens having been lost. In another letter Wetherby reiterated the opinion that *perfragilis* is a very distinct species. It should be possible to find the original locality and to recognize the species from the details given above. They could probably be cleaned successfully if drowned or narcotized before boiling. Otherwise the forcible retraction of the animal, in shells so fragile, breaks them up.

Subgenus OMPHALINA Rafinesque

Omphalina Rafinesque, 1831, Enum. and Account, p. 3, for *O. cuprea*.—Pilsbry, 1894, Proc. Acad. Nat. Sci. Phila., p. 14; same Proc., 1911, p. 469 (anatomy).—Von Martens, 1892, Biol. Centr.-Amer., p 104 (Mexican species).

The chief differences between *Mesomphix* and *Omphalina* are that the penial retractor is terminal in the latter, no part of the penis projecting beyond it; the teeth of the radula are more numerous, and the umbilicus of the large shell is wider.

Omphalina comprises only four species in the United States, but there are others in eastern and southern Mexico, where the shells are more varied in form and color.

The dentition is not greatly varied in the omphalinas of the United States, and probably the radulae of *M. pilsbryi*, *M. cuprea* and *M. friabilis* could not always be distinguished. *M. capnodes* has more lateral teeth than the other species. The number of teeth in radulae counted is as follows:

	Central	Lateral	Marginal	
M. capnodes	1	7	66	Huntsville, Ala.
M. capnodes	1	9	57	(W. G. Binney).
M. pilsbryi	1	5 or 6	49 or 50	Wetumpka, Ala.
M. cupreus	1	5	54	Emporium, Pa.
M. cupreus	1	5	45	Pennsylvania.
M. cupreus	1	4	60	(W. G. Binney).
M. c. ozarkensis.....	1	6	54	Magazine Mt., Ark.
M. friabilis	1	7	54	Wyandotte, Okla. (*immature*)
M. friabilis	1	5	65	San Marcos, Tex.
M. friabilis	1	5	55	Mablevale, Ark.
M. friabilis	1	6	51	(W. G. Binney).

Mesomphix friabilis (W. G. Binney) Fig. 169 a-e.

Helix friabilis W. G. Binney, 1857, Proc. Acad. Nat. Sci. Phila., p. 187; 1859, Terr. Moll., 4: 106, pl. 80, fig. 2.—Bland, Ann. Lyc. Nat. Hist. of N. Y., 7: 129.

Zonites friabilis W. G. Binney, 1878, Terr. Moll., 5. 101, fig. 21, pl. ii, fig. J; pl. xi, fig. D (anatomy).—Sampson, 1893, Ann. Rep. Geol. Surv. Arkansas for 1891, 2: 181.—Singley, 1893, 4th Ann. Rep. Geol. Sur. Texas for 1892, p. 302.

Omphalina friabilis (W. G. B.), Pilsbry, 1906, Proc. Acad. Nat. Sci. Phila., p. 563; 1911, p. 476, pl. 37, fig. 5; pl. 38, figs. 2, 4 (anatomy).

Mesomphix friabilis (W. G. Binney), F. C. Baker, 1939, Fieldbook Illinois Land snails, p. 67.

"Shell very globose, transparent, brittle, thin, sometimes thick, shining, reddish; spire very short, conic; whorls 5, convex, lightly wrinkled, rapidly increasing, the last very large and ventricose; suture moderate; aperture circular, equally high and broad, within bluish and slightly thickened by a very thin white callus; peristome simple, sharp, thin, at its junction with the body-whorl violet-colored and reflected, so as to cover a portion of the small and deep umbilicus; the parietal wall of the aperture is covered with a light violet-colored callus. Greatest diameter 26, lesser 20 mill.; height, 13 mill."[83] (W. G. B.)

Height 17 mm., diameter 26 mm., 4¾ whorls. New Harmony.
Height 19 mm., diameter 25.2 mm., 5 whorls. Gibson Co., Ind.
Height 20.5 mm., diameter 26.3 mm., 5 whorls. Nashville, Tenn.
Height 18.5 mm., diameter 24.7 mm., 4¾ whorls. Cape Girardeau, Mo.
Height 15.8 mm., diameter 21 mm., 4¾ whorls. San Marcos, Texas.
Height 18.5 mm., diameter 23 mm., 5 whorls. San Marcos, Texas.

INDIANA: Banks of the Wabash River (Mrs. Say, Type locality). New Harmony Posey Co.; Gibson Co. (Archer). Reported by L. E. Daniels from Grand Chain, Posey Co.; cypress swamps in Knox Co.; English and Wyandotte, Crawford Co.; Medora

[83] The height given is apparently that of the axis, not measured to the base of the lip as is now customary.

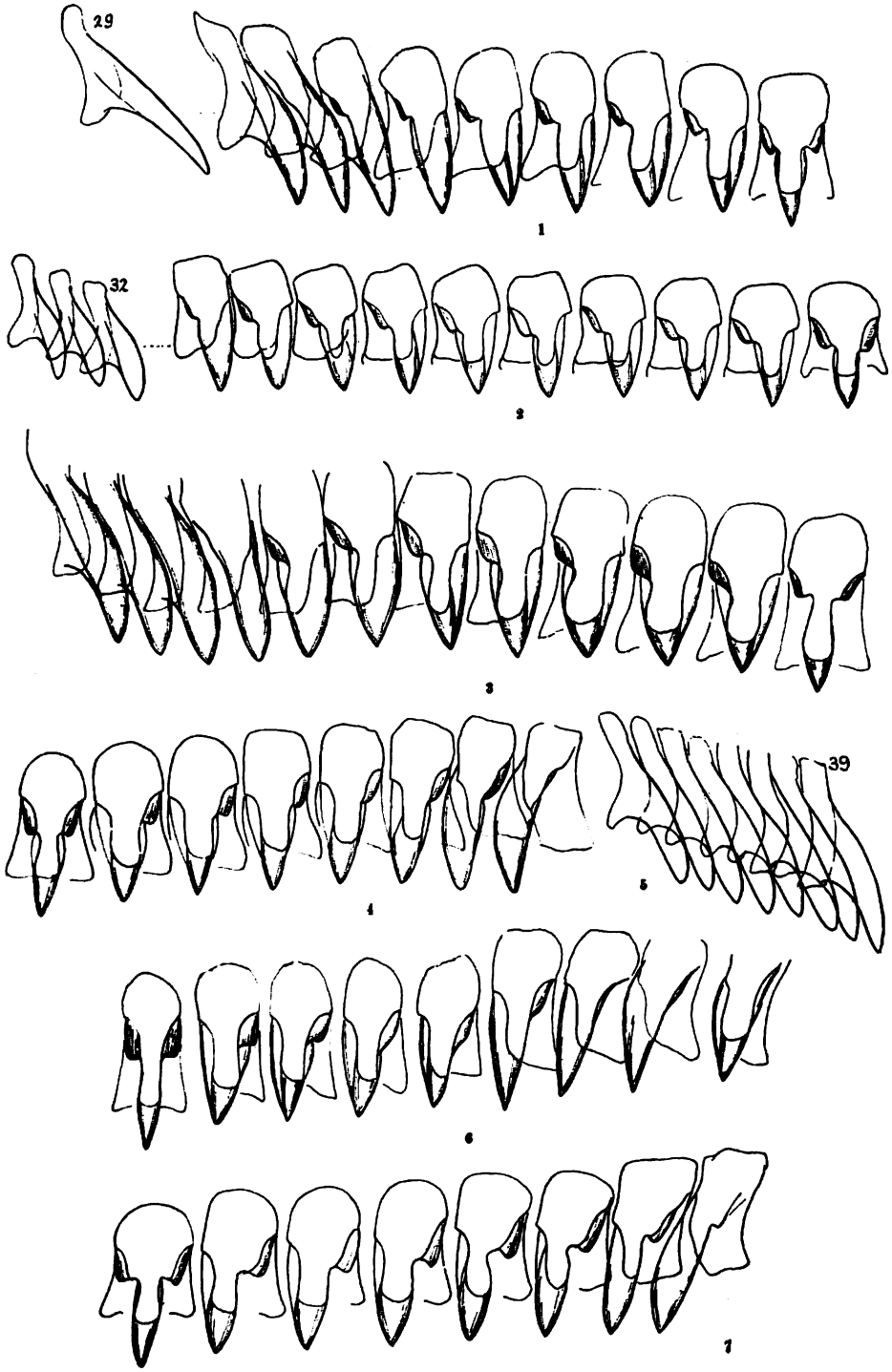

Fig. 168. Teeth of: 1, *Mesomphix cupreus,* Cameron Co., Pa. 2, *M. friabilis,* Wyandotte, Okla. 3, 5, *M. capnodes,* Monte Sano, Ala 4, *M. friabilis,* Mablevale, Ark.; 6, San Marcos, Tex. 7, *M. pilsbryi,* near Wetumpka, Ala.

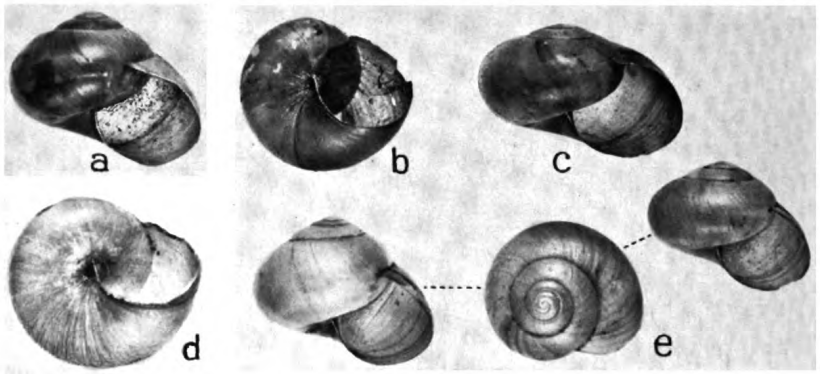

Fig. 169. *Mesomphix friabilis*. a, Gibson Co., Indiana; b, Mt. Carmel, Ill.; c, New Harmony, Ind.; d, Cape Girardeau, Mo.; e, San Marcos, Texas.

Jackson Co.; and by Goodrich & Vander Schalie from Marion, Jefferson and Carroll counties. ILLINOIS: Athens, Menard Co. (Hall); Mount Carmel, Wabash Co. (R. Walton). Also reported from south of Marion, Williamson Co. (F. C. Baker). KENTUCKY: Lawrence, Fayette and Trimble counties, according to W. G. Binney. TENNESSEE: Nashville, Davidson Co. (J. B. Clark) Franklin Co., according to W. G. Binney. ALABAMA: Perry Co. (Aldrich). MISSISSIPPI: Tombigbee River, near Columbus (H. G. Richards). MISSOURI: Cape Girardeau (F. A. Sampson); Sedalia, Pettis Co. (G. Van Ingen). Belton, Cass Co. (O. A. Crandall). Reported by Sampson from Carthage, and by Hubricht from St. Louis Co. ARKANSAS: Cross, Garland, Hot Springs, Little River, Logan, Montgomery, Polk, Pulaski and St. Francis counties. Also recorded by Sampson from Carroll, Helena and Independence counties. KANSAS: Ft. Scott, according to Sampson. OKLAHOMA: Wyandotte, Ottawa Co. (Pilsbry). Page, Le Flore Co. (Archer). LOUISIANA: near Jones, Morehouse Parish (C. B Moore). TEXAS: Bastrop, Bell, Caldwell, Hays, Travis, Victoria, Washington, Webb (fossil), and Wharton counties. Also, according to J. A. Singley, from the following counties and collectors: Gonzales and Bell (Askew), Brazos (Kennedy), Lampasas (Ragsdale), Williamson and Milam (Walker), Waller, Caldwell, Lee, Travis and Hays counties (Singley).

The shell differs from *M. cupreus* by the smaller apex, narrower and more closely coiled early whorls of *friabilis*, in which moreover the apical whorls are *smooth, polished, whitish-corneous and unworn*, while the summit in southwestern *cupreus* is invariably worn, the cuticle removed from the earlier whorls.

W. G. Binney's type,[84] figured in Terrestrial Mollusks, IV, is a quite thin, globose dark colored form, near " light brownish olive " color of Ridgway, or " smoky horn " color, as another author expressed it. In this typical form the small umbilicus is contained about 12 times in the diameter; the first $1\frac{1}{2}$ whorls are whitish, unworn (thereby differing from most *M. cupreus*, which have the apex worn). Fig. 169 a and b represents this thin, brittle dark form which is probably from places deficient in lime, but I have

[84] Of the two localities mentioned by Binney, " In ripis fluminis Wabash (Mrs. Say!); in Illinois (R. Kennicott!)" the former is selected as type locality. Gratacap stated that " the original specimen is from Wabash, Ill." in the American Museum. Specimens from W. G. B. from Illinois are 11852 M. C. Z.

not collected it. There are also more depressed shells, such as fig. 169 c. Over most of the range of the species the color is lighter, isabella color to honey yellow, the shell is somewhat stronger though still thin, and the umbilicus is a little larger, up to one-eighth of the diameter; apex whitish, Fig. 169 d, e.

Leslie Hubricht reports finding a sinistral specimen in St. Louis County, Missouri.

The surface is moderately glossy, with sculpture of quite light wrinkles and no microscopic spirals in the typical form, but light spirals are visible in some Arkansas lots.

A single fossil specimen from Laredo, Webb Co., Texas, was in a lot of shells from Ferriss. This seems to be farthest south for the species. The Alabama specimens seen from Perry Co. were from the Aldrich collection. All Alabama records appear to be from the one Aldrich lot. H. H. Smith and A. F. Archer seem not to have found the species in Alabama, and the record for that state should be verified. I have examined the specimens reported by Nathan Banks, 1892 (Nautilus, 5: 137) as *Zonites friabilis* W. G. B. and *Z. laevigatus* Pfr., from the Cayuga Lake Valley, New York. Both are immature stages of *M. cupreus*.

The mantle over the lung shows a few irregularly scattered small black spots of flecks, and an oblong black spot marking the position of the reflexed ureter, but the veins are not pigmented. The epiphallus is swollen and not much longer than the penis. The vagina is longer than usual, white to the base, which is not swollen (Fig. 170: 4). The jaw is yellow, with truncate ends and a rather low median projection.

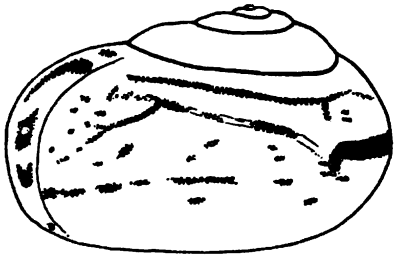

Fig. 171. *M. friabilis* from Wyandotte, Oklahoma, removed from the shell, showing pigmentation of mantle.

Fig. 172. — *M. friabilis* from San Marcos, end of foot with tail-pore.

In a specimen from San Marcos, Texas, the pedal lines are double as usual, the deeper ones meeting in a curve over the tail. No distinct caudal foss or pore is discernible in some alcoholic specimens, but the margin is less deeply grooved near the end of the tail than elsewhere. Other individuals have a simple slit. There are no specialized dorsal or facial grooves. The mantle margin has a short right body-lobe, but no shell-lobes. The sole is tripartite. All the veins and arteries of the lung are outlined with black pigment, causing it to appear much darker than the lung of Arkansas examples dissected.

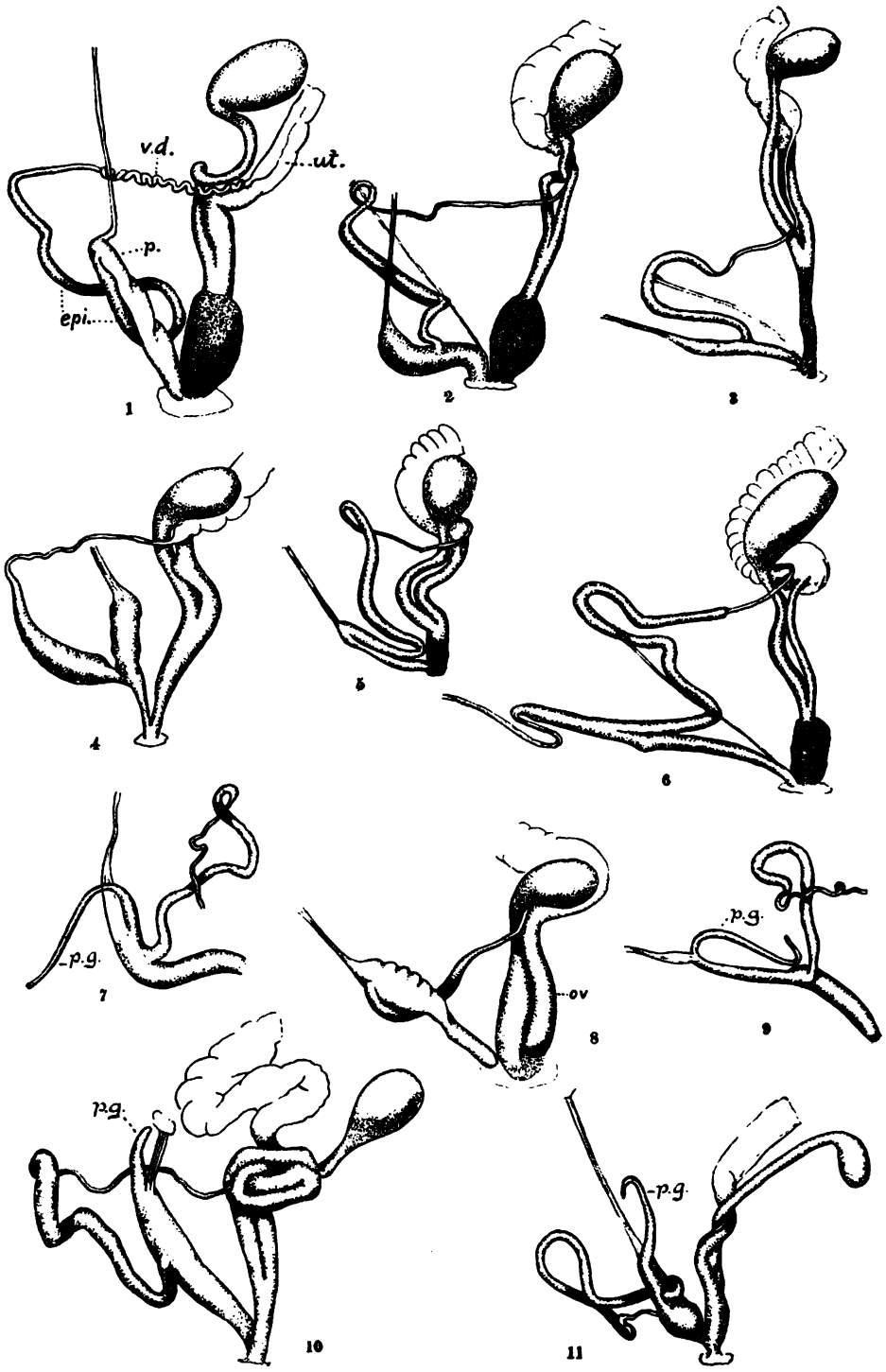

Fig. 170. See bottom of page 333 for legend.

The atrium is excessively short, only reaching through the integument. The penis is stout and short with terminal retractor muscle, inserted distally in the lung floor. About in the middle of the penis a long stout epiphallus enters. It tapers distally into the vas deferens, and near the end receives a very slender muscle which is inserted in the connective tissue around the base of the penis. The vagina is chocolate colored and swollen below. The spermatheca is very large, oblong, on a slender duct about as long as the vagina (Fig. 170: 2). Length of penis about 6 mm.; epiphallus about 15 mm.; vagina 8.5 mm.; spermatheca and duct 13.5 mm.

The jaw is pale yellowish-gray, with a median ridge and strong projection, sides distinctly striate.

The radula of a San Marcos specimen (Fig. 168:6) has 65, 5, 1, 5, 65 teeth, the cusps, especially of the centrals, being longer and narrower than in any other of our species of *Omphalina*. Two radulae examined.

In an individual from Mablevale, Ark. (Fig. 168: 4), there are about 55, 5, 1, 5, 55 teeth, the centrals somewhat less lengthened. Counted in another place, I found 53, 5, 1, 5, 53 teeth on the same radula. Teeth of a specimen from Wyandotte, Okla., are drawn in Fig. 168:2. Except in having somewhat longer cusps, the radulae I prepared differ very little from *M. cupreus*.

(*Friabilis*, brittle.)

Mesomphix cupreus (Rafinesque) Fig. 173 a-d.

Omphalina cuprea Rafinesque, 1831, Enumeration and Account of some remarkable natural objects, etc., p. 3.—Pilsbry, 1914, Proc. Acad. Nat. Sci. Phila., p. 14, pl. 1, fig. 5 (genitalia); same Proc., 1911, p. 471.—Walker, 1928, Terr. Moll. Ala., p. 68, figs. 91, 92.

Helix fuliginosa "Griffith," A. Binney, 1840, Boston Jour. Nat. Hist., 3: 417, pl. 24.—DeKay, Zool. of New York, Mollusca, p. 37, pl. 3, fig. 22.—Leidy in Terr. Moll., I, pl. 9, fig. 4.

[?] *Helix capillacea* "Fer." Pfeiffer, 1842, Symbolae ad hist. Hel., 2: 24, no. 101 (Ohio); not of Férussac.[85]

Zonites fuliginosus Griffith, W. G. Binney, 1869, L. & F. W. Sh. N. A. 1: 285; 1878, Terr. Moll., 5: 100, pl 31, pl. 2, fig. 1.—Call, 1899, Indiana Rep. Geol., etc., 24th Ann. Rep., p. 373.

Omphalina fuliginosa Griff., Pilsbry, 1894, Proc. Acad. Nat. Sci. Phila., p. 14, pl. 1, fig. 5 (genitalia).—Sampson, 1913, Trans. Acad. Sci. St. Louis, 22: 101.

Zonites cupreus form *sinistrorsus* Cockerell, 1893, Brit. Nat., 3: 81.

Mesomphix cupreus (Raf.), Baker, Fieldbook Illinois Land Sh., p. 66.

The shell is umbilicate (width of umbilicus contained 5 or 6 times in that of the shell), depressed; tawny-olive to honey yellow, indistinctly

[85] *Helix capillacea*, from Ohio, was later said by Pfeiffer (Symbolae, 3: 46), to be *H. fuliginosa* Griff. The description is far better for *M. vulgatus;* but pragmatically speaking, its identity is immaterial.

Fig. 170. Anterior part of genitalia of: 1, *Mesomphix capnodes*, Monte Sano. 2, *M. friabilis*, San Marcos. 3, *M. cupreus ozarkensis*, Magazine Mt. 4, *M. friabilis*, Mablevale, Ark. 5, *M. friabilis*, immature, Wyandotte. 6, *M. pilsbryi*, near Wetumpka. 7, *M. subplana*, Thunderhead. 8, *M. lucubrata* Say (Mexico). 9, *M. rugeli*, Roan Mt. 10, *M. latior monticola*, Cades Cove. 11, *M. andrewsae*, Cades Cove.

streaked and often with some brown growth-rest lines; more or less darker, often blackish, near the lip; cuticle lost from the earliest two or three whorls of adult shells, showing the gray or whitish calcareous layer. The

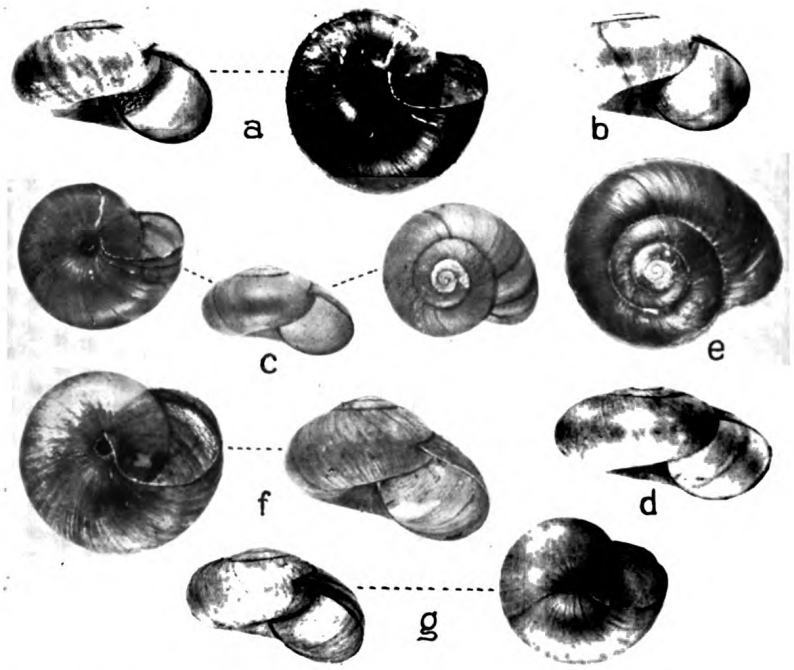

Fig. 173. a, *Mesomphix cupreus*, Pittsburgh; b, Burnside, Ky.; c, Cazenovia, N. Y.; d, Pine Mt., Ky. e, *Mesomphix cupreus politus*, Cades Cove, Blount Co., Tenn. f, *Mesomphix cupreus miktus*, type and paratype. g, *Mesomphix cupreus ozarkensis* paratype and type.

surface is smooth and glossy around the umbilicus but the gloss is more or less dulled on the upper face, which has a weak sculpture of growth wrinkles, stronger towards the suture, and an irregular, pebbly microscopic sculpture, sometimes with traces of short ill-defined impressed spiral lines. The spire is convex. Whorls 4½ to 5, but slightly convex, the last twice as wide as the preceding. Aperture rounded, about one-fourth of the circle excised by the preceding whorl; lined with a very thin calcareous layer, bluish white near the aperture, fleshy within.

Height 16 mm. diameter, 27 mm.; 5 whorls, aperture 13x13 mm.; umbilicus 5 mm. Pittsburgh, Pa.

Height 12.4 mm., diameter 22.3 mm.; 4½ whorls. Cazenovia, N. Y.

Height 15.4 mm., diameter 26.2 mm.; 4⅝ whorls; aperture 13.7x13.5 mm.; umbilicus 4 mm. Burnside, Ky.

Height 14.4 mm., diameter 28.4 mm.; 4½ whorls; aperture 14x14 mm. Pine Mt., Harlan Co., Ky.

ONTARIO: Beamsville, Lincoln Co.; Copenhagen, Elgin Co. (Oughton); Hamilton (Walton).

VERMONT: Mt. Equinox. MASSACHUSETTS: Bashbish Falls. CONNECTICUT: Hartford; Greenwich (Johnson). NEW YORK: Erie, Monroe, Ontario, Yates, Tompkins, Cayuga, Onondaga, Madison, Oneida, Herkimer, Otsego, Schenectady, Albany, Rensselaer, Greene, Columbia, Dutchess, and Ulster counties. NEW JERSEY: Warren and Sussex counties. PENNSYLVANIA: Allegheny, Beaver, Bucks, Cambria, Cameron, Clinton, Fayette, Indiana, Lehigh, Lycoming, McKean, Monroe, Potter, Somerset, Sullivan, Susquehanna, Union and York counties. MARYLAND: Cumberland, Allegany Co.; Jennings and near Bittinger, Garrett Co. VIRGINIA: Eggleston, Giles Co. (Bayard Long); Wythe and Lee counties. WEST VIRGINIA: Mercer and Wirt counties. NORTH CAROLINA: Cranberry, Avery Co.; Murphy and elsewhere in Cherokee Co. SOUTH CAROLINA: Columbia. GEORGIA: Monroe Co. KENTUCKY: Blue Lick, Nicolas Co. and Cascade, Carter Co. (Wurtz); Breathitt, Harlan, Pulaski and Wayne counties. TENNESSEE: Blount, Carter, Hamblen, Knox, Marion, Obion, Roane and Unicoi counties. ALABAMA: according to Walker, in Cherokee, Cleburne, Conecuh, DeKalb, Franklin, Jackson, Lauderdale, Madison and Marion counties; but these records need verification. MICHIGAN: Ottawa, Kent, Genesee, Tuscola, La Peer, Washtenaw and Monroe counties, according to Walker. Washtenaw and Wayne counties (Archer). OHIO: Delaware Co.; distributed over the state, according to Sterki. INDIANA: Hendricks Co.; Corydon, Madison, near Bloomington, Lawrenceburg and Brookville, not known from northern part of state (R. E. Call). ILLINOIS: southern, north to Calhoun and Moultrie counties, according to F. C. Baker. MISSOURI: Scott, Jasper, Cape Girardeau, MacDonald, Barry, Benton and Ballinger counties, according to Sampson. ARKANSAS: Benton, Calhoun, Ouachita and Van Buren counties.

The somewhat coppery tint, smooth surface, low, narrow, spire, worn at the summit, and the large aperture, often having a blackish border, the size of the umbilicus, and especially the irregularity of the extremely minute roughness of the surface, are recognition-features of this fine species, which has usually been known under the name *Zonites fuliginosus*.

Rafinesque's description follows: "Omphalina, differs from Helix by no lips, but an umbilic. *O. cuprea*, suboval, four spires, smooth, brittle, diaphanous, coppery, shining, opening very large. In Kentucky." While this definition leaves much to be desired, it is good as far as it goes. W. G. Binney (1859, 1869), recognized *O. cuprea* as identical with *Helix fuliginosa*, but he continued to use the later name, perhaps considering Rafinesque an outlaw, not deserving recognition.

Ontario and New York shells are small, rarely over 22 mm. in diameter, thin, usually dark colored, prout's brown to dresden brown, and not much streaked. It becomes larger and more solid in Pennsylvania. In the southern half of Kentucky and in Tennessee the color is often greener, near dark olive-buff, the surface smoothish, and the whitish apex often unworn.

F. C. Baker notes that the Illinois specimens are more globose than those of Kentucky, Tennessee and Indiana, the height being two-thirds of the diameter.

Bryant Walker, 1928, has recorded *cupreus* from many counties in northern Alabama. I have not seen his material; but all Alabaman shells of this type seen by me prove to have the micro-sculpture of *capnodes*. W. G. Binney's record, Volusia Co., Florida (Dury), does not seem credible. Charles Dury was a Cincinnati entomologist who picked up some shells in Florida, among them *Planorbis duryi* Wetherby.

George H. Clapp reported a sinistral shell of this species from Sewanee, Tennessee, in his collection, taken by Sanderson Smith. W. G. Binney also possessed one.

Mesomphix cupreus lives in densely shaded woodland on hillsides, and is usually found partly buried in the damp humus, under a layer of dead leaves. According to Mr. John Walton it feeds upon snails; fully one-third of the specimens found in July were "devouring shell and animal, sometimes of its own species, but more frequently the young of *Mesodon albolabris, M. thyroides, M. sayii* and *Triodopsis palliata.*"

The tail is flattened, the caudal foss a small slit not reaching the end, as figured for *M. friabilis* from San Marcos. The mantle over the lung has some irregular scattered spots and some of the branches of the vena cava are diffusely pigmented in places. The pulmonary vein and its branches are not pigmented. The collar usually has a black patch or several spots. Specimens from many localities examined.

In two examples of *M. c. politus* from Cades Cove I found a few spots near the branches of vena cava and on the collar in one, the other being without pigment spots.

The retractor muscle of the penis is rather short. The epiphallus arises near the end of the penis, but not quite so near as in *M. capnodes* (Fig. 174).

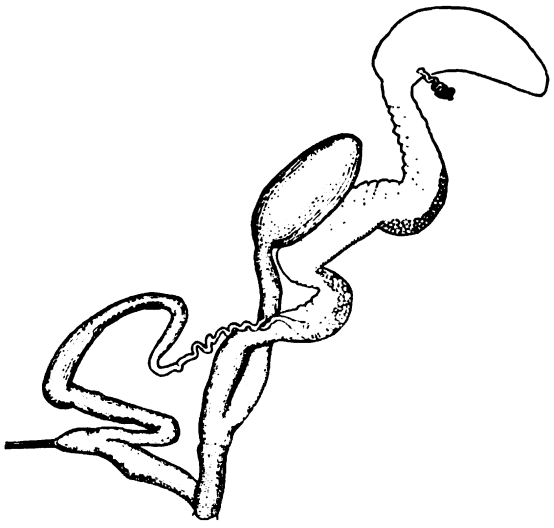

Fig. 174. *Mesomphix cupreus*, Allegheny Co., Pa.

In some specimens, such as that from York Furnace, Pa., figured in Proc. Acad. Nat. Sci. Phila., for 1894, pl. 1, fig. 5, the epiphallus is much more swollen.

A radula from Emporium, Cameron County, Pa., has 54, 5, 1, 5, 54 teeth (Fig. 168: 1), the central and laterals with side cutting points. The decrease of the marginals to the outer edge is very gradual, as usual.

Another from Pennsylvania has 45, 5, 1, 5, 45 teeth. Binney found 60, 4, 1, 4, 60 teeth in one, 57, 1, 57 in another radula.

The number of teeth and of laterals is variable in different colonies, but apparently neither reaches the number found in *M. capnodes*. The ectocones are a little better developed than in *M. friabilis*, but it is doubtful whether some radulae could be distinguished.

Mesomphix cupreus ozarkensis (Pilsbry & Ferriss) Figs. 173 g; 175.

Omphalina fuliginosa ozarkensis Pilsbry & Ferriss, 1906, Proc. Acad. Nat. Sci. Phila., p. 562.

Omphalina cuprea ozarkensis P. & F., Pilsbry, 1911, Proc. Acad. Nat. Sci. Phila., p. 472, fig. 1 a, b, pl. 37, fig. 3.

"The shell is light and thin, varying from dusky olive to olive-chestnut, dusky near or at the lip. The surface is indistinctly marked with fine spiral striae. Whorls 4½, the earlier ones invariably worn and white or whitish. The mantle is pale gray, *the branches of the vena cava black, pulmonary vein and its branches not pigmented.*" (P. & F.)

Height 13 mm., diameter 22 mm. Type.
Height 14 mm., diameter 24.5 mm. Paratype.
Height 16.2 mm., diameter 23.4 mm. Sugarloaf Mt.

Shell similar to that of *M. cupreus*. In the field this form is instantly recognizable by the black lines of the pallial region, sharply defined against a pale ground, and readily visible through the shell. In spirit this black pigment remains unchanged. Epiphallus inserted midway on the penis, not distally as it is in *M. cupreus*.

ARKANSAS: Petit Jean Mts., south of Magazine Mt., Logan Co. (Ferriss & Pilsbry), Type 91348 A.N.S.P. North side of Magazine Mt., Logan Co., and Sugarloaf Mt., Sebastian Co. (F. & P.). Sulphur City, Washington Co. (A. J. Brown). 8 mi. north of London, Pope Co. (R. W. Jackson).

The shell is a little more distinctly striate spirally than typical *cupreus*, and the intensely black pigmented lines of the pallial region, showing through the shell, give it a distinct appearance when seen in the flesh. Whether it is sufficiently differentiated for subspecific rank is still to be considered by those working in the Ozark-Ouachita country. As usual in this genus, it lives on moist, well-shaded hillsides, buried in the leaf-covered humus up to the apex, which alone is exposed.

The genital system (Fig. 170: 3) is nearly identical with that of *M. friabilis* from San Marcos, Texas, but differs in the following points: the base of the vagina is not swollen, the penis is more slender and the muscle controlling the epiphallus is inserted at the distal third of the latter instead of near its end. The epiphallus is inserted about midway on the penis, whereas in *M. cupreus* it inserts near the distal end. The organs of the

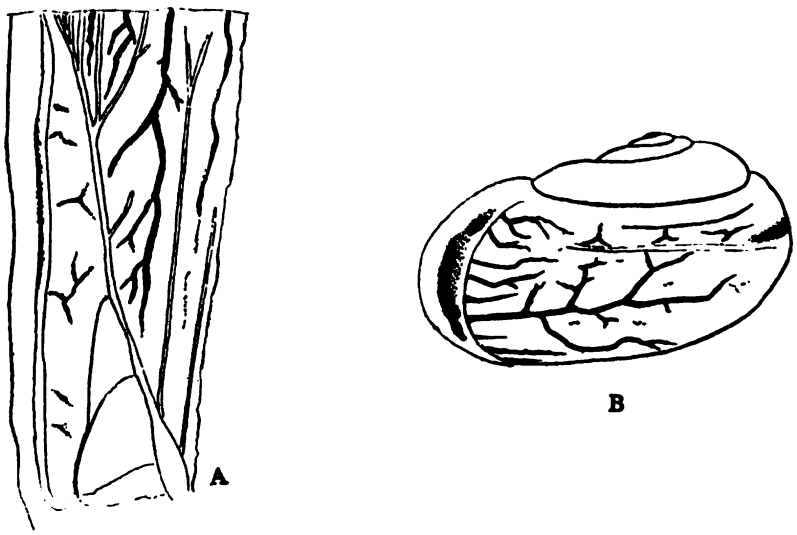

Fig. 175. *M. cupreus ozarkensis.* A, pallial region of individual from Magazine Mountain. B, the same as seen in an unopened specimen removed from the shell, the pigmented blood vessels showing through the mantle; Petit Jean, Ark.

individual drawn measure: length of penis 7.5 mm., epiphallus 14 mm., vagina 6.3 mm., spermatheca and duct 13 mm. Two radulae examined agree essentially with *M. cupreus*. Formula of teeth about 54, 6, 1, 6, 54.

Mesomphix cupreus politus (Pilsbry) Fig. 173 e.

Omphalina fuliginosa polita Pilsbry, 1898, Nautilus, 12: 86; 1900, Proc. Acad. Nat. Sci. Phila., p. 134.—Ferriss, Nautilus, 14: 56.

Omphalina cuprea polita Pilsbry, 1911, Proc. Acad. Nat. Sci. Phila., p. 474.

The shell is similar in form to *M. cupreus*, but the whole surface is brilliantly glossy, as though varnished. Under the microscope fine, very shallow, spiral striae are visible in the high-light; two apical whorls are worn. Isabella color (often somewhat clouded with honey-yellow) with dark lines at growth-rests (when present). Height 15.8 mm., diameter 28.4 mm.; 5 whorls.

TENNESSEE: Great Smoky Mountains and their foothills in Blount and Monroe counties (Mrs. George Andrews, Ferriss, Pilsbry), the type from "Sugar Cove," at the base of Thunderhead, 71362 A.N.S.P. Tellico Gorge, Monroe Co. (H. B. Baker).

Fine specimens up to 28 mm. diameter occur in Cades Cove at about 2000 ft. Those from Thunderhead, near the summit, are not so large, diameter 25-26 mm. Mr. Ferriss took it also at Chamber's Church, at the mouth of Chamber's creek, Swain County, N. C. Clapp collected specimens along the bluffs of Little River, in Tuckaleechee Cove, Blount Co., Tenn. They are small, the largest only 20 mm. in diameter.

M. cupreus is more or less polished at the base, but the upper face is somewhat dulled by microscopic roughness, which is lacking in *politus*. I am now disposed to doubt the subspecific value of *politus*, because rather glossy *cupreus* has turned up sporadically elsewhere, in Pennsylvania at Carrolltown and Ohiopyle, Fayette Co., Raymond, Potter Co., and in Indiana Co.

Mesomphix cupreus miktus new subspecies Fig. 173 f.

In some localities there is a form having the small umbilicus, large aperture and relatively wide last whorl of *capnodes,* but with minute spiral sculpture obsolete or very weakly and irregularly developed, and not in the least papillose. Apex worn. Specimens from Belleview measure:

Height 18.8 mm., diameters 27.3 and 23.4 mm., width of umbilicus 3 mm., aperture height 15.6, width 15.3 mm.; 5 whorls.

Height 18 mm., diameters 27.5 and 23.4 mm., width of umbilicus 3 mm., aperture 16x15.8 mm.; 4¾ whorls.

Height 18.7 mm., diameter 27.7 mm.; 5 whorls.

TENNESSEE: Belleview, Davidson Co. (S. N. Rhoads), Type and paratypes 69107, 69107a A.N.S.P. Seven miles east of Smithville, DeKalb Co. (Pilsbry). KENTUCKY: Bowling Green (Ferriss). Near Cave City, Barren Co. (J. B. Clark).

This appears to be a race of the "Interior low plateaus" region of Fenneman. By having the aperture at least as high as wide, as well as by the sculpture and the size, these shells resemble *cupreus;* but by the more ample aperture, the narrower spire and narrow umbilicus they are like *capnodes.* Examinations of the genitalia and the teeth are needed to determine whether it is a race of *cupreus* or of *capnodes.*

(Μικτός, mixed.)

Mesomphix capnodes (W. G. Binney) Fig. 176.

Helix kopnodes W. G. Binney, 1857, Proc. Acad. Nat. Sci. Phila., p. 186 (Alabama); 1859, Terr. Moll., 4: 104. pl. 80, fig. 14.

Zonites capnodes W. G. Binney, 1874, Ann. Lyc. Nat. Hist. of N. Y., 11: 24; 1878, Terr. Moll., 5: 98, pl. 2, fig. K, teeth; 1880, Ann. N. Y. Acad. Sci., 1: 357, pl. 14, fig. c, genitalia of specimen from near Knoxville; 1883, Bull. Mus. Comp. Zool., 11: 137, pl. 3, fig. c; 1885, Man. Amer. L. Sh., pp. 205, 476, figs. 215, 216.

Omphalina kopnodes (W. G. Binn.), Pilsbry, 1911, Proc. Acad. Nat. Sci. Phila., p. 474, fig. 3, pl. 38, figs. 3, 5. teeth.

"Shell depressed, horn-colored or smoky, globose, wrinkled, below smooth; spire short, depressed; suture moderate; whorls 5, rapidly increasing, the last very ventricose and large, sometimes marked with coarse revolving lines; aperture large, round; peristome simple, acute, ends approached, joined by a slight deposition of brownish callus over the parietal wall, reflected at the small and deep umbilicus. Greater diameter 35, lesser 28 mill.; height 13 mill." (W. G. Binney.)

Height 18.3 mm., diameter 29.4 mm., aperture, height 16, width 15.5 mm. Paratype. Alabama.

Height 22.7 mm., diameter, 33.3 mm., aperture, 17.7x17.5 mm. Monte Sano.

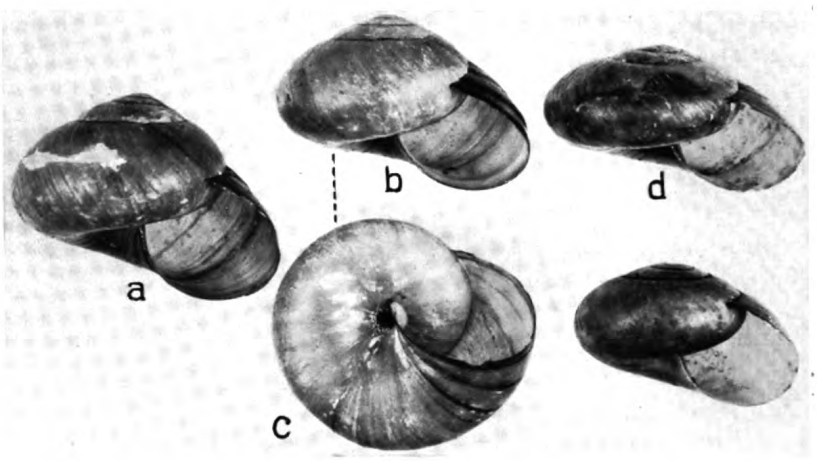

Fig. 176. *Mesomphix capnodes*, Alabama. a, near Wetumpka; b, c, Monte Sano; d, Woodville; e, Uniontown, paratype.

Height 26.2 mm., diameter 35.5 mm., aperture 19.5x19.7 mm. Near Wetumpka.

Height 19.3 mm., diameter 34.2 mm. Woodville, Ala.

Height 17.7 mm., diameter 30.5 mm. Dove, Tenn.

TENNESSEE: Bledsoe, Franklin, Lincoln, Marion and Wilson counties. ALABAMA: Colbert, Franklin, Jackson, Madison, Monroe, Talladega and Tuscaloosa counties; according to Walker, also: Cherokee, Clarke, Dallas, Elmore, Perry and Shelby counties. GEORGIA: Murray and Muscogee counties. Type locality, Uniontown, Perry Co., Alabama (Dr. E. R. Showalter) Type 11837 M.C.Z., paratype 38793 U.S.N.M.

The umbilicus is usually narrower than in *M. cupreus* and the aperture is more oblique and definitely larger in shells of about equal diameter; the shell is larger and more capacious than *M. cupreus;* but the main distinction is in the microscopic sculpture.

The last whorl is tawny-olive to isabella color, the tint becoming more greenish on the spire and often darkened toward the lip, and there may be one or more dark growth-rest streaks. There is a rather weak sculpture of low growth-wrinkles, and under the microscope crowded spiral threadlets cut into papillae which thus stand in spiral and retractively-axial order. This microscopic sculpture varies in different lots from clear-cut to more or less blurred. Such sculpture is distinctly developed in the paratypes recorded by Binney (1857) as in the collection of the Academy of Natural Sciences (No. 11845). In some shells it is to be seen only in a few places. It disappears on the base, which is smoother and more or less extensively polished, at least towards the center.

In degree of elevation the shells vary rather widely. The umbilicus is contained 8 to 10 times in the diameter; but in a few lots having the

capnodes sculpture, such as no. 150313 from Dove, Marion Co., Tennessee, it is as large as in *M. cupreus*, 6 times in the diameter.

Specimens from the Natural Bridge, Rockbridge Co., Virginia, No. 129124 A.N.S.P., differ from typical *capnodes* by the smaller size and the rather large umbilicus, contained about 6 times in the diameter, characters of *M. cupreus;* but they have close, distinct and somewhat granulose microscopic spiral sculpture as in *capnodes*. Though the lot of 15 was collected by three persons (J. B. Clark, H. B. Baker and H. N. Wardle), no living or adult shells were taken, the largest measuring, height 14 mm., diameter 23.5 mm., umbilicus 4 mm., aperture 12.8 x 12.7 mm.; $4\frac{2}{3}$ whorls. The specific affinities of this Virginian form need further investigation with adult, living material.

The specimen dissected was collected at Monte Sano, near Huntsville, Ala., by Mr. H. H. Smith.

The foot has the usual double margin. The tail pit is in form of a median slit, with some short converging furrows on each side (Fig. 178). The mantle has the same profuse maculation figured for *M. pilsbryi*. The mantle-lobes are not quite so large as in *M. pilsbryi*, but larger than in any other *Omphalina*.

In genitalia (Fig. 170: 1), it resembles *M. pilsbryi*, but the proportions of penis and epiphallus differ, and the latter is inserted much nearer to the distal end of the penis than in *M. pilsbryi*, only 1.5 mm. from the end, being nearly terminal. The epiphallus passes without abrupt contraction into the vas deferens. The vagina is enveloped in a large chocolate colored glandular coat.

The jaw is pale yellow, with a strong median projection. The radula (Fig. 168: 3, 5) has 66, 7, 1, 7, 66 teeth. There are distinct outer cutting-points on the central and lateral teeth; the change to the marginal type is very abrupt. A group of marginals from the middle of the marginal field is figured. The teeth decrease in size very gradually towards the outer margin of the radula.

W. G. Binney found 66, 1, 66 (57, 9, 1, 9, 57) teeth in one, 46, 1, 46 teeth in another radula. I doubt whether the latter radula was from an adult individual. He describes it as with no side cusps, but having cutting-points on the lateral and central teeth, thus agreeing with the radula I examined in the shape of the teeth; but the number of laterals was 9 in his preparation, 7 in mine. The genitalia as figured by Binney agree well with my dissection except in one important particular: he figures the epiphallus as arising near the base of the penis, whereas I found it to spring from near the distal end. The lower part of the epiphallus is bound to the penis, as shown in my figure, and it is possible that Binney did not determine its real point of insertion.

The number of lateral teeth in *M. capnodes* exceeds that of any others of our species examined except immature *M. friabilis* from Wyandotte, Okla., which has teeth of a quite different shape.

As the orthography of W. G. Binney's original name, "*kopnodes*," was clearly an error of transliteration or transcription, his revised form, *capnodes*, seems to be allowable, according to Article 19 of the International

code: "The original orthography of a name is to be preserved unless an error of transcription, a *lapsus calami*, or a typographical error is evident."

(Καπνώδης, smoky, dusky.)

Mesomphix pilsbryi (Clapp) Fig. 177 a-d.

Omphalina pilsbryi Clapp, 1904, Nautilus, 18: 30.—Pilsbry, 1911. Proc. Acad. Nat. Sci. Phila., 63: 474, figs. 2a-c, pl. 37, fig. 6, 7.—Walker, 1928. Terr. Moll. Alabama, p. 70, fig. 95.

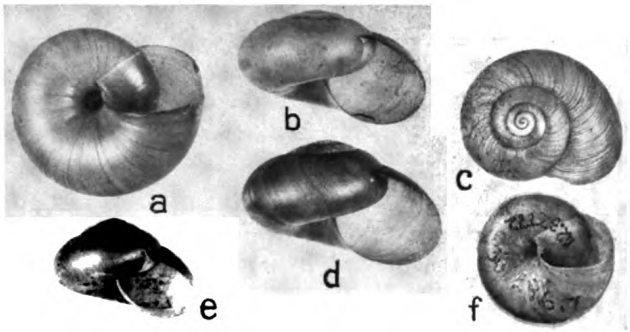

Fig. 177. a-c, *Mesomphix pilsbryi,* paratypes from Wetumpka; d, near Warrior, Ala. e, f, *Mesomphix pilsbryi globosus,* type.

"Shell about the size and general contour of *O. fuliginosa;* umbilicate, color rich reddish-chestnut with a dull satiny luster above, smoother and more polished below. Striae of growth fine and close, crossed by microscopic granules in spiral series like beads, giving the upper surface a dull luster; below, the granules are obsolete and the surface polished. Apex *smooth*, and in all adult specimens seen denuded of the epidermis. Whorls 5½, rather flattened and slowly increasing, the last whorl very much wider, more than double the width of the preceding one, almost round, no flattening on the base. Aperture oblique, circular. No thickening at the lip, which is darker than the balance of the shell.

"Greater diameter 27, lesser 23½, altitude 17½ mm. Oblique height of aperture 14, width 14 mm.

"Greater diam. 24, lesser 21, alt. 14.5 mm." (Clapp.)

Alabama: Hillsides in woods around Wetumpka, Elmore Co., Type 5115 Clapp Coll.; paratypes 87349 A.N.S.P. and in U.S.N.M. Bibb, Belmont, Chambers, Clarke, DeKalb, Lee and Montgomery counties. Reported by Walker also from Barbour, Blount, Choctaw, Crenshaw, Cherokee, Conecuh, Dale, Franklin, Jefferson, Macon, Madison, Perry, Shelby and Walker counties.

The striae are stronger than in *M. capnodes,* and the shell does not attain the size of that species; the microsculpture of papillae, evenly and very closely set in spiral and axial order, is finer and more distinctly developed in *pilsbryi.* There are some small differences in genitalia, and it has fewer lateral teeth than *M. capnodes;* but the species are closely related.

The foot has a wide double margin, the suprapedal groove obsolete near the end of the tail, as usual (Fig. 179c). The tail is elevated, not flat as in *cupreus*. The caudal pore is a short median slit, surrounded by concentric grooves (Fig. 179a). The mantle-edge bears a very large right lobe and smaller left, both being conspicuously larger than in other known Mesomphices. The lung is irregularly and rather copiously maculate (Fig. 179b, anterior end from the inside).

The penis and epiphallus are very long. Basal part of vaginal wall is thickened, glandular, and chocolate-colored. Other organs as usual in the genus (Fig. 176: 6).

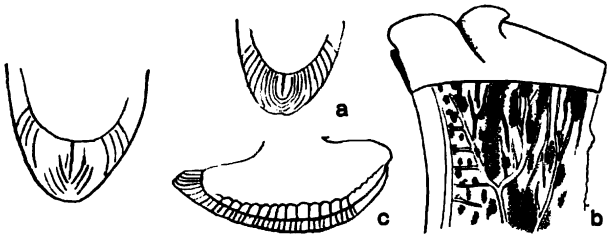

Fig. 178, at left, *Mesomphix capnodes*, end of foot and tail fossa. Fig. 179 a-c, *M. pilsbryi*: a, end of foot and tail fossa; b, anterior end of lung and mantle edge; c, foot, showing pedal and suprapedal grooves.

The pale yellow jaw has a very strong median projection. The radula (Fig. 168: 7) has 55, 1, 55 teeth with 5 or 6 laterals. The basal plates of central and lateral teeth are somewhat shorter than in *M. cupreus*, and the transition teeth have a more distinct and more acute ectocone. Otherwise the teeth do not differ materially from those of *M. cupreus*.

Mesomphix pilsbryi globosus (MacMillan) Fig. 177 e, f.

Omphalina pilsbryi globosa MacMillan, 1940, Amer. Midl. Nat., 23: 732, fig. 1.

"Shell very globose, thin, striated, reddish-chestnut color, umbilicated. Whorls 5½ somewhat rounded and slowly increasing, the last very much wider, and nearly flattened on the base. Sutures slightly impressed. Rib-striations prominent and regularly spaced. Spiral striae hardly perceptible and consisting of microscopic granulations; below, the granulations are obsolete and the surface is smooth and polished. Apex smooth. Aperture oblique, oval; parietal wall covered with a thin callus. Peristome simple, acute, and slightly reflected over the umbilicus. Umbilicus narrow, deep. Greater diameter 16.8, lesser diameter 15.5, height 18.5 mm." (MacMillan.)

Height 13.1 mm., diameters 18.5 and 15.2 mm.; 5⅓ whorls (type).

South Carolina: Santee Canal, Berkeley Co. (Miss E. B. Richardson), Type 62.32772 Carnegie Mus.

"This is a narrower and more elevated shell than *O. pilsbryi*. It also differs from that species in having the growth lines developed into prominent and regularly spaced rib-striations instead of close and fine striae, and in the spiral microscopic granules being hardly perceptible instead of being prominent and plainly visible as in *pilsbryi*. The aperture of *globosa* is

much more oblique and narrower than in *pilsbryi,* and the parietal wall is covered with a thin callus. Finally, the peristome is much more reflected over a narrower umbilicus than in *pilsbryi.*" (MacMillan.)

This is a strongly characterized race. The color of the upper surface is close to saccardo's umber with streaks of isabella color; the base shading into a more greenish tint, near ecru-olive. There is some error in the measurements quoted above from MacMillan. The figures and second measurements are from the type, kindly lent by Dr. Brooks.

VITRINIZONITES W. G. Binney

Vitrinizonites W. G. Binney, 1879, Bull Mus. Comp. Zool., 5: 333, for *Vitrina latissima* Lewis.

The vitriniform shell is thin, imperforate, depressed and polished, with narrow, depressed and somewhat sunken spire of few (about 3) flat whorls; the last whorl enlarges rapidly and is dilated transversely. Aperture very large, the peristome thin and sharp.

Snail externally resembling *Mesomphix,* the sole tripartite, lateral areas half as wide as the central. In movement numerous direct waves are seen over the median area of sole. In life the side areas are separated from the central only by lighter tint, being more densely speckled with white. There is a raised area bounded by grooves, behind the meeting of the pedal grooves above the tail, and projecting above the caudal pore (Fig. 180 b, c).[86] Lung short with weak venation. Kidney wedge-shaped, nearly twice as long as the pericardium.

Genitalia about as in *Mesomphix* subgenus *Omphix.* The penis terminates in a slender, shortly flagelliform appendage which arises at insertion of penial retractor. Epiphallus enters at distal fourth of the penis.

Jaw solid, opaque black, with median projection; similar to that of *Mesomphix.*

Radula with rather few (about 24, 1, 24) teeth, those of the middle field small. Centrals narrow with long mesocone and minute side cusps. Laterals about 5 or 6, approaching the form of marginals, being narrow, with minute ectocones, obsolete on the outer ones. A group of marginals is strongly developed, the 10th tooth in *V. uvidermis* the 11th or 12th in *V. latissimus,* being largest, after which they diminish.

They are snails of the humid mountains of the southern Blue Ridge system, being the only genus of land snails special to that region.

Apparently *Vitrinizonites* is a relatively recent derivative from an ancestral *Mesomphix* stock which had characters of the *Omphix* group. It agrees fully with these in structure of the genitalia. It differs mainly by the slightly more specialized caudal pore, and especially by the degeneration of the imperforate shell with consequent restriction of the pallial cavity. These are practically the only features differing generically from *Mesomphix.*

(Name is a compound of the generic terms *Vitrina,* glassy, and *Zonites,* Ζωνίτης, girdled.)

---

[86] In alcoholic specimens the area above the pore becomes oval or rounded, and the horn is not, or scarcely, noticeable.

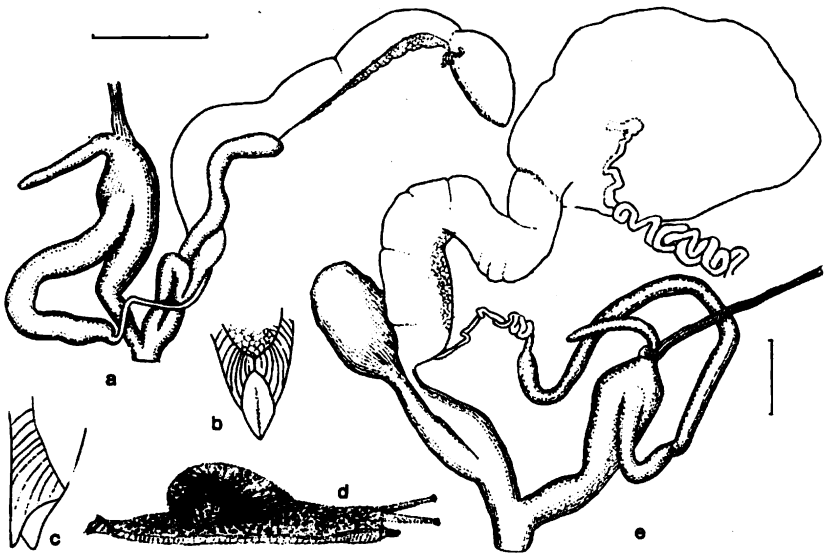

Fig. 180. *Vitrinizonites latissimus,* a, genitalia, immature, Thunderhead; b, c, dorsal and lateral diagrams of tail, near Waynesville, N.C. d, living animal (after W. G. Binney, drawn by Miss Emma Pringle). e, *Vitrinizonites uvidermis,* genitalia, Thunderhead. Scale lines for figs. a and e = 1 mm.

Vitrinizonites latissimus (Lewis) Fig. 181.

Vitrina latissima Lewis, 1875, Proc. Acad. Nat. Sci. Phila., p. 336. pl. 22, fig. 7.—W. G. Binney, 1878, Terr. Moll., 5: 136, fig. 51.

Vitrinizonites latissimus Lewis, W. G. Binney, 1879, Bull. Mus. Comp. Zool., 5: 340. pl. 2, fig. H; 1883, Bull. Mus. Comp. Zool., 11: 145, pl. 1, fig. H, pl. 3, figs. A, B; Ann. N. Y. Acad. Sci. 1: 356, pl. 14, figs. A, B; 1885, Man. Amer. L. Sh., pp. 50, 231, figs. 11a, 253, 254.—Wetherby, 1881, Jour. Cincin. Soc. Nat. Hist. 4: 328; 1894, same Jour., 16: 214.—Pilsbry, 1900, Proc. Acad. Nat. Sci. Phila., p. 137.—Walker & Pilsbry, 1902, same Proc. for 1901, p. 430.—Banks, 1932, Nautilus, 45: 138.

The very thin, fragile shell is imperforate, vitriniform, with small, flat, slightly sunken spire and rapidly expanding last whorl. There are nearly 3 whorls. Color dresden brown to olive-citrine, the spire paler. The surface is polished. Upper side with conspicuous, unevenly spaced, arcuate radial grooves (or wide low wrinkles), which retract near the suture and gradually fade out at the periphery, leaving the base nearly smooth. The large aperture is very oblique, much wider than high. It shows a very thin whitish lining within, often scarcely perceptible. Peristome thin, with a dark edge, the columellar margin simple, inserted at the axis.

Height 7.1 mm., diameters 17.3 x 11.9 mm. (Lewis.)
Height 6.8 mm., diameters 16.2 x 11 mm. Thunderhead.
Height 6 mm., diameters 17 x 12 mm. Roan Mt.
Height 8 mm., diameter 17.7 mm. Roan Mt.
Height 9.2 mm., diameter 19.5 mm. Cade Cove.

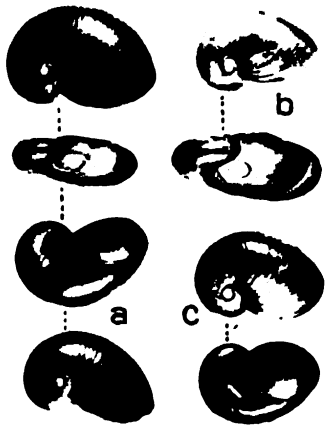

Fig. 181. *Vitrinizonites latissimus*. a, upper figure Cades Cove, the rest from summit of Thunderhead. b, Roan Mt. c, Cranberry.

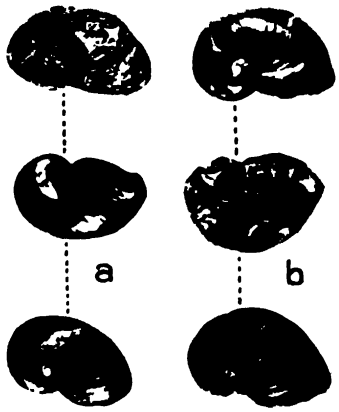

Fig. 182. *Vitrinizonites uvidermis*. a, summit of Thunderhead. b, Clingman Dome. Upper left figure the type.

TENNESSEE and along N. C. boundary: "Tusquita Bald Mt. at 6600 ft." (Annie E. Law). Type Clapp Coll. No. 2366. Great Smoky Mts., Cades Cove, 2100 ft., to 5400 ft. near the summit of Thunderhead; Miry Ridge; Clingman Dome, 6500 ft. (Ferriss, Pilsbry et al.) Indian Pass, Newfound Gap, 12 mi. S.-E. of Gatlinburg (A. M. Leeds); Mt. Le Conte, Sevier Co. (Clench & Archer). South side of river at Paint Rock (Walker). Roan Mt. in both States, 3500-5000 ft. (Mrs. Andrews, Wetherby and others). Washington Co. (Rugel, according to W. G. B.) Limestone Cove, Unicoi Co. (H. B. Baker.)

NORTH CAROLINA: Blockhouse Mt., south of Thunderhead, and Stratton Bald, Swain Co. (Ferriss). Blowing Rock, Watauga Co. (P. N. Moore). Beef Market Mt., Balsams, Jackson Co. (J. B. Clark). Nantahala Gap, 4500 ft.; Frypan Gap, near Big Pisgah Mt. (Bishop). Top of Mt. Pisgah, 25 mi. west of Asheville (Jacot). "Grandfather Mt., about 20 mi. east of Roan Mt." (G. S. Banks). Mountain near Waynesville, Haywood Co. (J. B. Clark). "Mt. Mitchell, Bluff Mt., Tyson's, Wilson's and Meadow Cove and Bee Tree Creek" (Walker). Cranberry, Avery Co. (H. B. Baker and others.) Binney recorded specimens collected by Hemphill on the "Nantahala mountains between Franklin and Hayesville, at about 5000 ft.," and on Pinnacle of the Blue Ridge, also Banners Elk, Watauga Co.

ALABAMA: Hills around Gurley, Madison Co. (H. B. Baker.)

Vitrinizonites is ubiquitous in the Great Smokys above 2,000 feet, though not found in great numbers, and is restricted to moist places where moss carpets the rocks or logs. These conditions are met on the lower levels where the mountain slopes are densely shaded, but on the cloud-touched heights not much shade is necessary.

Just where Miss Law found this snail is uncertain. I have not been able to find Lewis' locality, "Tusquita Bald Mountain, 6600 ft. elevation, East Tennessee" on the topographic sheets. The elevation given was evidently an over-estimate, made before altitudes in the Great Smokys

had been accurately measured. Were it not that Lewis places the mountain in East Tennessee, it might be thought that Tusquita was a variant spelling of Tusquitee Bald, 5200 ft., at the northeastern end of the Tusquitee mountains, on the Clay-Macon county line (Nantahala Quadrangle), North Carolina. W. G. Binney had specimens from Miss Law, who, he said, collected them at " the original locality, Bald Mountain, Blount Co., Tennessee, on dividing line with North Carolina." This may possibly have been Thunderhead, where we collected *Vitrinizonites* on the mossy rocks of the " bald ". The exact location of this type locality thus remains dubious.

The shell of *V. latissimus* is often deficient in calcareous stiffening in the region near the axis behind the columella, and some specimens become more or less shrunken or dented there when dried. Such dented shells are not always readily separable from *V. uvidermis*.

The genitalia and teeth have been figured by W. G. Binney. His figure is clearly inaccurate, as it shows no terminal appendage of the penis, which he did not distinguish from the epiphallus. In several specimens opened from the summit of Thunderhead collected July 27th, the genitalia (Fig. 180a) were found to be immature and very small, though the shells were about full size. They were probably young of the year. The male organs are more developed than the female in this specimen. They show the apical appendage or extension of the penis, which Binney apparently overlooked. As these specimens were collected with sexually mature *uvidermis*, the possibility that *uvidermis* is the mature, second season form of *latissimus* is suggested. However, many lots of *latissimus* seem to lack *uvidermis*, and the radulae are conspicuously different.

The radulae of specimens from Thunderhead and Clingman Dome are much smaller than that of *V. uvidermis*, about 2.6 mm. wide, with 24.1.24 teeth (Fig. 183a, Clingman Dome). Centrals have long mesocones and small ectocones. At least five " laterals " have distinct ectocones with cutting points, the sixth tooth having the cutting point subobsolete. The marginals increase slowly in size to about the 11th tooth, after which they diminish regularly. The largest marginal is not quite double the length of the central. A specimen from Thunderhead agrees with this; also the radula described and figured by W. G. Binney (1885), except that he found the 12th tooth the largest.

(*Latissimus*, broadest.)

Vitrinizonites uvidermis Pilsbry Fig. 182.

Vitrinizonites latissimus uvidermis Pilsbry, 1890, Proc. Acad. Nat. Sci. Phila., p. 137.—Ferriss, 1900, Nautilus, 14: 57.—Banks, 1932, Nautilus, 45: 138.

Near the summits of Thunderhead and Clingman Dome, in the wet moss covering the rocks, there lives a form of *Vitrinizonites* of about the size of *latissimus*, but almost wholly lacking any calcareous layer of the shell. The cuticular test is more or less dented and distorted in the living snails; and when " cleaned " the shell collapses like wet paper, unless stuffed

with cotton. The surface is usually less brilliant than in *V. latissimus* and the last half-turn of the suture often deviates somewhat more tangentially. The color varies from that of the ordinary *V. latissimus* to a very dusky, even blackish, shade. Diameter up to 19 mm.

TENNESSEE-NORTH CAROLINA: Thunderhead, at about 5300 ft., Type 76772 A.N.S.P.; Clingman Dome at about 5000-6500 ft. (Ferriss, Pilsbry and others). North side of Roan Mt. (H. B. Baker). "Grandfather Mt., about 20 miles east of Roan Mt." (G. S. Banks.)

These "grape-skin *Vitrinizonites*," as we called them, live with the normal *latissimus*, but apparently are easily distinguished as above indicated. A freshly cleaned shell resembles the empty skin of the free-skinned purple Concord grape, which suggested the name.

Specimens collected on Thunderhead, July 27, 1899, were dissected. The long foot is coarsely and strongly granulose above in alcoholic specimens, with pedal grooves as in *Mesomphix;* sole tripartite, the side areas about half as wide as the middle area.

Genitalia (Fig 180e). Penis club-shaped, tapering rapidly above the entrance of epiphallus, terminating in a digitiform process, alongside which the penial retractor attaches. Distally the retractor arises from the lung floor. The interior of the penis is corrugated, the rugae irregularly transverse, running towards the opening of the epiphallus. In the anterior part there are some low longitudual welts which are finely grooved obliquely. The epiphallus enters at about the distal fourth of the penis and is very long. The vagina is short. Spermatheca is large, oblong, on a short duct. The albumen gland is short and wide. There is no talon, at least none external to the albumen gland.

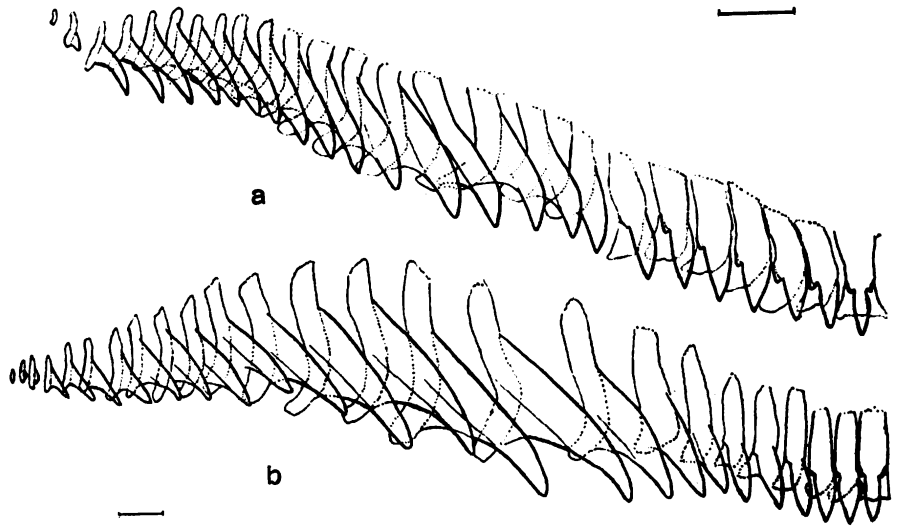

Fig. 183. Half row of teeth of: a, *Vitrinizonites latissimus*, Clingman Dome. b, *V. uvidermis*, Thunderhead. Scale lines = 0.1 mm.

Radula 4 mm. wide, with 23.1.24 teeth (in the row figured), Fig. 183b. The centrals are narrow with a long mesocone and very low, almost vestigeal ectocones. There are no teeth with the typical form of laterals, but the inner 5 teeth are narrow like the central, with similarly long mesocones and on the inner two or three teeth, very small ectocones. The marginals then increase rapidly in size, the ninth and tenth teeth being largest, nearly three times the length of the central. There are about six large marginal teeth, but after the tenth tooth they diminish regularly to the edge of the radula. The centrals are about 0.26 mm. long, the largest marginal tooth about 0.62 mm.

The radula of *uvidermis* differs from that of *latissimus* by the far greater size of a group of inner marginal teeth, and by having fewer laterals bearing ectocones; the laterals are narrower and the ectocones are smaller. The teeth are all far larger than the corresponding teeth of *V. latissimus*, and the radula is larger. The disparity in size of the teeth in these two species is greater than it appears in Fig. 183, since the teeth of *V. latissimus* were drawn to about double the scale of those of *uvidermis*. The epiphallus was found to be much longer in *uvidermis*, but the specimens of *latissimus* compared were immature. The radular differences, which have been verified in three specimens of each form, indicate that *uvidermis* is specifically distinct, and not a form of *latissimus*, as formerly thought. However, it would not be amiss to go over additional material from other localities to test the constancy of the differential structures described.

PARAVITREA Pilsbry

Paravitrea Pilsbry, 1898, Nautilus, 11: 130; Proc. Acad. Nat. Sci. Phila., 1903, 205-212 (revision).—H. B. Baker, 1928, Proc. Acad. Nat. Sci. Phila., 80: 29, type *Vitrea capsella* = *Helix capsella* Gould.

Taxeodonta Pilsbry, 1898, Nautilus, 11: 132, monotype *Gastrodonta significans* = *Helix significans* Bland. Cf. Proc. Acad. Nat. Sci. Phila., 1903, p. 206.

Paravitreops H. B. Baker, 1928, Proc. Acad. Nat. Sci. Phila., 80: 29, type *Helix multidentata* Binney.

Pectovitrea H. B. Baker, 1931, Proc. Acad. Nat. Sci. Phila., 83: 97, type *Paravitrea variabilis* H. B. B.

Parmavitrea H. B. Baker, 1931, l. c., type *Paravitrea pontis* H. B. B.

Petrovitrea H. B. Baker, 1931, l. c., type *Paravitrea petrophila* (Bld.).

The shell is depressed or discoidal, umbilicate or perforate, thin, polished, with radial grooves or lines of growth; of numerous closely coiled whorls parted by a superficial suture; internally having baso-palatal radial rows or pairs of teeth or radial barriers, usually recurring at intervals, and developed chiefly in the neanic stage, usually reduced or wanting in adults or wanting at all stages of growth; no parietal or columellar lamellae; lip thin and simple.

Sole undivided. Kidney 1½ times to twice as long as the pericardium. Opening of genitalia near middle of visceral stalk. Right ocular retractor free from genitalia. Penis large; epiphallus well developed. Spermathecal duct long. Jaw with a few vestigeal rib-like thickenings, forming a median

projection on the cutting edge. Radula with tricuspid centrals and three tricuspid lateral teeth, marginals simple, thorn-shaped.

Distribution.—Eastern United States and Canada. Mainly an Appalachian genus, but spreading west of the Mississippi into the Ozark-Ouachita region.

(Παρὰ, next to + *Vitrea*, a palearctic genus.)

Dr. H. B. Baker (1931) has defined several subgenera and sections, based mainly upon details of the genitalia, composing for their discrimination the following:

Key to Subdivisions of Genus Paravitrea

A. Talon much longer than carrefour; penial apex divided into large, reflected, epiphallar limb and shorter caecum that receives retractor, but apical chamber not differentiated; spermoviduct little longer than combined lengths of free oviduct and vagina; shell corneous, closely coiled, with spiral striae as strong as or stronger than growth-lines; internal armature present in most stages of growth.
Subgenus *Pectovitrea* H. B. B.

AA. Talon shorter than carrefour; penial apex not divided (or with limb to retractor longer and with apical chamber well differentiated); shell with growth-lines much stronger than spirals.

B. Spermoviduct more elongate; apical penial chamber (when present) demarcated by sphincteric thickening; shell with gradually increasing whorls or with closely coiled sutural spiral; usually (except in *Parmavitrea*) with corneous epidermis and internal armature in juvenile stages.
Subgenus *Paravitrea* s. s.

C. Ovotestis consisting of 2 to 4 clavate, weakly lobate sacs; apical penial chamber weakly differentiated; radula with quadrate central and inner laterals; shell with close and regular growth-lines
Section *Paravitreops* H. B. B.

CC. Ovotestis consisting of 4 to 6 groups of alveoli; apical (papillate) penial chamber well differentiated; radula usually with longer central and laterals; shell with more widely and irregularly spaced growth-lines.

D. Free oviduct moderate; epiphallus with apical caecum; radular laterals with prominent entocones; shell corneous, with more gradually increasing whorls.....Section *Paravitrea* s. s.

DD. Free oviduct very long; epiphallus with transverse, glandular columns; laterals with weak entocones; shell hyaline, with more rapidly increasing whorls but with closely coiled spiral, which makes last whorl appear prominent.....Section *Parmavitrea* H. B. B.

BB. Spermoviduct stouter, about as long as combined lengths of free oviduct and vagina; apical penial chamber continuous with epiphallus and extending into large penial papilla that half fills basal chamber; shell hyaline, with more rapidly increasing whorls and more loosely coiled sutural spiral and apparently without internal armature at any stage..Subgenus *Petrovitrea* H. B. B.

Bibliographic references to these subgenera will be found under *Paravitrea* on the preceding page.

A number of the species of *Paravitrea* have very similar shells, and their characters change with age. Using shell characters only, it is difficult to construct a key to species which will be of much use, especially in the *capsella* group.

Key to species of Paravitrea

A. Surface closely, regularly, costulate-striate or grooved, at least above; umbilicus minute.
  B. Diameter 6 to 6.5 mm.; spire flat or slightly convex, of 6½ convex, narrow whorls, the suture deep. No internal teeth.....*P. clappi*
  BB. Diameter 2.5 to 3.5 mm.; spire but slightly convex, of 5½ to 6¼ closely coiled whorls.
    C. Without spiral striae.
      D. One to three radial rows of 5 or 6 teeth each, visible through the base .....*P. multidentata*
      DD. One to three radial barriers.....*P. lamellidens*
    CC. Spiral striae as strong as the growth striae.
      D. With radial barriers as in *lamellidens*, or none; umbilicus about 5½ times in diameter.....*P. walkeri*
      DD. Similar but without distinct raised growth-wrinkles; impressed lines more widely and irregularly spaced; spiral striae sharper; umbilicus 4½ times in diameter.....*P. variabilis*
AA. Surface with sculpture of unequally spaced radial grooves and striae.
  B. Eastern species.
    C. Diameter 7 to 7½ mm., toothless or with 1 to 5 teeth in each row.
      D. Whorls 7 to 7½, no teeth at any stage.....*P. placentula*
      DD. Teeth in young, persisting or absent in adults; shell very fragile, 8 to 8½ whorls.....*P. andrewsae*
    CC. Diameter 3 to 6 mm.
      D Umbilicus 4 times in diameter of 5 mm., 8 whorls; young with 2 teeth in a row.....*P. pilsbryi*
      DD. Umbilicus smaller
        E. About 6 whorls or more.
          F. Young with one or more series of 3 teeth each.
            G. Diameter up to 4.7 mm., 6-6½ whorls....*P. reesei*
            GG. Diameter 6 mm., 6¾ whorls; teeth in young only *P. capsella tridens*
          FF. Young with teeth in pairs or wanting.
            G. Diameter 4.5 mm., 6 whorls, adult toothless. Alabama .....*P. conecuhensis*
            GG. Larger, diameter 5-6 mm. *P. capsella, P. c. lacteodens, P. calcicola*
          FFF. Young having smooth radial barriers; adult with 7½ whorls, diameter 6 mm.....*P. pontis*
          FFFF. No teeth at any stage; umbil. 4.2 times in diameter of about 6 mm., 5½-6 whorls.....*P. petrophila*
        EE. 4½ whorls in diameter of 4.5 mm.; no teeth; Alabama *P. smithi*
  BB. Species from on or west of the Mississippi River.
    C. Young usually with pairs of teeth.
      D. Adults toothless, with dome-shaped spire and subbasal periphery; diameter about 6 mm.....*P. significans*
      DD. Depressed, diameter 1.5 mm., 4 whorls.....*P. (?) roundyi*
    CC. Toothless at all stages.
      D. Discoidal, diameter 4.5-5.5 mm., 5-5⅔ whorls, aperture subtriangular *P. simpsoni*
      DD. Aperture crescentic.

E. Diameter 5.7 to 6 mm., 6 whorls.....*P. petrophila*
EE. Diameter 8 mm., 5¼ whorls, coarse striation.....*P. aulacogyra*

PARAVITREA MULTIDENTATA GROUP (section *Paravitreops* H. B. Baker)

Key to Species of Section Paravitreops (by H. B. Baker)

A. Shell smaller; growth-wrinkles quite prominent; internal armature usually present (even in adults).
B. Penial apex with apical insertion of retractor and lateral entrance of vas deferens; shell slightly smaller; umbilicus (of largest individuals) more than ¼ major diameter (relatively narrower in smaller shells); northern U. S., south in mountains to Tennessee and Missouri.....*P. multidentata* (Binney)
C. Internal armature consisting of radial rows of teeth.....typical form
CC. Internal armature consisting of radial barriers
form *lamellata* H. B. B.
BB. Penial retractor inserting on base of epiphallus, which enters penial apex; shell slightly larger, with umbilicus less than $\frac{1}{10}$ major diameter; Great Smoky Mountains.....*P. lamellidens* (Pils.)
AA. Shell larger; growth-lines deep and subregular, but growth-wrinkles very weak; internal armature absent (as far as known); Great Smoky Mountains
P. clappi (Pils.)

Paravitrea multidentata (Binney) Figs. 184: 6, 6a; 185 (part).

Helix multidentata Binney, 1840, Jour. Boston Soc. Nat. Hist. 3: 425, pl. 22, fig. 5 (Massachusetts); 1851, Terr. Moll., 2: 258, pl. 48, fig. 3.

Hyalina multidentata Binney, Morse, 1864, Jour. Portland Soc. Nat. Hist., 1: 15, figs. 30, 31, pl. 6, fig. 32 (jaw and teeth).

Zonites multidentatus W. G. Binney, 1878, Terr. Moll., 5: 133, pl. 3, fig. x (teeth).

Vitrea multidentata Binney, Pilsbry, 1903, Proc. Acad. Nat. Sci. Phila., p. 208, pl. 10, fig. 6; 1906, p. 560.

Vitrea (*Paravitrea*) *multidentata* G. H. Clapp, 1920, Nautilus, 33: 115, pl. 3, figs. 2, 4, 6-12, 14, 16.

Gastrodonta multidentata Binn., Latchford, 1935, Ottawa Field-Nat., 49: 60.

Paravitrea (*Paravitreops*) *multidentata* (A. Binney), H. B. Baker, 1928, Proc. Acad. Nat. Sci. Phila., 80: 31, pl. 6, figs. 1-3 (anatomy); 1931, same Proc., 83: 100.

Paravitrea (*Paravitreops*) *lamellidens* (Pilsbry) H. B. Baker, 1928, Proc. Acad. Nat. Sci. Phila., 80: 31, pl. 4, figs. 9, 10 (anatomy; not of Pilsbry, 1898).

Paravitrea (*Paravitreops*) *multidentata lamellata* H. B. Baker, 1931, Proc. Acad. Nat. Sci. Phila., 83: 100.

Paravitrea multidentata lamellata H. B. Baker, 1929, Nautilus, 42: 88.

Gastrodonta multidentata umbilicaris Ancey, 1887, Conch. Exch., 1: 55.

"Shell depressed, sub-planulate above, very thin, pellucid; epidermis smooth, shining; whorls six, narrow, slightly convex, increasing but slowly in diameter, lines of growth hardly visible; suture impressed; aperture semi-lunate, narrow; lip acute; umbilicus very small, rounded, not exhibiting any of the volutions; base convex, indented around the umbilicus.

Fig. 184. 1, 1a, 1b, *Paravitrea clappi*, type. 2, 3, 3a, 3b, *Paravitrea lamellidens*, young, diam. 1.4 mm., and adult, Thunderhead. 4, 4a, *Paravitrea walkeri*, type; 5, specimen from Talassee Ford. 6, 6a, *Paravitrea multidentata*, West Granby, Hartford Co., Conn. 7, *Paravitrea multidentata* form *lamellata*, Garrettsville, O. 8, 8a, *Paravitrea clappi*, var., Clingman Dome, No. 2490 Clapp Coll. Small outlines actual size, the shaded figures enlarged. Pilsbry del.

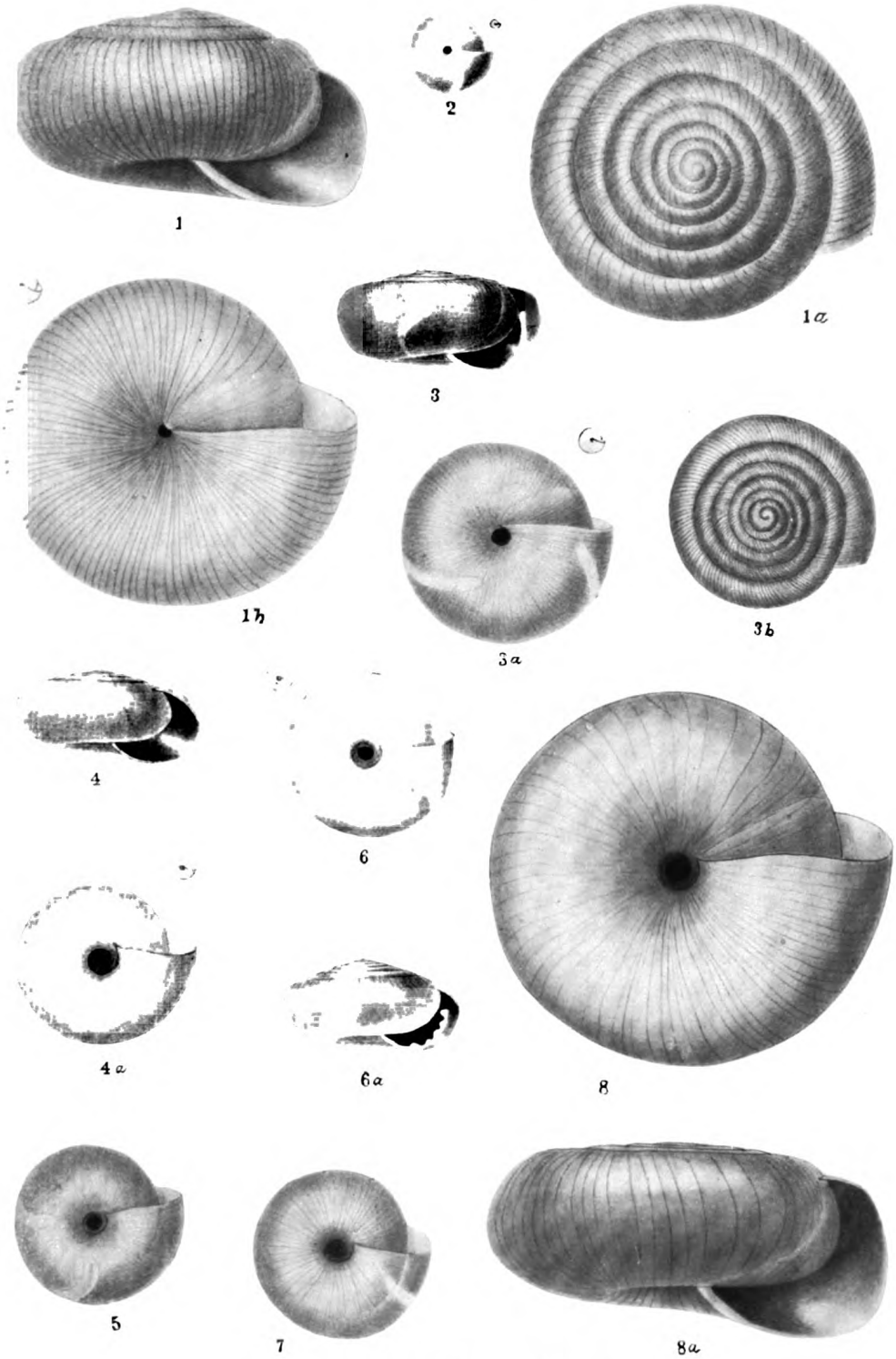

Fig. 184. See bottom of page 352 for legend.

Two or more rows of very minute, white teeth, radiating from the umbilicus, are seen through the shell, within the base of the last whorl. Greatest transverse diameter one-eighth of an inch." (Binney.)

ONTARIO: Iron Island, Lake Nipissing; Ontario, Huron and York counties (J. Oughton); Ottawa (Fairbairn). QUEBEC: Kings Mountain, Ottawa Co., and Hall City (Latchford).

MAINE: Cumberland, Oxford and York counties. VERMONT: "eastern slope of Green Mountains," Type loc.; Middlebury, Addison Co. MASSACHUSETTS: Westport, Bristol Co. RHODE ISLAND: Tiverton (Thomson). CONNECTICUT: Hartford Co. NEW YORK: Albany, Essex, Monroe, Onondaga, Wayne, Tompkins, Washington, Herkimer, Rensselaer and Ulster counties. PENNSYLVANIA: Allegheny, Beaver and Indiana counties. OHIO: Portage and Licking counties. MICHIGAN: Marquette, Ontonagon, Emmet, Grand Traverse, Benzie, Iosco, Saginaw and Kalamazoo counties (Walker). INDIANA: LaPorte Co. (Daniels). MARYLAND: Garrett Co. VIRGINIA: Rockbridge Co. WEST VIRGINIA: Pendleton, Pocohontas and Monroe counties. NORTH CAROLINA: Cranberry, Avery Co.; summit of Mt. Pisgah, Madison Co. KENTUCKY: Breathitt Co. TENNESSEE: Carter, Unicoi and Marion counties. ALABAMA: Jackson, Madison and Lauderdale counties. ARKANSAS: Magazine Mt., Logan Co.

This gem-like little snail has no near relatives in the northern states, being the only *Paravitrea* north of Mason & Dixon's Line. It spreads from the western counties of Maine west to the upper peninsula of Michigan, the northern point being Lake Nipissing, Ontario. Southward, it follows the Appalachian system to the northern counties of Alabama; but from collections seen, it seems not to have spread far east or west except for an outlying, isolated occurrence on Magazine Mountain, Arkansas, where it was found in some abundance in a talus on the north side of the summit.

"I have examined the living animal of *Paravitrea multidentata* under the binocular. It moves slowly and seems to have some difficulty with the balance of the shell on the elongate and high foot. The sole has no indication of longitudinal furrows and shows no pedal waves in locomotion. Commonly, the snail moves along like a worm, with coarse, irregular contractions and expansions that affect the entire foot, but it can also glide along without these disturbances." (H. B. Baker.)

Ancey has defined a var. *umbilicaris*, "characterized by its more compressed form, less high body-whorl, larger umbilicus and by the absence (under a lens) of any radiating striae.... Mountains of eastern Tennessee, collected by Mrs. George Andrews." Dr. Bryant Walker, who possessed the type, considered it synonymous with *multidentata*.

H. B. Baker gave the following account of *multidentata*. "My material comes from Cheboygan County Michigan; two animals were dissected. As the anatomy is similar in many respects to that of *P. capsella*, only distinctive points will be mentioned. Living animal; mainly white, but with large eyes and their stalks darker and foot grayish. Ovotestis (Fig. 186:2): two clavate lobules, imbedded 3 whorls below apex; duct less convoluted; talon fusiform, with about half its length above entrance of duct; carrefour ellipsoid. Albumen gland: extensive but thin. Uterus: relatively shorter. Free oviduct: medium in length. Spermatheca: sac ellipsoid,

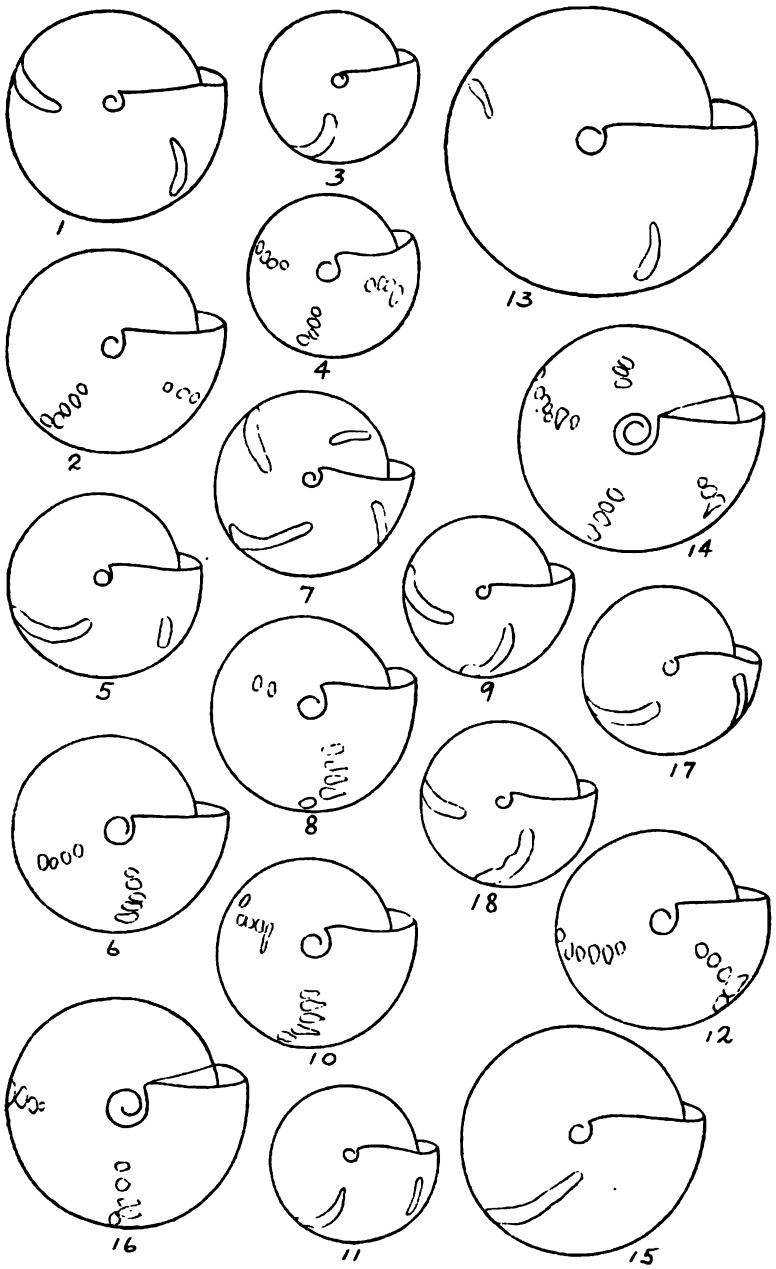

Fig. 185. *Paravitrea multidentata*: 1, Oakdale, Morgan Co., Tenn.; 4, Sherwood, Franklin Co., Tenn.; 6, Cranberry, N. C.; 8, Litchfield, N. Y.; 12, 16, Quebec; 14, Stevenson, Ala. *P. m. lamellata*: 3, Anderson, Tenn.; 5, Banners Elk, N. C.; 7, Litchfield, N. Y.; 9, Deering, N. H.; 11, Norway, Me. *Paravitrea lamellidens*: 1, 13, 15, 17, 18, Thunderhead. All × 10. (After G. H. Clapp.)

imbedded on side of albumen gland. Vagina: quite short and stout. Prostate: little more than half length of uterus. Epiphallus (Fig. 186:3): relatively shorter; walls thickened and glandular, but without transverse columns. Penis: apical $\frac{1}{3}$ swollen, with heavy longitudinal plicae; basal $\frac{2}{3}$ more slender, with weaker folds. Radular formula (Fig. 186:1): 14-3-1-17; 59 transverse rows counted. Central: base more nearly square; mesocone less elongate and ectocones relatively stronger than in *P. capsella*. First lateral: base almost square; entocone large." (H. B. Baker, 1928.)

"Animals collected during the summer (Aug. 15-30) in the Roan Mt. region are sexually immature, although some of the specimens are larger than usual. On the other hand, those obtained in the spring near Dove, Marion Co. (Mar 31) and in Limestone Cove, Unicoi Co. (April 6-8) are fully ripe, as are also individuals of the form *lamellata* from the last locality. The anatomy of these southern individuals is very similar to that of specimens from northern Michigan, but that of some of the examples of *lamellata* approaches the thin-walled penis with apical thickenings that has been described in a paratype (1928)." (H. B. Baker.)

In many localities from Maine, Ontario and Michigan to Tennessee it is accompanied by the form *lamellata*. The relation existing between *multidentata*, *lamellata* and *lamellidens* has been considered by the author, 1903, Dr. G. H. Clapp, 1920, and Dr. H. B. Baker, 1931. Dr. Clapp found the umbilicus constantly differing, "contained 5.5 times in the diameter of the shell in *multidentata* and 8.7 times in *lamellidens*.... *Multidentata* when adult has a well-defined callus connecting the end of the lip which is entirely absent in *lamellidens*."

Paravitrea multidentata form *lamellata* H. B. Baker (Figs. 184:7; 185:3, 5, 7, 9, 11). "Shell: apparently identical with, but not attaining maximum size of typical *P. multidentata*. Internal armature: consisting of curved, obliquely radial barriers. Umbilicus: 7.5 times in major diameter.

"Altitude 1.32 mm., maj. diam. 2.49 mm., min. diam. 2.30 mm., alt. apert. 1.08 mm., diam. apert. 132 mm.; 6 whorls.

"Type locality: valley of Blue Ridge in Rockbridge County, near Snowden, Virginia (A.N.S.P. 137443), but known to occur from Cheboygan County, Michigan, east to Maine and south to the Roan Mountain Region between Tennessee and North Carolina. It is always much less abundant than the typical form, but is more frequent in the southern part of its range." (H. B. Baker.) Other localities are: Ottawa, Ontario; Deering, New Hampshire; Connecticut; Ithaca and Greenwich, New York; Ohio; Avery and Mitchell counties, N. C.; Carter and Unicoi counties, Tennessee. Also Alabama.

On account of the occurrence of this form associated with normal *multidentata* apparently throughout the range of the latter, and always in fewer individuals, I have regarded it (1903) as a sporadic variant, not a real

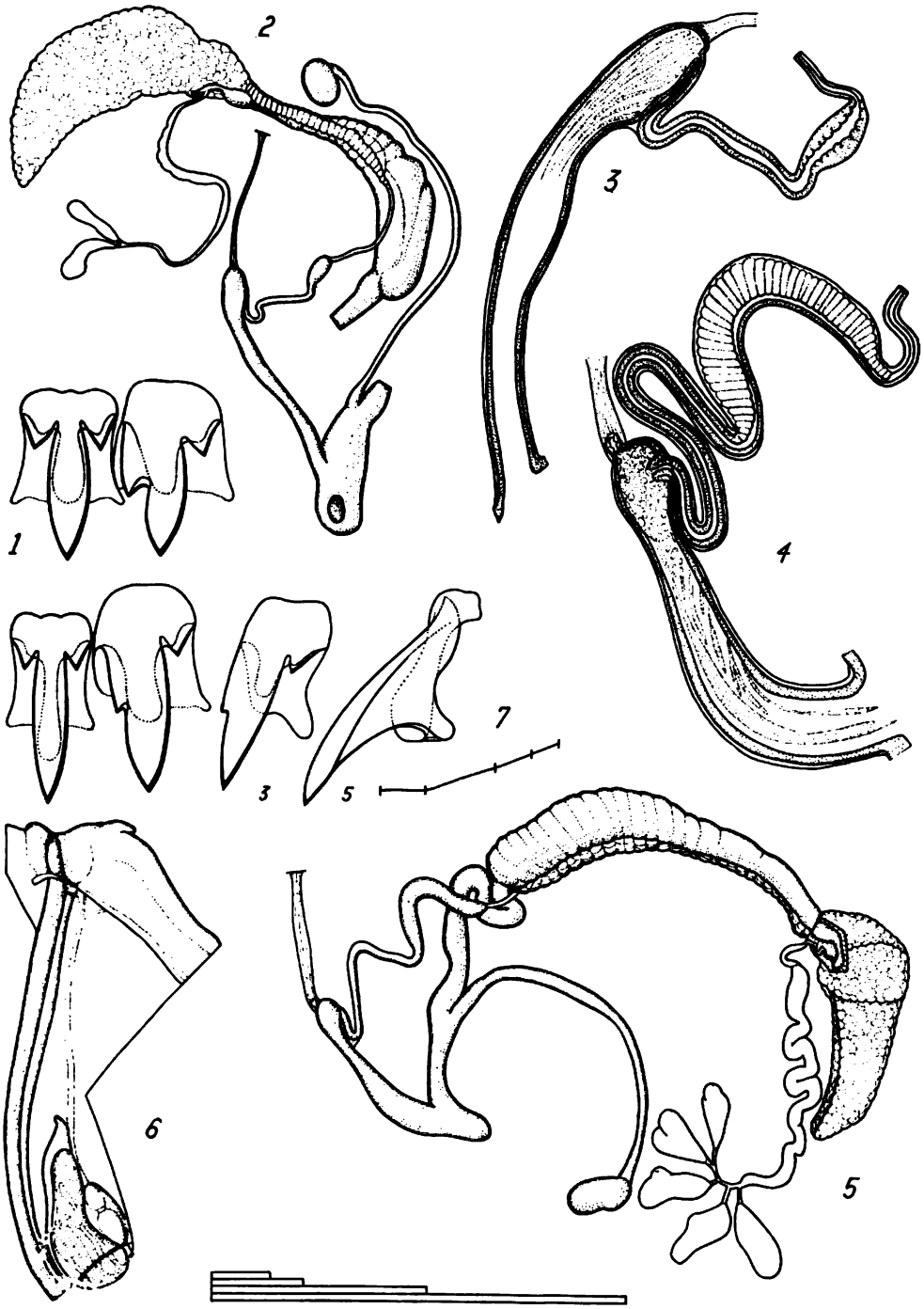

Fig. 186. 1-3, *Paravitrea multidentata*, Michigan. 4-7, *P. pontis*, Virginia (after H. B. Baker).

race or subspecies. Dr. Clapp (1920) considered these lamellate specimens to be *P. lamellidens*. Dr. Baker has given the name *lamellata* to this form as a "new variety," with this note: "Dr. Pilsbry (l. c.) has already carefully differentiated between this form of *P. multidentata* and the similarly armed *P. lamellidens* from the Great Smokies; in addition, the latter has a considerably larger apical whorl, more slowly expanded later whorls and a greater maximum size (slightly larger than that attained by typical *multidentata*). Although I agree with him that *P. multidentata lamellata* is little more than a sporadic tendency towards an incipient race, it is not known to intergrade with the typical form and the single paratype dissected differs slightly in anatomy."

In a specimen from near Natural Bridge, Virginia, "the anatomy is very similar to that of *multidentata*, and will be compared to the latter. Talon (Fig. 131: 10), caecum recurved. Prostate about three-fourths as long as uterus. Epiphallus (Fig. 131:9) relatively longer and more slender. Penis smaller, apical knob with a few large papillae, remainder thin-walled and almost featureless. Radula formula 13-3-1-16, 57 transverse rows counted." (H. B. Baker.)

Paravitrea lamellidens (Pilsbry) Figs. 184: 2, 3, 3 a, 3 b; 185: 1, 13, 15, 17, 18.

Gastrodonta lamellidens Pilsbry, 1898, Nautilus, 11: 134; 1900, Proc. Acad. Nat. Sci. Phila., p. 145.—Ferriss, 1900, Nautilus, 14: 52, 58.—Walker & Pilsbry, 1902. Proc. Acad. Nat. Sci. Phila., p. 437.

Vitrea lamellidens Pilsbry, 1903, Proc. Acad. Nat. Sci. Phila., p. 208, pl. 10. figs. 2, 3.—Clapp, 1920, Nautilus, 33: 115.

Paravitrea (Paravitreops) lamellidens (Pilsbry), H. B. Baker, 1931, Proc. Acad. Nat. Sci. Phila., 83: 102, pl. 17, figs. 1-3 (anatomy).

The shell is depressed with low-conoid spire of many closely coiled whorls, and equably rounded periphery; umbilicate, the umbilicus contained about 8.5 to 10 times in the diameter; cinnamon-buff (but of a darker reddish brown when fresh). Surface glossy; the first whorl pale and smooth, the rest of the upper surface closely, regularly and strongly striate, the striation much weaker on the peripheral and basal surfaces. The aperture is narrowly lunate, the peristome thin, dilated close to the columellar insertion. Cavity of the last whorl obstructed by one to three white, curved, obliquely protractive radial barriers within the outer and adjacent basal walls.

Height 1.9 mm., diameter 3.7 mm.; 6½ whorls.
Height 1.6 mm., diameter 3.5 mm.; 6½ whorls.

TENNESSEE: Thunderhead, Great Smoky Mts., Type and paratypes 71378 A.N.S.P. (Ferriss, Pilsbry and others). Blount Co. 10 mi. north of N. C. line (Archer); Talassee Ford of Little Tennessee River, Monroe Co. (Ferriss). NORTH CAROLINA: Highlands, and 2 miles south of Gneiss, Macon Co. (Archer). Murphy, Cherokee Co. and Nantahala Gorge, Swain Co. (Archer). Stratton's Bald, Graham Co. (Ferriss). Black Mts. at Bluff Mt. and Pinnacle of the Blue Ridge, Yancey Co. (B. Walker).

A glossy and brilliant, dark reddish-brown shell, with the closely coiled whorls and size of *P. multidentata*, but differing from that species in never

having radial rows of teeth, but having obliquely radial laminae, three in young, rarely more than one or two in adult shells. The surface shows no spiral striation under an enlargement of 50 or 75 diameters; it is rather deeply, closely and regularly costulate-striate; and the width of the umbilicus is contained about ten times in the diameter of the shell.

The type locality is a steep slope close to the middle summit of Thunderhead, deeply covered with a talus of angular stones, small and large, in the interstices of which there is considerable mold which supports a herbaceous growth. *Vitrinizonites, Ventridens acerra* and a few *Stenotrema depilatum* are the chief dwellers among the moss of the superficial stones, but a " quarry " must be opened to find *P. lamellidens.* Each one of the wet stones must be closely examined on all sides before it is thrown out. The snails occur from a few inches to a foot or more below the surface of the talus.

A very large shell, diameter 3.8 mm., found by Mr. Ferriss on Thunderhead in 1900, has no lamellae whatever—a feature of senility. Even in the youngest individuals I have seen, such as Fig. 184:2, diameter 1.4 mm., there are two or three barriers, though one would expect rows of teeth in so early a stage. Not one *P. multidentata* has yet been found with *lamellidens,* which lives mainly in the moist heights. We did not find it in the " coves " below.

" The following anatomical description is founded on preserved paratypes (A.N.S.P. 82773) which were kindly lent me by Dr. Pilsbry; only salient differences from *multidentata* will be noted.

" Animal faded. Lung wall 5 times as long as its base and $3\frac{1}{2}$ times length of kidney. Kidney twice as long as its base and over $1\frac{1}{2}$ times length of pericardium. Ovotestis (Fig. 187:2) consisting of 4 long-clavate sacs; talon teat-shaped. Spermathecal stalk more evenly enlarged towards base. Prostate almost as long as uterus. Epiphallus exceptionally long; glandular region elongate-fusiform; terminal end continuous with penial apex. Penis (Fig. 187:3) with fewer, heavier folds internally; oblique ones near apex broken into rows of papillae. Penial retractor inserting on basal loop of epiphallus. Jaw rather heavy, with prominent median projection. Radular formula (Fig. 187:1) is $16 + 3 + 1 + 19$, with 51 transverse rows." (H. B. Baker.)

Paravitrea clappi (Pilsbry) Fig. 184: 1, 1 a, 1 b.

Gastrodonta clappi Pilsbry, 1898, Nautilus, 12: 86; 1901, Nautilus, 15: 37, pl. 2, figs. 8, 9; 1900, Proc. Acad. Nat Sci. Phila., p. 144.—Ferriss, 1898, Nautilus, 12: 99; 1901, Nautilus, 15: 58.

Vitrea clappi (Pils.). Pilsbry, 1903, Proc. Acad. Nat. Sci. Phila., p. 207, pl. 10, figs. 1-1*c*, 8, 8*a*.

Paravitrea (Paravitreops?) clappi (Pilsbry), H. B. Baker, 1931, Proc. Acad. Nat. Sci. Phila., 83: 102, pl. 17, figs. 4-6 (anatomy).

" Shell depressed, shaped much like *G. multidentata*, the upper surface somewhat convex, lower surface flattened, deeply indented around the

minute umbilicus; thin, a little transparent, deep chestnut-amber colored and brilliantly glossy; composed of fully 6½ very narrow and closely coiled whorls, the initial one rather coarse, the first half turn smooth, the rest of the shell sculptured with closely spaced impressed radiating grooves, which extend with undiminished strength over the base; last whorl broadly rounded at the periphery. Aperture very narrowly lunate, the convex outline of the crescent somewhat angular in the middle; peristome thin and simple." Height 3.2 mm., diameter 5.8 mm., umbilicus 0.2 mm.; 7 whorls. Type.

TENNESSEE-NORTH CAROLINA boundary range: Thunderhead; Mirey Ridge, Type 73648 A.N.S.P.; Clingman Dome, at about 5800 ft.; Blockhouse Mt., south of Thunderhead; Mt. LeConte; Mt. Guyot; Indian Gap; Newfound Gap, on the Big Pigeon River. Most localities are near or above the 5000 foot contour, and the extremes about 13 miles apart.

The type locality is Mirey Ridge. The type (Fig. 184:1, 1*a*, 1*b*), has a minute umbilicus, about 0.2 mm. wide, and the spire of 7 whorls is convex. In all other specimens seen the spire is lower, either flat or but slightly convex; and with one exception, all have the same minute umbilicus.

In one specimen, from Clingman Dome, No. 2490 of the collection of Mr. George H. Clapp (Fig. 184:8, 8*a*), the umbilicus is decidedly larger, 0.54 mm. wide, the shell having a diameter of 6.2 mm., height 3 mm., with 6½ whorls, the spire nearly plane. Below "The Balsams" on the western end of Clingman, a few hundred feet down the Tennessee side, I found two half-grown specimens of about 3.8 mm. diameter, also having the umbilicus somewhat wider than in the Mirey Ridge type, though less wide than Clapp's specimen, and the spire nearly flat. It is unsafe to draw conclusions from the three specimens thus far known from Clingman, but perhaps that peak has a race with more depressed spire and wider umbilicus. The figures in Nautilus, 15, pl. 2 represent this form.

Four localities are now known for this species, the Thunderhead, Mirey Ridge and Clingman shells coming from very near, but a little north of the interstate boundary, in Tennessee; the Block House shell from south of the boundary, in North Carolina. The shells are extremely fragile, like most forms living on the Clingman and Thunderhead conglomerates. The figures do not sufficiently emphasize the radial grooves, which are strongly impressed.

"Animals from the 'Balsams,' Clingmans Dome, Blount Co. (A.N.S.P. 76762) have been examined; unfortunately, these are very immature. Female genitalia still thread-like. Penis and epiphallus (Fig. 187:6) still small and featureless but apparently similar to those of *multidentata*. Jaw (Fig. 187:5) quite heavy; median projection weak. Radular formula (Fig. 187:4) is (26–28) + 3 + 1 + (29–31), with 53 transverse rows. Central considerably smaller than first lateral; both squarish." (H. B. Baker.)

(Named for George H. Clapp.)

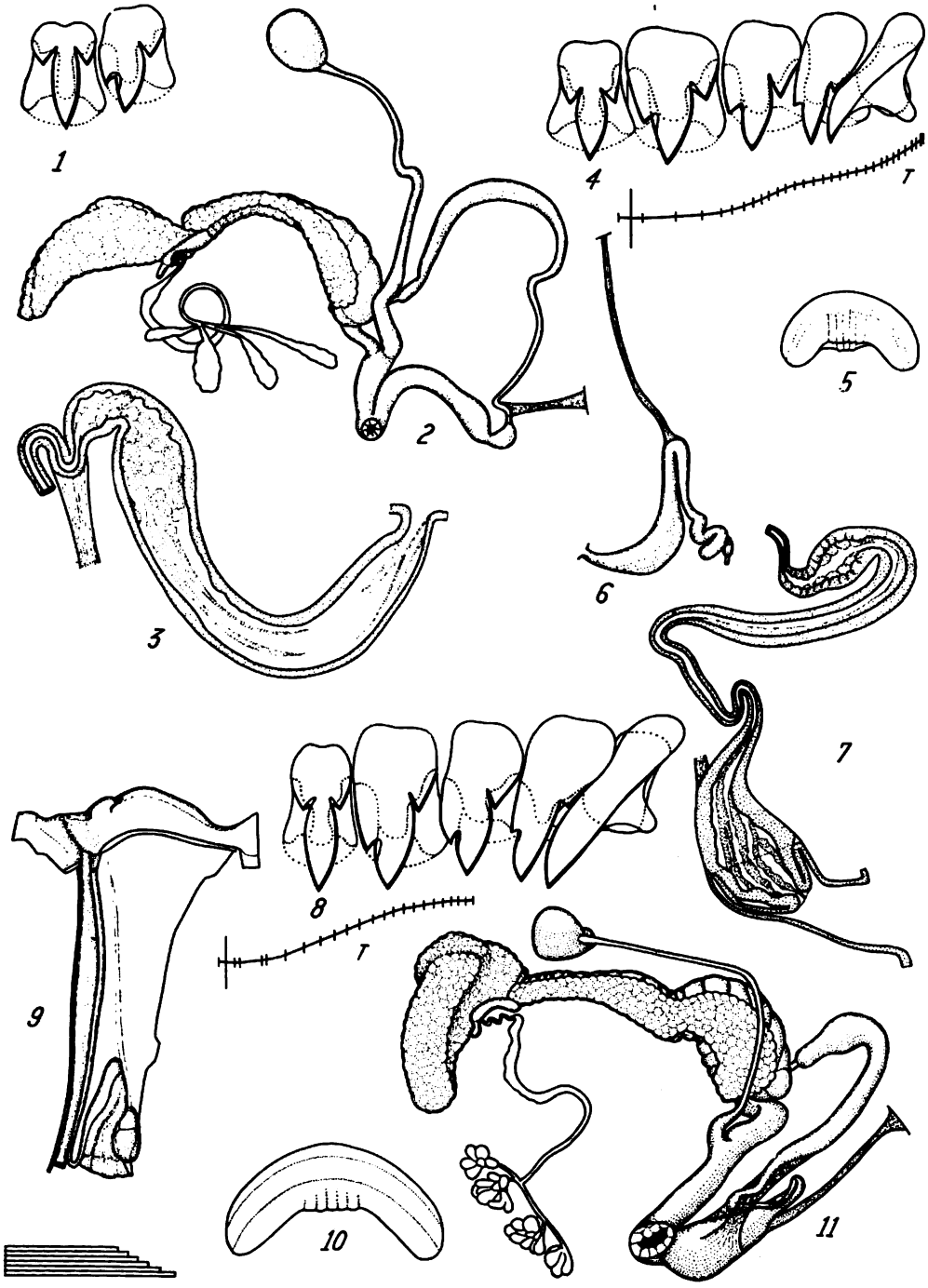

Fig. 187. 1, *Paravitrea lamellidens,* central and first lateral teeth; 2, genitalia; 3, diagram of penis. 4, *Paravitrea clappi,* radula; 5, jaw; 6, penis and epiphallus, immature. 7, *Paravitrea petrophila,* diagram of penis and epiphallus; 8, radula; 9, pallial complex; 10, jaw; 11, genitalia (after H. B. Baker).

Subgenus PECTOVITREA H. B. Baker

Key to Species of Subgenus Pectovitrea (by H. B. Baker)

A. Apical chamber of penis almost as long as recurved one; shell more polished; growth-lines with wider and more irregular interspaces that are almost flat; spiral striae sharper and quite continuous; internal armature (only in young shells) of denticulate barriers; southern Cumberlands.....*P. variabilis* H. B. B.

AA. Apical penial chamber about ⅓ as long as recurved one; shell duller; growth-lines with narrower and more regular interspaces that form weak growth-wrinkles; spiral striae about as strong as growth-lines; internal armature usually present in adults; southen Appalachians proper.....*P. walkeri* (Pils.)

B. Internal armature consisting of radial rows of teeth, typical form.

BB. Internal armature consisting of smooth, radial barriers, form *dentata* H. B. B.

Paravitrea walkeri (Pilsbry) Fig. 184: 4, 4 a.

Gastrodonta walkeri Pilsbry, 1900, Proc. Acad. Nat. Sci. Phila., p. 146.—Ferriss, 1900, Nautilus, 14: 52, 58.

Vitrea walkeri Pilsbry, 1903. Proc. Acad. Nat. Sci. Phila., p. 209, pl. 10, figs. 4, 4a, 5.

Paravitrea (Paravitreops) walkeri dentata H. B. Baker, 1929, Nautilus, 42: 88.

Paravitrea (Pectovitrea) walkeri (Pilsbry) and form *dentata* H. B. Baker, 1931, Proc. Acad. Nat. Sci. Phila., 83: 100, pl. 16, figs. 6-8.

Paravitrea walkeri form *lamellata* H. B. Baker, 1931, Proc. Acad. Nat. Sci. Phila., 83: 100 (in key; error for *dentata*).

"Size of *G. lamellidens*, and general contour about the same; whorls 5¾; umbilicus much wider and more open, its diameter contained about 5½ times in that of the shell; *surface rather dull to the naked eye*, under strong magnification seen to be extremely finely and irregularly plicatulate-striate, *the striae cut into minute beads by close decussating, impressed, encircling lines*. No internal laminae or teeth in adults, or with two transverse, curved barriers, as in *G. lamellidens*. Alt. 1.45, diam. 2.9, width of umbilicus 0.5 mm." (Pilsbry.)

North Carolina: Cheoah River near junction of Yellow Creek, Graham Co. (Ferriss). Type 77750 A.N.S.P. Tuskegee Mountain between heads of Tuskegee and Yellow Creeks (Sargent). Tennessee: Tellico River gorge near mouth of Laurel Creek (H. B. Baker) and Tallassee Ford, Monroe Co. (Ferriss.)

This form is about the size of *P. multidentata*, ordinarily measuring about 2.9 mm., with 5½ to 5¾ whorls, and an umbilicus contained about 5½ times in the diameter of the shell, much as in *multidentata*. It is either toothless or has radial barriers of the *lamellidens* type, but the wider umbilicus and minutely decussate surface readily separate the species from *lamellidens*. It differs from *P. clappi* in the sculpture and in size. It resembles *P. lamellidens* and *multidentata*, but is ornamented with densely crowded spiral lines, and very conspicuously finer growth-striae, and has a wider umbilicus. A half-grown specimen of the type lot has two curved internal laminae, like *P. lamellidens*, with finely denticulate edges; the others have no internal armature. Four specimens from Tallassee Ford of the Little Tennessee, Monroe County, Tenn., have the spirals rather more spaced, and each has two internal denticulate transverse laminae; umbilicus about one-seventh the diameter of shell.

Of the specimens taken by Sargent, one from Ramp Cove has an internal barrier, another none; and those from Sam Blair's, at Tallassee Ford, vary in the same way. The decussated sculpture is constant.

The species will be most easily recognized by the finer radial sculpture and wider umbilicus than *lamellidens,* as the spirals are nearly or quite invisible under an ordinary lens, though their development is an essential specific character.

(Named for Bryant Walker.)

Paravitrea walkeri form *dentata* H. B. Baker.

"Shell: similar to *P. walkeri,* but with weaker and less continuous growth-wrinkles, so that apical side of last whorl, under high light, appears to be decorated with minute points, which are arranged in both spiral and incremental series. Internal armature: similar to typical *P. multidentata,* but with individual teeth of each obliquely radial row even higher and more distinct. Umbilicus: 4.5 times in major diameter. Altitude 1.65 mm., maj. diam. 215 (3.55 mm.), min. diam. 197 (3.26 mm.), alt. apert. 79 (1.31 mm.), diam. apert. 114 (1.19 mm.); 6½ whorls." (H. B. Baker.)

TENNESSEE: in leaf humus at base of slate ledges in gorge of Tellico River, just above mouth of Laurel Creek and about 1½ miles east of Tellico Plains, Monroe County (H. B. Baker), Type A.N.S.P. 147187.

"Although the armature of this form is more different from typical *walkeri* than typical *multidentata* is from form *lamellata,* a lot of 22 specimens, collected at and near the type locality of *dentata,* contains three individuals with the smooth internal barriers of typical *walkeri!*

"The larger paratypic animals of the dentate form are fully mature (Aug. 10) but two animals of the lamellate form happen to be immature. In the following anatomical notes on *dentata,* only significant differences from *variabilis* will be noted.

"Sole narrowly rounded posteriad. Kidney 2½ times as long as its base. Talon (Fig. 189:7) twice as long as carrefour. Free oviduct and vagina more elongate; base of spermathecal stalk more swollen. Prostate slightly shorter than uterus. Penis (Fig. 189:6) with arm receiving vas deferens very much longer than short apical caecum. Jaw thinner; median point prominent. Radular formula (Fig. 189:8) is (15–16) + 3 + 1 + (17–18), with 57 transverse rows; central and first lateral subequal." (H. B. B.)

Paravitrea variabilis H. B. Baker Fig. 188.

Paravitrea (*Paravitreops*) *variabilis* Baker, 1929, Nautilus, 42: 89, pl. 3, figs. 11-14.
Paravitrea (*Pectovitrea*) *variabilis* Baker, 1931, Proc. Acad. Nat. Sci. Phila., 83: 99, pl. 16, figs. 9-11.

"Shell: similar to *P. walkeri,* but more polished. Color: apex almost colorless; remainder corneous with light chestnut tinge and with a narrow, dark chestnut line just below suture. Whorls: 6½, similar to *P. walkeri,* but forming slightly higher spire. Sculpture: apical whorl almost smooth; second whorl with impressed growth-lines at quite regular intervals; later

whorls with closely but somewhat irregularly spaced, impressed growth-lines, which are weaker on base, and with microscopic, closely spaced, spiral, impressed lines, which are almost as prominent on basal as on apical side. Umbilicus: 4.6 times in major diameter. Aperture and peristome: much as in *P. walkeri*. Internal armature; lacking in adults; half-grown shells with 1 to 3, low lamellae, which are almost vertical and about ½ length of periphery of whorl, and which usually exhibit weak and irregular subdivision into 5 or 6 points (Fig. 188 b).

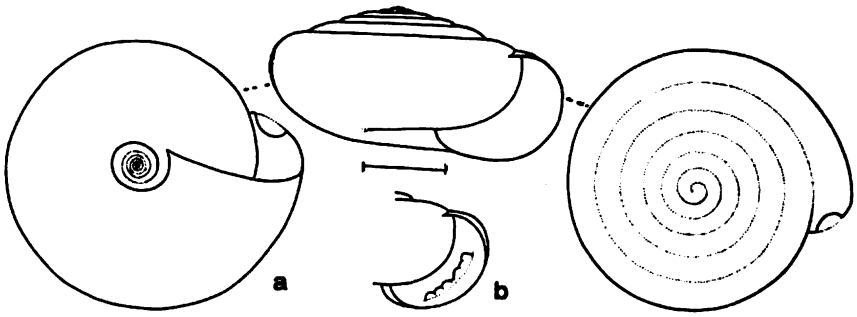

Fig. 188. *Paravitrea variabilis*, a, type × about 10; b, aperture of halfgrown shell from Walden Ridge. Scale line = 1 mm. (After H. B. Baker.)

" Altitude: 1.81 mm., maj. diam. 197 (3.57 mm.), min. diam. 175 (3.17 mm.), alt. apert. 75 (1.36 mm.), diam apert. 112 (1.52 mm.); whorls 6½." (H. B. Baker.)

TENNESSEE: leaf humus among sandstone rocks in a valley of the Cumberland escarpment, about 2 miles northwest of Pikeville, Bledsoe County, alt. 1100 ft., Type A.N.S.P. 147190. Also found on slopes of Walden Ridge east of Pikeville and on the Cumberland escarpment near Let and near Cannon Creek in Bledsoe County; also Martin Spring, at Dove, Marion County Underlying rocks are limestone at Dove, but sandstone at the other localities. (H. B. Baker.)

" As indicated above, this species is most like *P. walkeri*, but the surface of the shell in *P. variabilis* is without distinct, raised growth-wrinkles (i. e., the interspaces between growth-lines are almost flat), the impressed growth-lines are more widely and irregularly spaced and the spiral striae are sharper and more nearly continuous. In addition, the internal armature (of young shells) is almost intermediate in structure between that in typical *walkeri* and that in var. *dentata*, although each bar is shorter and more nearly vertical than in either *P. walkeri* or *P. multidentata*. *P. variabilis* is the only small *Paravitrea* that I found in the Sequatchie Valley (or in the southern Cumberlands), but it is superficially similar to, and has probably been confused with *P. multidentata* and var. *lamellata*.

" Some of both the summer (July 16-20) and the early spring (Mar. 29) animals of this species are fully mature. The following anatomical description is mainly based on paratypes (summer animals).

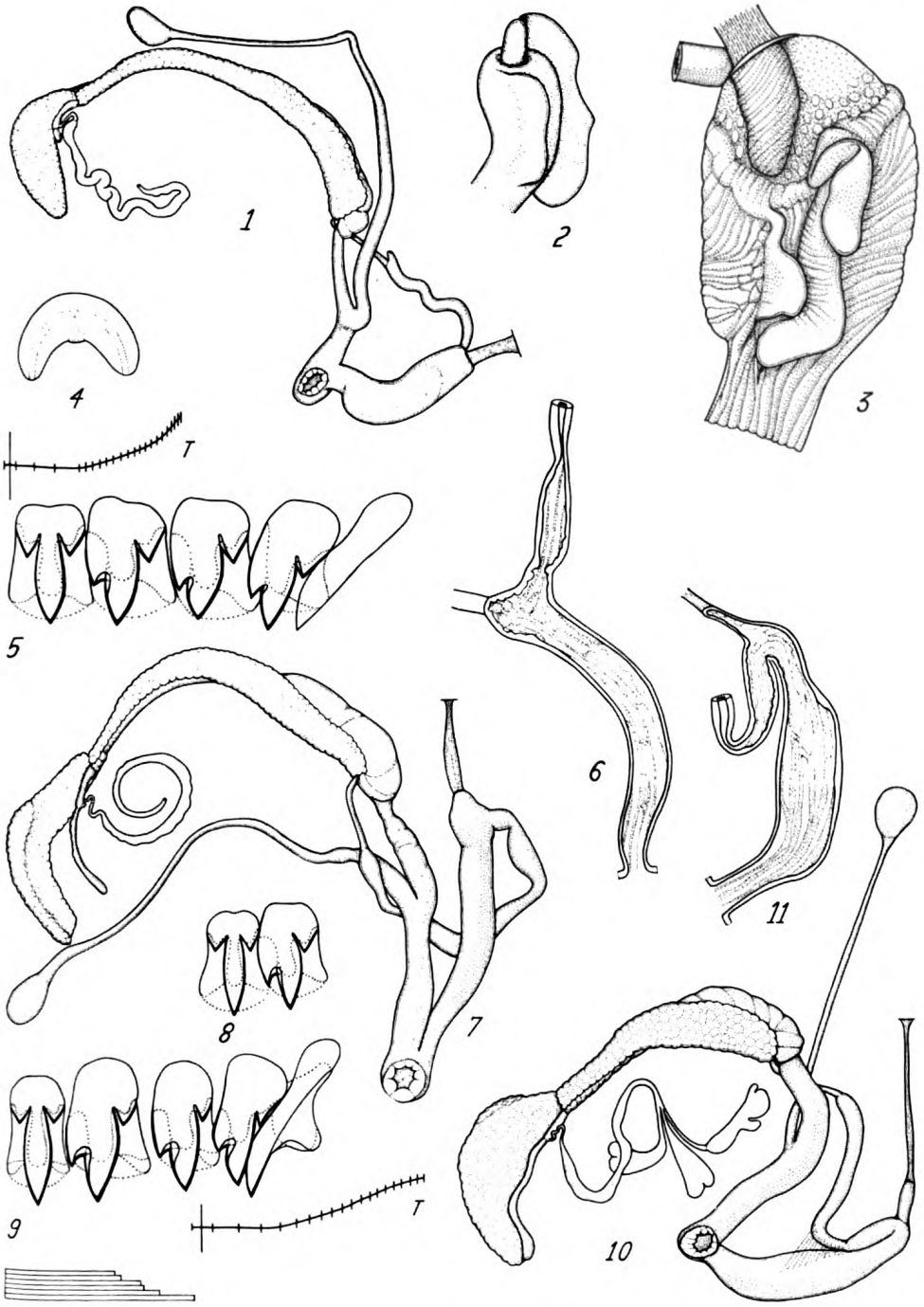

Fig. 189. 1, *Paravitrea andrewsae,* Unicoi Co., Tenn., genitalia; 2, everted penis; 3, introverted penis, cut open; 4, jaw; 5, radula; 6, *Paravitrea walkeri* form *dentata,* diagram of penis; 7, genitalia; 8, radula; 9, *Paravitrea variabilis* paratypes, radula; 10, genitalia; 11, diagram of penis (after H. B. Baker).

"Animal whitish with very diffuse dark pigment on dorsum of head and mantle collar; sole rounded posteriad. Mantle collar rather narrow. Lung wall about 6 times as long as its base or 3½ times length of kidney. Kidney 3 times as long as its base.

"Ovotestis (Fig. 189:10) consisting of 3, weakly lobed, clavate sacs; talon vermiform, over 3 times as long as carrefour and reaching almost to tip of albumen gland. Uterus relatively short, about as long as combined lengths of free oviduct and vagina, which are subequal. Prostate of long type. Epiphallus long-clavate, continuous with penial apex and without distinct penial papilla. Penis (Fig. 189:11) markedly bifid at apex to receive vas deferens (larger lobe) and penial retractor (caecum); internally with weakly anastomosing longitudinal folds which are convoluted and may break into rows of papillae near apex. Penial retractor arising near middle of diaphragm on right but passing down left side of spermoviduct. Atrium very short.

"Jaw corneous, almost copper-colored. Radular formula (Fig. 189:9) is 15 + 3 + 1 + 18, with 49 transverse rows. Central quite elongate, slightly smaller than first lateral; laterals slightly elongate with prominent entocones." (H. B. Baker.)

Subgenus PARAVITREA s. s.

"On account of their usual predeliction for basic rocks, the species of the section *Paravitrea* s. s. are often quite sporadic in their occurrence. Their shells display tendencies toward colony divergence in addition to a bewildering amount of individual variation. Apparently, internal armature is always present in very early stages (2 to 3 whorls; diam. 1 to 2 mm.) but such juvenile examples commonly escape collectors. Occasional specimens, colonies (*lacteodens*) or species (*andrewsi* and *pilsbryana*) may retain the teeth until near sexual maturity, which seems to occur usually quite early in the spring and even in rather small specimens. Because juvenile shells and preserved material are available from only a few localities, the ranges given are quite tentative, especially those for *capsella, calcicola* and *placentula*. Probably, additional knowledge will require recognition of other colonies as specifically separable. The following key attempts to show the probable relationships of all of the named forms, although the soft parts of *lacteodens* and *significans* are unknown. (H. B. Baker.)

Key to Species of Section Paravitrea s. s. (by H. B. Baker)

A. Penial retractor inserted on penial apex above epiphallar entrance; shell usually smaller for same number of whorls.

B. Apical chamber of penis much less than ½ its length, filled by large, apical vergic papilla; radular marginals less than 20; umbilicus about ¼ maj. diam. of shell (typical group).

C. Spermoviduct very elongate; verge teat-shaped, marked by oblique folds; basal penial chamber with two large, wing-like pilasters; shell very close-coiled, usually with radial rows of 5 teeth which are often retained to or near adult stage; Appalachians proper in northern N. C.-Tenn. ..... *P. andrewsi* (W. G. B.)

CC. Spermoviduct quite elongate; verge acuminate and armed with large papillae; basal penial chamber with one lower wing; shell with contracted sutural spiral (last whorl relatively prominent), typically with radial rows of 3 teeth which are lost at an early stage; northeastern Tenn. and Cumberland Plateau (Ky. to northern Ala.?).
P. capsella (Gould)

BB. Apical chamber about ½ penial length; vergic papilla small or absent; radular marginals more than 20; umb. ¼-⅓ maj. diam.; juveniles (at least) with pairs of internal teeth (*Taxeodonta*).

D. Adult shell retaining paired teeth; umb. about ¼ maj. diam., with slightly flattened slope; spermoviduct very elongate; apical penial chamber ellipsoid with small, lateral vergic papilla; radular marginals more than 30; southern Cumberlands near Tenn.-Ala. line
P. pilsbryana (Clapp)

DD. Adult shell usually lacking teeth; umb. about ⅛ maj. diam.

E. Shell with domed spire and flattened umbilical slope; anatomy unknown; Ozarks and vicinity....*P. significans* (Bland)

EE. Shell more depressed, with rounded umbilical slope; spermoviduct quite elongate; apical penial chamber acuminate, without vergic papilla; marginals less than 30; coves and lowlands around southern Cumberlands
P. calcicola, new species

AA. Penial retractor inserted below epiphallar entrance (penis with short flagellum); shell typically larger for same number of whorls; around southern Appalachians proper.....*P. placentula* (Shuttleworth)

F. Pairs of teeth usually retained in shells that approach *P. capsella* in size and umb.; anatomy unknown; south western N. C., also (?) Fla. and Ala.
P. placentula (?) *lacteodens* (Pils.)

FF. Paired teeth typically lost at early stage; western side of southern Appalachians proper
P. placentula placentula (Shuttl.)

Paravitrea andrewsae (W. G. Binney) Fig. 190: 9-11 b.

Zonites andrewsi W. G. Binney, 1879, Ann. N. Y. Acad. Sci., 1: 358, pl. 15, fig. D; (first) Supplement, Bull. Mus. Comp. Zool., 11: 144, pl. 2, fig. D; 1885, Man. Amer. Land Sh., p. 228, fig. 251.—Sterki, 1893, Nautilus, 7: 16.

Gastrodonta andrewsae W. G. B., Walker & Pilsbry, 1902, Proc. Acad. Nat. Sci. Phila., p. 437.

Vitrea andrewsae (W. G. Binney) Pilsbry, 1903, Proc. Acad. Nat. Sci. Phila., p. 209, pl. 11, figs. 9, 9a, 10, 11, 11a, 11b.

Paravitrea (*Paravitrea*) *andrewsi* (W. G. Binney), H. B. Baker, 1931, Proc. Acad. Nat. Sci. Phila., 83: 103, pl. 16, figs. 1-5.

"Compared with *Z. lasmodon,* it has fully 8 whorls, is 6½ mill. in diameter, the umbilicus 1 mill. wide, whilst *lasmodon* with 7 whorls is 7 mill. in diameter, with an umbilicus 2 mill. wide; the Roan Mountain shell has also five parallel lamellae, while *lasmodon* has only two, or at most three, and does not show the successive rows of lamellae which are characteristic of *andrewsi,* radiating from the centre.

"From *Z. significans* it differs in its larger size, greater number of whorls, much wider umbilicus, and in the character of its internal denticles, which are long and winding on the wall of the whorl; while in *significans* the denticles are simply erect and conical, with broad base. The same differences distinguish it from *multidentatus,* which is still smaller than *significans,* and has a much narrower umbilicus." (W. G. Binney.)

Height 4.3 mm., diameter 7.6 mm.; 9 whorls.

North Carolina: Roan Mt. Mitchell Co., type loc.; Cranberry, Avery Co.; Potato Top, Mt. Mitchell and Bluff Mt., Black Mountains, Yancey and Buncombe counties; Paint Rock, Madison Co. Tennessee: northern slopes of Roan Mt., Carter Co.; Limestone Cove, Unicoi Co.

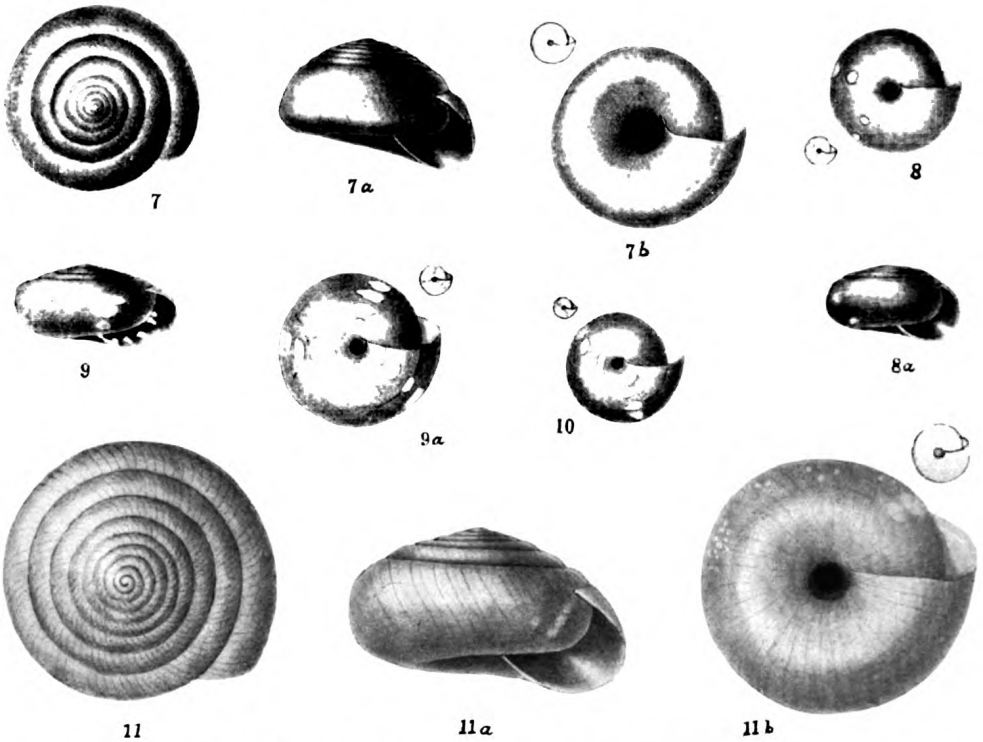

Fig. 190. 7, 7a, 7b, *Paravitrea significans,* fully adult specimen from Seligman, Missouri; 8, 8a, young shell with internal teeth, diam. 3.8 mm., same locality; 9, 9a, *P. andrewsae,* half-grown shell from Roan Mountain, N. C., diam. 4.5 mm.; 10, younger shell, diam. 3 mm.; 11, 11a, 11b, adult, Roan Mountain, N. C. Figs. 9, 9a, 10 and 11-11b are from specimens of the original lot, collected by Mrs. George Andrews. Small outlines actual size, the shaded figures enlarged. Pilsbry, del.

Shell similar to *P. placentula* in general form and size, but the whorls increase more slowly, the last being narrower; thin and fragile, often sprinkled with buff dots. Teeth are generally present, 3 to 5 being arranged in a radial row, or with several such rows within the basal wall, though the number of teeth may vary down to 0 in the adult stage, or less frequently at any stage of growth. Whorls 8 to 8½ in adults, which measure 7 to 8 mm. diameter.

In some localities, as around Roan Mountain, teeth are almost invariably developed. In some other localities they are rare in adult shells, and developed in the young ones only. Such toothless individuals are separable

from *P. placentula* by their slightly more fragile structure and greater number of narrower whorls.

One young specimen with a diameter of 4 mm. from Paint Rock, on the south side of the river, has the teeth fused together, forming a continuous rib across the cavity of the shell as in *P. lamellidens*.[87]

"Summer specimens of this species from the upper beech zone on Roan Mt. (Aug. 22), although very large, are sexually immature, as are also those (Aug. 15-30) from lower altitude. On the other hand, spring individuals from Limestone Cove, Unicoi Co. (April 8) have practically ripe genitalia and are the basis of the following notes.

"Foot pearl-gray, top of head bluish and tentacles still darker; dorsum of mantle collar and surface over hindgut with some dark pigment; sole pointed posteriad. Mantle collar deep and heavy; right neck-lappet fairly prominent; left one quite small with very attenuate tip. Lung wall very elongate; about 11 times as long as its base and almost 5 times length of kidney. Kidney slender; 5 times as long as its base and over $1\frac{1}{2}$ times length of pericardium.

"Ovotestis consisting of 6 clumps of alveoli; talon (Fig. 189:1) short, ellipsoid. Uterus elongate. Free oviduct medium in length. Spermathecal stalk gradually swollen towards base. Vagina quite short and stout. Epiphallus relatively short and cylindrical, with small apical caecum; opening through longitudinal slit at base of ventral side of penial papilla. Penis (Fig. 189:2, 3) stout but with short, basal, stalk-like constriction; apical third demarcated to form vergic sac by a heavy sphincteric fold and internally complicated by diamond-shaped papillae in basal half; verge teat-shaped, nearly $\frac{1}{3}$ as long as penis and covered with fine, oblique ridges; basal $\frac{2}{3}$ (penis proper) with two very high pilasters that form wings in the extended organ and with inner wall sculptured by sharp folds which are weaker and more widely spaced on pilasters. Penial retractor short and stout; origin near right side of base of spermoviduct; insertion on apex of penis.

"Buccal mass elongate. Jaw (Fig. 189:4) quite heavy, with low, rounded, median projection. Radular formula (Fig. 189:5) is $18 + 3 + 1 + 21$, with 51 transverse rows; centrals and laterals squarish and subequal in size; entocones of laterals large." (H. B. Baker.)

(Named for Mrs. George Andrews of Knoxville, Tennessee.)

Paravitrea placentula (Shuttleworth) Fig. 196: 1-1 b.

Zonites placentula Shuttleworth, 1852, Mittheil. Naturforsch. Ges. Bern, p. 194 (Tennessee).

Zonites placentula Shuttl., W. G. Binney, 1885, Man. Amer. Land Sh., p. 222, fig. 236.—Sterki, 1893, Nautilus, 7: 17.

Vitrea placentula (Shuttleworth), Pilsbry, 1903, Proc. Acad. Nat. Sci. Phila., p. 210, pl. 11, figs. 1, 1a, 1b.

Paravitrea placentula (Shuttl.) H. B. Baker, 1931, Proc. Acad. Nat. Sci. Phila., 83: 108, pl. 18, figs. 1, 2, 9.

Helix (*Hyalina*) *monroensis* Lewis, 1871, Amer. Jour. Conch., 6: 188, pl. 12, figs. 1, 2. (Monroe Co., Tenn.).

[87] This specimen is No. 16963 of Bryant Walker's collection.

"Shell openly umbilicate, much depressed, closely coiled; very glossy, marked with distant, irregular, impressed striae; corneous, diaphanous, of the same color beneath; whorls 7, very slowly increasing, but slightly convex, the last convex beneath, somewhat excavated around the umbilicus; aperture oblique, lunar; peristome simple and acute. Height 3 mm., greater diameter 7.5 mm., lesser 6.25 mm." (Shuttleworth.)

Height 3.6 mm., diameter 7.2 mm.; 7½ whorls; umbilicus 5.8 times in diameter. Knoxville.

TENNESSEE: Knoxville, Knox Co.; near Gatlinsburg and Pigeon Forge, Sevier Co.; Cades Cove and to the top of Thunderhead, Blount Co.; Philadelphia, Louden Co.; Tellico Gorge and elsewhere in Monroe Co.; Parksville, Polk Co.; Lookout Mt., Chattanooga, Hamilton Co. NORTH CAROLINA: Chambers Creek and Blowing Springs, Swain Co.

"Related to *Z. demissa* Binn., but very distinct by the more depressed shell, wider umbilicus, and especially by the absence of an opaque white callus in the cavity of the last whorl." (Shuttleworth.)

P. placentula is closely similar to *P. capsella*, but it is larger with a slightly smaller umbilicus. It is confined to the Great Smoky Mountains and vicinity in southeastern Tennessee and North Carolina, with a single unexpected locality west of the Tennessee River at Lookout Mt., near Chattanooga. It was first collected by Dr. Rugel, whose locality was merely "Tennessee". Dr. H. B. Baker proposes to take Knoxville as the type locality. The figures 1-1b are from a specimen collected by Miss Law at Philadelphia, Loudon Co. The radial sculpture is not well represented in the figures, being stronger than shown.

Up to nearly half of the final diameter some examples have pairs of teeth. In a lot from Knoxville most (about 20) of the immature specimens of 3.5 mm. diameter and smaller possess two or three pairs of teeth, but in a few of equal size, and down to 1.5 mm. diameter, there are no teeth. In a lot from Tellico Gorge only one of 3.6 mm. diameter, among 8 young ones, has teeth. When two or three pairs of teeth are present, they are usually crowded together into less than half a turn, not well spaced, as in *lacteodens*. Moreover, in none of the 16 lots of *placentula* seen are there any toothed shells as large as *lacteodens*.

Dr. Lewis briefly described *H. monroensis* as having, "a diameter of nearly one-third of an inch, and a fraction over 7 whorls," thus differing from the smaller *capsella* Gld. Found on hillsides in Monroe Co., Tenn., by Miss Annie E. Law.

"Type locality (now chosen): Cherokee Bluffs, Knoxville, Knox Co., Tennessee (A.N.S.P. 150393).

"Summer animals (July 12) from Knoxville are immature but spring specimens (April 4) are sexually ripe or even approach senility. Only very juvenile shells in either lot show paired teeth, but fairly large (although not the largest) individuals from Tellico Gorge retain them.

Unfortunately, all my animals from Monroe Co. (Aug 10) have very immature genitalia, but a radula shows slight differences and the synonymic status of *monroensis* is still open to question.

"Animal quite darkly pigmented. Lung about 5 times as long as its base or 3 times length of kidney. Kidney about 2½ times as long as its base.

"Ovotestis consisting of 8 clumps of alveoli; duct (Fig. 191:2) much swollen, but again slender and convoluted near carrefour; talon ellipsoid. Uterus quite long, swollen (in specimen figured) by large eggs with calcareous shells; darkly stained near base. Epiphallus short; entrance, near middle of apical penial chamber, guarded by heavy transverse lips. Apical chamber of penis about ⅓ total length, brown; internally with closely packed papillae in flagellum, with more widely spaced ones in body and with a hemispherical, papillate thickening opposite epiphallar entrance. Basal penial chamber relatively thin-walled, whitish; internally with very weak, longitudinal folds. Penial retractor inserting below level of epiphallar entrance and on opposite side of penis. Radular formula of a Knoxville animal (Fig. 191:1) is 24 + 3 + 1 + 27, with 57 transverse rows and with elongate central and 1st lateral; a large, immature, Tellico Gorge animal (form *monroensis*) has less elongate 1st lateral, 24–25 marginals and 56 rows (Fig. 191:9)." (H. B. Baker.)

(*Placentula*, a little cake.)

Paravitrea placentula lithodora new subspecies Fig. 192.

The shell is depressed, the height not quite half of the diameter, with low, convex spire; umbilicate, the umbilicus contained 5.2 times in the diameter; pale gray, somewhat translucent; glossy; after the initial 1½ whorls, sculptured with rather close impressed lines along lines of growth,

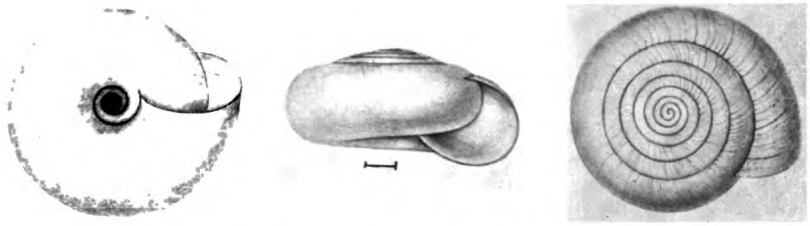

Fig. 192. *Paravitrea placentula lithodora*, type.

becoming weak at the periphery and faint on the base in adult shells. The whorls increase slowly to the last, which is distinctly wider, somewhat as in *P. pontis*. The aperture is lunate with thin lip.

Height 3.7 mm., diameter 7.8 mm.; 7¼ whorls.

KENTUCKY: Pine Mountain, Harlan Co. (Witmer Stone), Type and paratypes 128494 A.N.S.P.

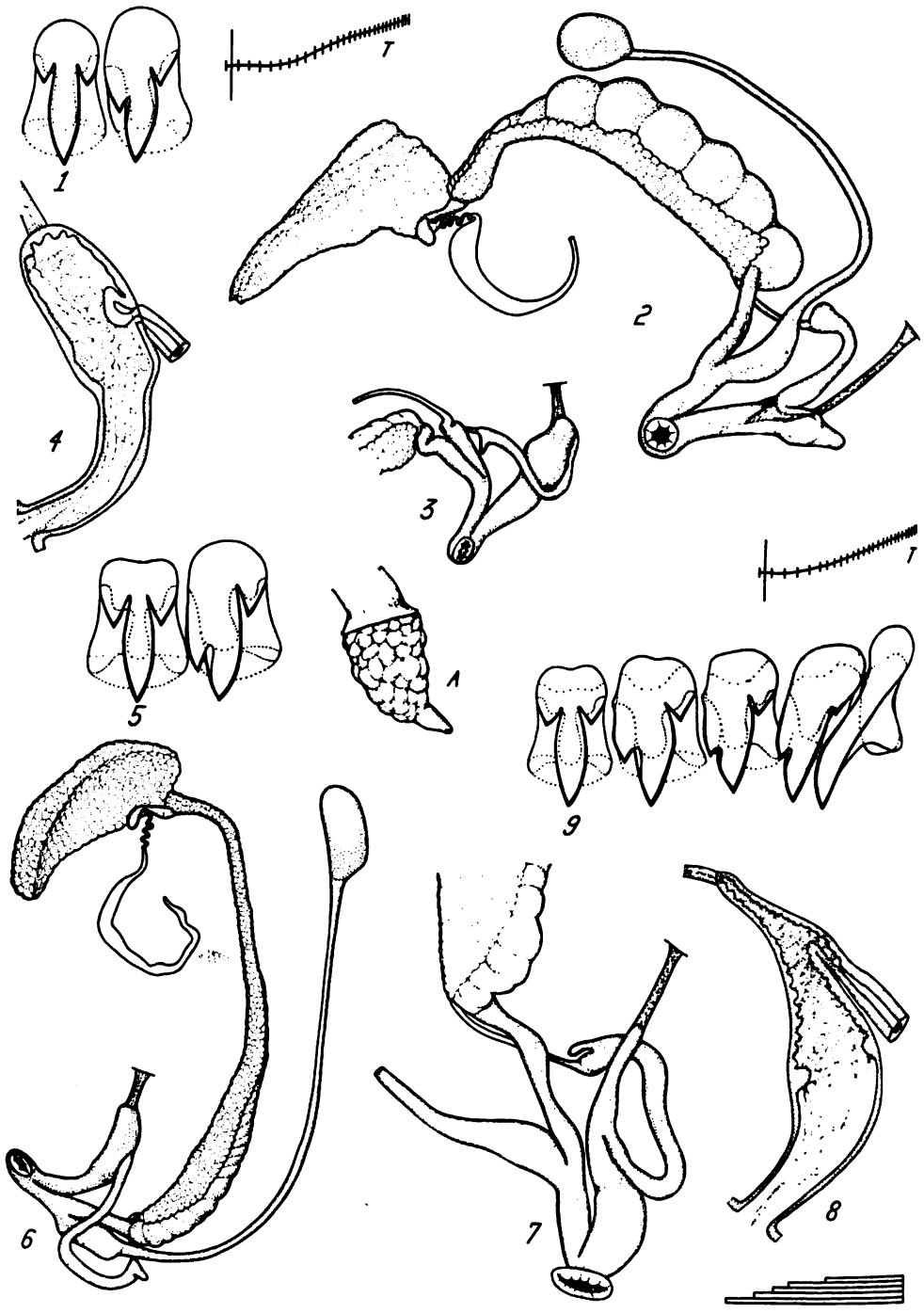

Fig. 191. See bottom of page 373 for legend.

This form is not so deeply and is more closely grooved than *P. placentula,* and the umbilicus is somewhat wider. If it were not so far out of its range the Pine Mountain snail might be thought to be a form of *placentula,* and it is provisionally placed with that species. None of the specimens show teeth, the youngest one collected being 4.7 mm. diameter.

(*Lithodora,* gift of Stone.)

Paravitrea reesei Morrison Figs. 193, 194.

Paravitrea reesei Morrison, 1937, Proc. Biol. Soc. Wash., 50: 58, pl. 4, figs. 5-7.

"Shell small, subdiscoidal, polished, the $5\frac{3}{4}$ whorls (of type) closely wound. Spire low, with shallow sutures. Periphery well rounded above and below, in an almost even curve from suture to umbilicus. Sculpture consisting of irregularly spaced growth-wrinkles or radial grooves; spiral sculpture indistinct above and below. Umbilicus deep, well-like, exhibiting all the whorls to the apex, contained about 5 times in major diameter of the shell. Aperture transverse-lunate; lip thin, simple. Internal armature consisting in the smallest shells seen (of 2 to $2\frac{1}{2}$ whorls and 1.0 to 1.3 mm. major diameter) of two conical teeth in a radial row, dividing the periphery

Fig. 193. *Paravitrea reesei* × 8 (after Morrison).

into three almost equal sectors. In a specimen of 3 whorls and 1.4 mm. major diameter, two other teeth appear, a third prominent conical tooth basal to the earlier pair, and a fourth which is an indistinct callus or tubercle just beneath the suture. All the teeth are retained in the largest (adult) specimens; the uppermost prominent tooth is at the periphery, the two others in each row are evenly spaced on the base of the whorl. Height 1.6 mm.; major diameter 3.1 mm.; minor diameter 3.0 mm.; aperture height 1.2 mm.; aperture width 1.45 mm.; umbilical diameter 0.6 mm.; whorls 5.75." (Morrison.)

West Virginia: The Type (U.S.N.M. 423599) was collected on Peters Mountain, Monroe County, along State highway No. 3, about $\frac{1}{4}$ mile from the Virginia boundary, by G. R. Hunt. Talcott, Summers Co. (G. K. Macmillan). Virginia: Radford, Montgomery Co.; Goodwin's Ferry (in the New River gorge about 5 miles to the northwest); and at Towe's Ferry, Pulaski Co., Va. (Paul R. Burch, in U.S.N.M.).

Fig. 191. 1, *Paravitrea placentula,* Knox Co., Tenn., radula; 2, genitalia; 3, *Paravitrea capsella tridens,* Carter Co., Tenn., terminations of genitalia; 3A, verge. 4, *Paravitrea pilsbryana,* diagram of penis; 5, radula; 6, genitalia. 7, *Paravitrea calcicola,* terminations of genitalia; 8, diagram of penis 9, *Paravitrea placentula,* Monroe Co., Tenn., radula (after H. B. Baker).

"This new form may be easily distinguished by its small size; three prominent teeth in a radial row retained in large shells; and by an umbilicus narrower than that of *pilsbryana* Clapp. It is named in honor of A. M. Reese, who has inspired much recent work in the systematic zoology of West Virginia." (Morrison.)

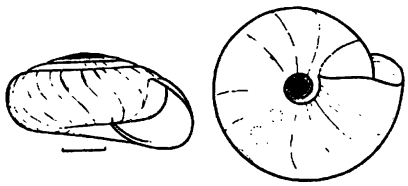

Fig. 194. *Paravitrea reesei,* Radford, Virginia. Scale line = 1 mm.

The original figures and description of *P. reesei* were from a specimen not fully mature. A somewhat larger and fully grown form from Radford, Va., is drawn in Fig. 194. The shell measures, height 2.4, diameter 4.7 mm., 6½ whorls; one row of 3 teeth visible through the base.

P. capsella, found with *reesei* at Radford, and at other localities in Virginia, differs from the latter by the less depressed last whorl and narrower aperture in specimens of equal size. It also becomes larger, up to 5.3 mm. in the lot seen. *P. reesei* differs from young *P. andrewsae* of similar size by showing but three teeth in a basal view, among other differences.

Paravitrea capsella (Gould) Fig. 195 a, b.

Helix rotula Gould, 1848, Proc. Boston Soc. Nat. Hist., 3: 38, not of Lowe, 1833.

Helix capsella Gould, 1851, in Binney's Terr. Moll., 2: 239, pl. 29a, fig. 1. (Tennessee).

Zonites capsella Gould, W. G. Binney, 1878, Terr. Moll., 5: 123, fig. 43; 1885, Man. Amer. Land Sh., p. 221.

Vitrea capsella (Gould), Pilsbry, 1903, Proc. Acad. Nat. Sci. Phila., 55: 210, in part. —Walker, 1928, Terr. Moll. Ala., p. 86, in part.

Paravitrea capsella (Gould), cf. H. B. Baker, 1928, Proc. Acad. Nat. Sci. Phila., 80: 29, pl. 6, figs. 4-7.—F. C. Baker, 1939, Fieldbook Ill. Land Sh., p. 73, figs. (Illinois).—MacMillan, 1939, Nautilus, 53: 48 (Westmoreland Co., Pa.).

"Shell quite small, planorboid, pellucid, glistening, amber-colored. Spire nearly plane, composed of about six and a half closely revolving, flattened whorls. Surface with distant, impressed, radiating striae. Suture margined. Aperture narrow, semilunar, lip simple, not thickened by callus within. Base perforated by a deep, rather small, funnel-shaped umbilicus. Diameter one-fifth of an inch; axis one-tenth of an inch." (Gould.)

ILLINOIS: southern, north to Vermilion Co.; Monroe Co. (F. C. Baker). INDIANA: Jefferson, Parke and Posey counties (Baker); Knox and Dubois counties (Daniels). KENTUCKY: Breathitt, Butler, Fayette, Franklin and Pulaski counties. OHIO: Adams, Fairchild and Warren counties. WEST VIRGINIA: Summers Co. VIRGINIA: Wythe and Lee counties. NORTH CAROLINA: Clay and Cherokee counties. TENNESSEE: Bledsoe, Blount, Carter, Davidson, Franklin, Madison, Roan, Sevier and Unicoi counties. ALABAMA: Jackson, Madison and Tuscaloosa counties.

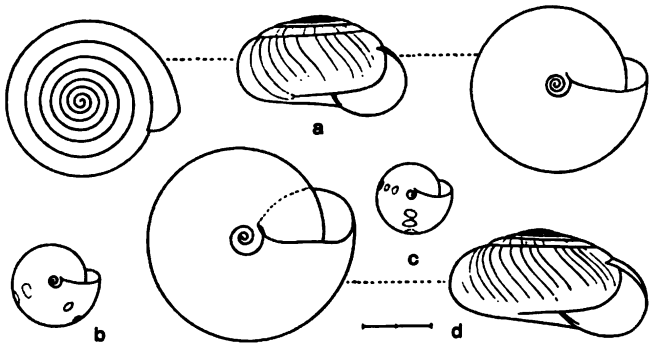

Fig. 195. a, *Paravitrea capsella,* Adams Co., Ohio, adult and b, dentate stage. c, *Paravitrea capsella tridens,* Marbleton, Unicoi Co., Tenn., dentate stage; d, adult stage of same, Valley Forge, Tenn. Scale line = 2 mm.

This is a widely spread but not yet well understood species, closely related to the western *significans,* to *placentula* of the Great Smoky range, to *lacteodens, calcicola* and *reesei.*

Young shells possessing teeth are rare and small, the toothless form of young predominating in lots seen. It appears that there are two races, characterized by young having respectively two and three teeth in a row, the latter now called *P. c. tridens, q. v.* In what is here taken to be typical *capsella* I find teeth paired, two in a row, in young specimens from several places, extremes of range being Bassett Bluff, Adams Co., Ohio, the toothed young 2.6 mm. diameter (Fig. 195b), and Stevenson, Alabama, very slightly larger. An adult shell of this Ohio lot measures 3 x 5.55 mm., 7¼ whorls, umbilicus about 7 times in diameter.

Whiteaves' Canadian record of *H. capsella* Gld., "Island of Orleans, Quebec" (1861, Canadian Naturalist and Geologist, 6:452, 458) must have been an erroneous identification or a misplaced label.

(Name a diminutive of *capsa,* a box.)

Paravitrea capsella tridens new subspecies Fig. 195 c, d.

The adult shell is toothless, like *capsella* but with noticeably wider aperture. The young shells, up to about 3.3 mm. diameter, have 1 to 3 (usually 2) radial sets of three teeth each, one tooth peripheral and two basal (Fig. 195c); some other young ones of similar size having no teeth.

Height 2.7 mm., diameter 6.2 mm.; 6¾ whorls. Marbleton.
Height 3 mm., diameter 5.6 mm.; 6½ whorls. Marbleton.
Height 2.9 mm., diameter 5.6 mm.; 6¾ whorls. Marbleton.
Height 3.4 mm., diameter 6.2 mm.; fully 7 whorls. Valley Forge.
Height 3.3 mm., diameter 5.8 mm.; 7 whorls. Limestone Cove.

Tennessee: Valley Forge, Carter Co.; Limestone Cove and near Marbleton, Unicoi Co. (H. B. Baker), Type 150403 A.N.S.P.

This form stands close to *P. reesei* Morrison, but the toothed young are smaller, and it attains a toothless adult form larger than any *reesei* known. The aperture is wider than in *P. reesei*. It appears to be a local form of northeastern Tennessee, the localities known being only about 10 or 15 miles apart.

Dr. H. B. Baker (1928) considered this form to be typical *capsella*, or at least he proposed to make Valley Forge, Carter Co., Tenn., the type locality of that species. However, it seems from the evidence available, that Bartlett, who collected Gould's types, got the widely spread, narrow-mouthed form of *capsella*, not this wider mouthed local race. The specimens from Gould in A.N.S.P., thought to be paratypes, have a narrower aperture than *tridens* of similar size, like our Fig. 195a, not like the Carter Co. form, Fig. 195d. Gould's figure in Terrestrial Mollusks III, though too small to be of much use, shows the aperture very narrow. W. G. Binney's woodcut, Man. Amer. Land Sh., p. 221, fig. 234, also is the narrow-mouthed form.

"A few summer animals from Valley Forge (Aug. 20) have reached sexual maturity although a larget set from Marbleton (Aug. 29) are all immature. Spring animals from Marbleton (April 9) have mature male but adolescent female organs. The anatomy is similar to that of *P. andrewsi;* only salient differences will be noted.

"Foot whitish; top and sides of head greyish. Lung 4½ times as long as its base or almost 3 times length of kidney. Kidney about twice as long as its base. Spermoviduct less elongate. Spermathecal sac clavate; stalk shorter. Vagina (Fig. 191:3) relatively more elongate. Apical chamber of penis not ¼ total length; verge smaller, acuminate and armed with large papillae (Fig. 191:3a), with epiphallar opening at its base; inner surface also papillate. Basal penial chamber more attenuate basally; internally with large pilaster, which must form a lower wing in extended organ, and numerous oblique folds. Radular formula of a Valley Forge animal is 18 + 3 + 1 + 21, with 57 transverse rows; another from Marbleton has 19 marginals and 56 rows; central and laterals more elongate (like in *placentula*)." (H. B. Baker.)

Paravitrea capsella lacteodens (Pilsbry) Fig. 196; 5, 5a.

[?] *Hyalina significans* Bld., Harper, 1881, Jour. Cincin. Soc. Nat. Hist., 4: 258, figs. 2, 2a. East Tennessee. Not of Bland.

[?] *Zonites significans* Bld., Wetherby, 1881, Jour. Cincin. Soc. Nat. Hist. 4: 328, No. 25.—W. G. Binney, 1885, Man. Amer. Land Sh., p. 228, fig. 250 (in part).—Sterki, 1895, Nautilus, 7: 16, 17.

Gastrodonta significans Bld., Pilsbry, 1900, Proc. Acad. Nat. Sci. Phila., p. 147.

Vitrea capsella lacteodens Pilsbry, 1903, Proc. Acad. Nat. Sci. Phila., p. 211, pl. 11, figs. 5, 5a.

Paravitrea (*Paravitrea*) *placentula* (?) *lacteodens* (Pilsbry), H. B. Baker, 1933, Proc. Acad. Nat. Sci. Phila., 83: 107.

"The shell is similar to *V. capsella*, except that most specimens have one to three pairs of tubercular teeth within the last whorl. The sutures

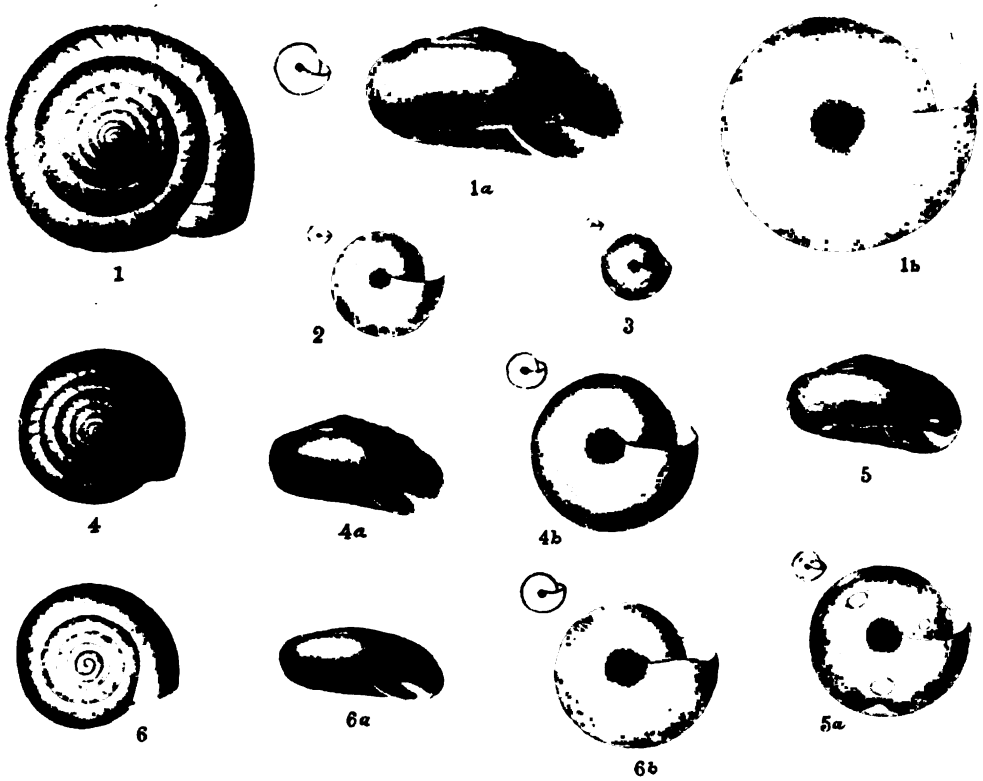

Fig. 196. 1, 1a, 1b, *Paravitrea placentula,* Philadelphia, Loudon County, Tenn. 2, *P. capsella,* half-grown shell, diam. 3 mm., Woodville, Ala.; 3, young specimen with two pairs of internal teeth, diam. 2 mm., Woodville, Ala.; 4, 4a, 4b, adult from Woodville, Ala., diam. 4.5 mm. 5, 5a, *P. capsella lacteodens,* Tuskeegee Mountain, Graham County, N. C. 6, 6a, 6b, *P. simpsoni,* type, Limestone Gap, Okla. Small outlines actual size, the shaded figures enlarged. Pilsbry, del.

are a trifle less impressed, and the striation perceptibly closer. It differs from *V. significans* in the usual persistence of the teeth in the adult stage, and the median position of the periphery. In fully adult *significans* the periphery is subbasal, and there are no teeth."

Height 2.4 mm., diameter 4.8 mm.; 6¾ whorls; umbilicus contained 5.4 times in diameter. Type.

NORTH CAROLINA: "Ramp Cove," Tuskeegee Mt., Graham Co., Type and paratypes 77798 A.N.S.P. ALABAMA: Wetumpka. FLORIDA: Rock Bluff, Liberty Co. (C. R. Crosby).

On account of its similarity to immature stages of *P. capsella* and *P. placentula* the status of this form cannot be considered settled. The specimens found by Wetherby and Harper in east Tennessee, referred to *significans* by them (see above), were probably immature *P. placentula,* as Wetherby stated that they occurred with that species.

It is separable from *P. capsella* and *P. placentula* by the persistence of the pairs of teeth in most apparently adult shells of any given lot and the

relatively larger umbilicus. In the type lot, collected by Mr. H. E. Sargent on Tuskeegee Mountain, Graham County, N. C., one adult out of thirteen before me is quite toothless. Some others have only one or two teeth remaining. It is the general character of the specimens from any one place, not the particular condition of each individual, that must be considered. Dr. H. B. Baker thought that: "True *lacteodens* may be more closely related to *P. placentula* than to *P. capsella;* its type locality is closer to the range of the former and my set of very large '*monroensis*' from Tellico Gorge contains also the largest individuals with paired teeth that I have seen. The single Florida specimen looks like typical *lacteodens,* but, as mentioned under *calcicola,* the armed shells from Wetumpka, Ala., intergrade with toothless individuals that more closely resemble the Cumberland form."

Paravitrea calcicola H. B. Baker Figs. 196: 2-4 b; 197.

Vitrea capsella Pilsbry, in part, 1903, Proc. Acad. Nat. Sci. Phila., p. 210, pl. 11, figs. 2-4 (Woodville, Ala.); not of Gould.

Paravitrea calcicola H. B. Baker, 1931. Proc. Acad. Nat. Sci. Phila., 83: 107, pl. 18, figs. 7, 8; pl. 20, fig. 1

"Shell higher than *P. capsella,* with more closely coiled whorls; umbilicus about 5 times in major diameter. Last whorl in large individuals slightly descending. Dimensions of aperture: altitude 65 (2.37 mm.), diameter 113 (2.68 mm.)." (H. B. Baker.)

Height 3.65 mm., diameters 6.18 and 5.6 mm., width umbilicus 4.8 mm.; whorls $7\frac{3}{4}$. Type.

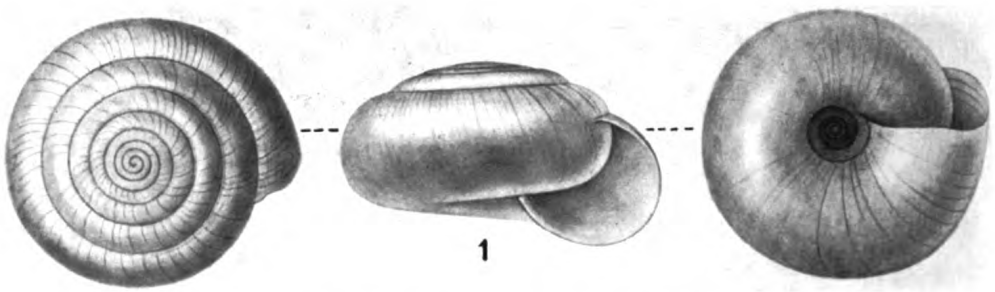

Fig. 197. *Paravitrea calcicola,* type. End figures slightly over × 6. (After H. B. Baker.)

TENNESSEE: (85° 47′, 35° 10′; altitude 800 ft.) west-facing hillside south of big spring that forms eastern source of Battle Creek, at Dove, Marion Co., Type A.N.S.P. 150395. ALABAMA: Jackson, Madison, Randolph, Jefferson and Elmore counties.

"All of my summer animals (July 25) from the type locality (and elsewhere) are immature sexually but most of the spring paratypes (Mar. 29-31) are fully ripe. *P. pilsbryana* and *P. calcicola* apparently do not

occur together, although the latter replaces the former in the upper end of Prior Cove. Only very young paratypic shells of *P. calcicola* show the pairs of internal teeth, but fairly large individuals in two A.N.S.P. lots from Wetumpka, Ala. (labeled *lacteodens*) retain the teeth although they otherwise resemble those from Dove." (H. B. Baker.)

In the type lot very few of the young shells show pairs of teeth, the largest 3 mm. in diameter. In lots from Alabama, teeth are retained longer, up to 4.7 mm. in some Wetumpka specimens.

"Animal whitish, top of head pearly gray, tentacles dark bluish; sole narrowly rounded posteriad. Lung almost 5 times as long as its base and 3½ times length of kidney. Kidney almost twice length of its base. Epiphallus (Fig. 191:7) elongate, continuous with reflected penial limb and without vergic papilla. Penis (Fig. 191:8) fusiform, with internal, sphincteric fold below middle; apical chamber long-conical, with very short, epiphallar limb arising between middle and basal thirds, and with oblique, papillate, internal folds, basal chamber stout with weak, internal folds. Penial retractor inserting on apex of penis. Radular formula is (21–22) + 3 + 1 + (24–25), with 56 transverse rows." (H. B. Baker.)

Paravitrea pilsbryana (Clapp) Fig. 198.

Vitrea (*Paravitrea*) *pilsbryana* Clapp, 1919, Nautilus, 33: 9, lower 5 text-figs.

Paravitrea (*Paravitrea*) *pilsbryana* (Clapp), H. B. Baker, 1931, Proc. Acad. Nat. Sci. Phila., 83: 106, pl. 18, figs. 4-6 (anatomy).

"Shell widely umbilicate, elevated, convex above, flattend below, thin, translucent, highly polished when immature but becoming more opaque and yellowish in adults, light horn color, sculptured with unequally spaced radial grooves stopping at the periphery which is rather high; suture well impressed; whorls about 8 very closely coiled and slowly increasing, the last flattened above and below; lip simple very slightly reflected where it joins the columella, ends united by a thin callus; umbilicus wide, contained a little more than 3 times in the diameter of the shell, and showing all of the apex. There are 3 or 4 pairs of large, tubercular, sometimes slightly oval teeth, visible through the base of the shell at all stages of growth, and

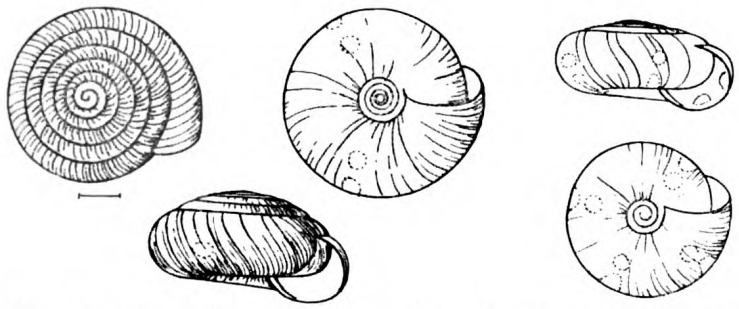

Fig. 198. *Paravitrea pilsbryana*, type × about 5. Two figures at right are an immature stage (after Clapp). Scale line indicates diameter of type specimen.

in immature shells the upper teeth are visible from above. The upper teeth, which are slightly below the periphery, are the larger, more elevated and round at the top. The lower teeth are about centrally located on the base and are flattened on top. When four pairs of teeth are present they are equally spaced at intervals of 90° and this appears to be the normal arrangement as only a few shells show three pairs which are spaced from 100° to 120°. The single fully adult shell (figured) appears to have but 2 pairs of teeth, but the shell is a dead one and quite opaque. Two young shells, 1.5 mm. diameter with 3.5 whorls, and 2.5 mm. diameter with 4.5 whorls, each have 3 pairs of teeth.

" Greatest diameter 5, lesser 4.5, altitude 2 mm." (Clapp.)

TENNESSEE: A cove in Cumberland Plateau 3 miles north of Anderson, Franklin Co. Type 9159 Clapp Coll., paratypes 116882 A.N.S.P. and in University of Michigan. Prior Cove, Marion Co. (H. B. Baker). ALABAMA: Jackson Co., 3 miles south of Anderson, Tenn.

" This species belongs to the same group as *V. capsella lacteodens* and *V. andrewsae*. It differs from both by the smaller size and wider umbilicus and from *andrewsae* by the tubercular teeth arranged in pairs.

" I name this species after Dr. H. A. Pilsbry whose ' Revision of Paravitrea,' Proc. Acad. Nat. Sci. Phila., 1903, has done much to clear up this most interesting group." (Clapp.)

Dr. Baker writes: " Summer animals (July 23) from the lower end of the south branch of Prior Cove are sexually immature but spring examples (April 2) from the same locality are fully ripe. The obliquely depressed aperture and flattened columellar wall of this species approach the accentuated conditions in *P. significans*.

" Animal very light grayish, darker on dorsum of mantle collar and head; eyes and tips of tentacles black; sole pointed posteriad. Lung about 7 times as long as its base and over 3 times length of kidney. Kidney almost 3 times as long as its base. Ovotestis consisting of 8 clumps of alveoli; talon (Fig. 191:6) clavate. Spermoviduct very slender, darkly stained near base. Free oviduct and vagina subequal and relatively small. Spermathecal sac large, ellipsoid; stalk very long, abruptly enlarged at base. Epiphallus long, entering near middle of apical penial chamber; vergic papilla small. Apical chamber of penis (Fig. 191:4) ellipsoid; internally with a few, papillate or convoluted pilasters; constricted abruptly at base. Basal chamber more slender; internally with low, longitudinal folds. Penial retractor inserting on apex of penis. Jaw thin and transparent. Radular formula (Fig. 191:5) is (33–34) + 3 + 1 + (36–37), with 65 transverse rows; innermost laterals with entocone carried out towards tip of mesocone." (H. B. Baker.)

Paravitrea significans (Bland) Fig. 190: 7-8 a.

Helix significans Bland, 1866, Amer. Jour. Conch., 2: 372. pl. 21, fig. 9.

Zonites significans Bland, Binney, 1878, Terr. Moll., 5: 132, exclusive of Union Co. Tennessee record.

Vitrea significans Bland, Pilsbry, 1903, Proc. Acad. Nat. Sci. Phila., p. 212, pl. 11. figs. 7, 8.—F. C. Baker, 1912, Trans. Ill. Acad. Sci., 5: 145.

Paravitrea significans (Bland), H. B. Baker, 1931, Proc. Acad. Nat. Sci. Phila., 83: 106.—F. C. Baker, 1939, Fieldbook of Ill. Land Snails, p. 74, text-figs.

"Shell umbilicate, depressed, discoidal, thin, with fine irregular striae, which are almost obsolete at the base, shining, pale horn-colored; spire little elevated; suture slightly impressed; whorls 6, subplanulate, the last roundly inflated, rather flat at the base, excavated around the umbilicus, which is pervious, and equal almost to $\frac{1}{3}$ of the diameter of the shell; aperture oblique, depressed, lunate; peristome simple, acute. Diameter maj. $4\frac{1}{2}$, min. 4, alt. 2 mill." (Bland.)

OKLAHOMA: Fort Gibson, Muskogee Co. (V. B. Hubbard), Type 11984 A.N.S.P. MISSOURI: Seligman, Barry Co. (Ferriss); 4 miles east of Eureka, St. Louis Co. (Hubricht). ARKANSAS: Sulphur City, Washington Co. (A. J. Brown); Caddo Gap, Montgomery Co. and Hot Springs, Garland Co. (A. F. Archer); Mablevale, Pulaski Co. (C. W. Johnson); Stader's Ldg., Arkansas R., Jefferson Co. (C. B. Moore). Hardy, Sharp Co. (Ferriss). ILLINOIS: south of Valmeyer, Monroe Co. (F. C. Baker and T. D. Foster). TENNESSEE: Memphis, Shelby Co. (J. B. Clark, 1927).

As Bland stated following his original description, the young shells are sometimes provided with one or two pairs of tubercular teeth within, visible through the base of the shell as white spots. The full-grown shells are toothless, more or less dome-shaped, the periphery being situated below the middle of the last whorl, the circumference of which is flattened and sloping. The base is very concave in the middle. This gives the shell a peculiar and unusual contour. Half-grown and young individuals are normal in shape, and very similar to *P. capsella* and its variety *lacteodens*, from which, indeed, it is difficult to separate them except by the locality. The spire, seen from above, is about the same in *capsella, placentula* and *significans*. Figs. 190: 7, 7*a*, 7*b* represent adult specimens of the typical form from Seligman, Barry county, Missouri; figs. 8, 8*a* are immature shells from the same place and lot.

It appears to have crossed the Mississippi eastward in southern Illinois and in Tennessee, but in both states it is known from the vicinity of the river only. Eastern localities given in the earlier literature are erroneous.

PARAVITREA PONTIS GROUP (Section *Parmavitrea* H. B. Baker)

Key to Species of Section Parmavitrea (by H. B. Baker)

A. Shell larger, intermediate in height of spire, with less prominent last whorl; Rockbridge Co., Va. ..... *P. pontis* H. B. B.

AA. Shell smaller, with more prominent last whorl.

B. Shell more depressed, with flattened basal lip; vicinity of Ozark Mts. *P. simpsoni* (Pilsbry)

BB. Shell higher, with more rounded basal lip; Conecuh Co., Ala. *P. conecuhensis* (Clapp)

Paravitrea pontis H. B. Baker Fig. 199.

Paravitrea (s. s.) *capsella* (Gould), H. B. Baker, 1928, Proc. Acad. Nat. Sci. Phila., 80: 29, pl. 6, figs. 4-7 (anatomy of paratypes of *P. pontis*). Not *Helix capsella* Gould.

Paravitrea (*Parmavitrea*) *pontis* H. B. Baker, 1931, Proc. Acad. Nat. Sci. Phila., 83: 108, pl. 20, fig. 2.

"Shell larger than in *simpsoni* or *conecuhensis;* height of spire intermediate. Last whorl not as prominent, but often shortly though quite suddenly expanded and deflected centrifugally in gerontic individuals, so that umbilicus becomes markedly larger. Internal armature (only present in shells of 2-3 whorls; diam 1.5 mm.) consisting of smooth, radial barriers, each of which extends through middle half of periphery of last whorl. Dimensions of aperture: altitude 77 (2.18 mm.) and diameter 120 (2.62 mm.)." (H. B. Baker.)

Height 2.82 mm., diameters 5.87 and 5.12 mm., width umbilicus 4.7 times in diam.; $7\frac{1}{4}$ whorls. Type.

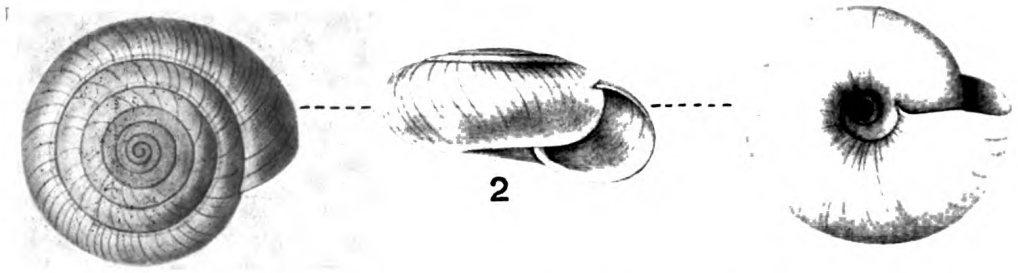

Fig. 199. *Paravitrea pontis,* type × about 6. (After H. B. Baker.)

VIRGINIA: limestone talus in canyon just above base of Natural Bridge, Rockbridge Co. Type A.N.S.P. 129123. Range of A.N.S.P. material: nearby hills; also (?) near entrance to Mammoth Cave, Edmonson Co., Kentucky.

"The spring animals (early in April), which I erroneously identified as *capsella,* are quite mature. The hyaline shell and gerontic deflected last whorl in *pontis* actually give it much more resemblance to *P. simpsoni,* as has been noted, in Dr. Pilsbry's handwriting, on another, topotypic lot. In a still larger ($7\frac{1}{2}$ whorls) and more senile shell than the type, the major diameter (6.48 mm.) is only 4.2 times the width of the umbilicus. Radial barriers have rarely been reported in the larger species of *Paravitrea.*" (H. B. Baker.)

The anatomy has been investigated by Dr. Baker, from whose account the following is extracted (Fig. 186:4-7). "Talon clavate with almost no caecoid tip . . . Free oviduct: very long, but mainly folded into S-shaped loops at base of uterus; internally plicate, but without definite glands. Spermatheca: ellipsoid to subspherical sac imbedded posterior to talon; duct long, with longitudinally plicate walls. Vagina: quite long, similar in structure to free oviduct. Prostate: long type. Vas deferens: short and slender, looped around base of spermatheca to nearby apex of epiphallus. Epiphallus (Fig. 186:4): very long; apical $\frac{2}{5}$ swollen, with a very large pilaster, which shows transverse, glandular columns (reminiscent of the flagellum of *Hojeda vanattai*); basal $\frac{3}{5}$ much more slender with quite heavy wall and narrow, simple lumen; attached for short distance along side of penis; penial papilla small, on side of apex of penis. Penis: apical $\frac{1}{3}$ clavate

in shape, with a small caecum in base of retractor, and lined by numerous, closely-crowded papillae; basal ⅔ with a heavy pilaster and weaker oblique folds. Penial retractor: medium in length and stout; insertion at apex of penis; intimate sheath complete. Cloaca: short, opening by a vertical slit in its right face, situated on side of foot behind middle of visceral stalk.

"Columellar muscle gives off: 1) buccal retractor which is practically separate; 2) long and slender left free retractor slightly below; 3) very heavy right free muscle far below, near root of tail; and 4) tail fan, which is not much heavier than left free retractor. Free retractors: each divides promptly into tentacular and lateral muscles, so that left tentacular is much longer than right; right lateral much heavier than left, and with short band to base of cloaca.

"Jaw: thin and delicate, quite similar to that of *P. multidentata* in shape. Radular formula (Fig. 186:7): 18-3-1-21. Transverse rows: 57 counted; central and lateral fields of each almost straight, but marginal ones inclined abruptly anteriad. Central: base elongate; mesocones very long and slender; ectocones small. First lateral: slightly larger than central, with weak entoconal notch and small ectocone. Marginals: largest one slightly larger than central, with oblique, aculeate cusp, irregularly elongate base and a heavy ecto-posterior process to strengthen the inward tilt of the cusp." (H. B. Baker.)

(Named for the Natural Bridge.)

Paravitrea simpsoni (Pilsbry) Fig. 196: 6-6 b.

Zonites simpsoni Pilsbry, 1889, Proc. Acad. Nat. Sci. Phila., 41: 412, pl. 12, figs. 8-10.—W. G. Binney, 1892, 4th Suppl., Bull. Mus. Comp. Zool., 22: 168, pl. 1, fig. 8.

Vitrea simpsoni Pilsbry, 1900, Proc. Acad. Nat. Sci. Phila., p. 456; 1903, p. 212, pl. 11, figs. 6-6*b*; 1906, same Proc., p. 560.

Paravitrea (*Parmavitrea?*) *simpsoni* (Pilsbry) H. B. Baker, 1931, Proc. Acad. Nat. Sci. Phila., 83: 109.

"This species belongs to that group comprising *capsella* Gld., *lawi* W. G. Binn., and *placentula* Shutt.,—species with narrow umbilicus, numerous closely coiled narrow whorls, and without a callus or thickening within the base of the last whorl. *Z. simpsoni* differs from *placentula* in its much smaller size, nearly straight, instead of arcuate basal lip, seen from beneath, proportionately wider last whorl, and the more trigonal, wider aperture. With *Z. lawi* I need not compare, as that species is much larger and more elevated. *Z. capsella* is about the same size, color and texture as *simpsoni*, but has a narrow umbilicus and very much narrower aperture, narrowly semilunar instead of trigonal in outline." (Pilsbry.)

Umbilicus contained 4.5 to 4.6 times in the diameter.

Height 2, diameter 4.6 mm.; 5½ whorls. Type.

Height 2.5 mm., diameter 5.5 mm.; 5⅔ whorls. Topotype.

Diameter 4 mm., 5 whorls. Logan Co., Ark.

MISSOURI: Chadwick, Christian Co. (Pilsbry). ARKANSAS: Sharp, Polk, Little River and Scott counties (Ferriss); Montgomery and Hot Springs counties (Archer); Washington Co. (A. D. Brown); Logan, Benton and Scott counties (Pilsbry). OKLAHOMA: Limestone Gap, Atoka Co. (C. T. Simpson, Pilsbry), Type 61676 A.N.S.P.; Wyandotte, Ottawa Co. (Pilsbry).

P. simpsoni is more depressed than *significans* or *capsella,* with the last whorl decidedly wider, when viewed from above, much as in *P. pontis.* It has not yet been found with teeth, and has not been dissected. The type is figured.

(Named for Charles Torrey Simpson, who first found it.)

Paravitrea conecuhensis (Clapp) Fig. 200.

Vitrea (Paravitrea) conecuhensis Clapp, 1917, Nautilus, 30: 138, pl. 5, figs. 5-7.—Walker, 1928, Terr. Moll. Alabama, p. 88, fig. 119.

"Shell thin, depressed, umbilicate, the umbilicus being about 1 mm. in diameter and showing all the whorls; color light horn, highly polished; whorls 6, the first five closely coiled, the last rapidly expanding. Surface sculptured with spaced, unequal, radial grooves stopping at the periphery,

Fig. 200. *Paravitrea conecuhensis* × about 5.4 (after Clapp).

which is slightly subbasal. Aperture subtriangular, lower lip slightly flattened and reflected where it joins the columella. Adult shells are toothless, but a young shell of 4½ whorls, 2¾ mm. in diameter, shows a single pair of small tubercular teeth.

"Diameter 4½, altitude 2¼ mm." (Clapp.)

ALABAMA: Evergreen, Conecuh Co. (H. H. Smith, Type 8111 Clapp Coll., paratypes in coll. Bryant Walker.

"This species resembles *Vitrea* [*Paravitrea*] *simpsoni* Pils., but has about one more whorl in the same diameter; it is also less depressed, and the basal lip is less flattened." (Clapp.)

PARAVITREA PETROPHILA GROUP (Section *Petrovitrea* H. B. Baker)

Key to Species of Section Petrovitrea (by H. B. Baker)

A. Shell smallest, with intermediate spire; Jackson Co., Ala.....*P. smithi* (Walker)

AA. Shell intermediate in size, with highest spire and widely and irregularly spaced growth-lines; Tenn., Ky. and Ark.....*P. petrophila* (Bland)

AAA. Shell largest, with most depressed spire and with more closely and regularly spaced growth-lines; Magazine Mt., Ark.....*P. aulacogyra* (Pils. and Ferr.)

Paravitrea smithi (Walker) Fig. 201.

Vitrea (Paravitrea) smithi Walker, 1928, Terr. Moll. Ala., p. 88, fig. 120.

"Shell thin, depressed, umbilicate, umbilicus round and deep and about .75 mm. in diameter; whitish horn color; polished; whorls 4.5 regularly increasing; suture well impressed; surface sculptured with spaced, unequal, radial grooves more numerous and closer together above and practically

obsolete below the periphery; body whorl regularly rounded, somewhat flattened on the base; aperture oval, the upper and basal margins somewhat flattened, but rounded on the periphery. Diameter 4.5, alt. 2.25 mm." (B. Walker.)

Fig. 201. *Paravitrea smithi* × about 4.6 (after Walker).

ALABAMA: Sand Mountain near Pisgah, Jackson Co. (H. H. Smith), Type 85618 Coll. Univ. Mich., paratype in Clapp Coll., Carnegie Museum.

"Only two specimens of this species were found by Mr. Smith. It is nearer to *V. conecuhensis* Clapp than to any other species and is of about the same size, but it differs in having fewer whorls, in the more depressed shape, the narrower umbilicus, the less closely coiled upper whorls and the regularly rounded and unexpanded body whorl." (Walker.)

Paravitrea petrophila (Bland) Fig. 202.

Zonites petrophila Bland, 1883, Ann. N. Y. Acad. Sci., 2: 369, fig. 2.

Zonites petrophilus Bland, W. G. Binney, 1885, Man. Amer. Land. Sh., p. 223, 478, fig. 238.

Zonites petrophilus sinistrorsus Cockerell, 1893, Brit. Nat., 3: 81, based on W. G. Binney, 1885: 478, Toccoa Falls, Ga.

Vitrea petrophila (Bland), Pilsbry, 1906, Proc. Acad. Nat. Sci. Phila., p. 562.

Paravitrea petrophila (Bland), H. B. Baker, 1931, Proc. Acad. Nat. Sci. Phila., 83: 110, pl. 17, figs. 7-11.

"Shell broadly umbilicate, depressed; subglobose, thin, shining, translucent, whitish, irregularly striated, suture moderately impressed; whorls 5½-6, rather convex, the last more convex, not descending; umbilicus widely

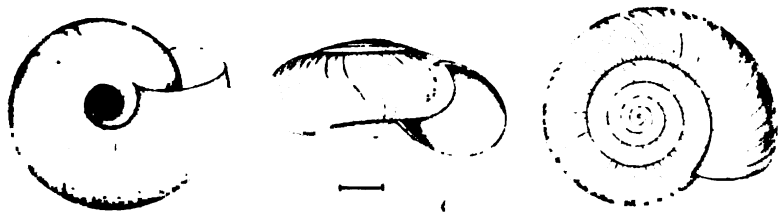

Fig. 202. *Paravitrea petrophila*, Knoxville. Scale line = 1 mm.

excavated externally, pervious; aperture roundly lunate; peristome simple, somewhat thickened, often rose-colored, the columellar margin slightly reflected. Diam., major 6, min. 5-5¼; alt. nearly 3 mill." (Bland.)

Height 2.96 mm., diameters 5.75 and 5.13 mm., umbilicus in diameter 4.2 times; 5⅞ whorls (H. B. B., topotype).

TENNESSEE: The Cliffs (Cherokee Bluffs), Knoxville (Mrs. George Andrews), type locality: Chattanooga, Hamilton Co.; near Jasper, Marion Co. Head of Sequatchie Valley, Cumberland Co. KENTUCKY: Burnside, Pulaski Co. ARKANSAS: Magazine Mt., Logan Co.; Mena and Rich Mountain, Polk Co.

By the relatively wide last whorl it has some resemblance to *P. simpsoni* and some Retinellae. It is clear and colorless typically, but some Arkansas shells have a slight rufous tint.

The distribution as now known is remarkably discontinuous, the nearest localities in Tennessee and Arkansas being about 400 miles apart, widely separated by the Mississippi valley. W. G. Binney has recorded it from Toccoa Falls, Georgia, one reversed specimen in the lot of thirteen. Dr. Baker writes as follows.

'Summer animals from the type locality, collected July 12, are fully mature but individuals obtained in the early spring at the same place (April 4) and near Jasper (Mar. 29) are immature.

"Animal whitish, with dorsum of head and mantle collar lightly pigmented; tips of ommatophores blue-black; sole uniform, quite elongate, rounded posteriad. Mantle collar (Fig. 187:9) quite deep; right necklappet prominent, left one quite short. Lung wall 5½ times as long as its base or over 3 times length of kidney. Kidney twice as long as its base and over 1½ times length of pericardium.

"Ovotestis (Fig. 187:11) consisting of 4 clumps of alveoli; talon short, clavate. Uterus relatively short, slightly longer than combined lengths of free oviduct and vagina. Epiphallar enlargement of vas deferens with bulbous swelling near apex; attenuate basally and continuous with epiphalloid chamber of penis. Penis (Fig. 187:7) short but stout, fusiform; apical ⅔ containing a plicate epiphalloid chamber which extends into large penial papilla that almost half fills short, quite thin and simple walled penis proper. Penial retractor arising near middle of uterus and inserting on side of penis near apex of epiphalloid enlargement. Atrium very short.

"Jaw (Fig. 187:10) corneous, quite shallow; median area almost straight, with 5 rib-like projections. Radular formula (Fig. 187:8) is 16 + 3 + 1 + 19, with 50 transverse rows. Central considerably smaller than first lateral; entocones of laterals carried out on mesocones. Salivary glands each about ⅔ as long as buccal mass.

"The extremely peculiar penis of *P. petrophila* would almost warrant the separation of *Petrovitrea* as a distinct genus. In shell characters, this species also approaches the section *Glyphyaloides* of *Retinella*. *Retinella pentadelphia* (Pilsbry), which was proposed as a subspecies of *petrophila*, has a much more corneous epidermis; even fresh shells of *P. petrophila* are almost ivory white. In Bland's original figure of *P. petrophila*, as in the accompanying one of *R. wheatleyi*, the relative size of the umbilicus is grossly exaggerated." (H. B. Baker.)

Paravitrea aulacogyra (Pilsbry & Ferriss) Fig. 203.

Vitrea aulacogyra Pilsbry & Ferriss, 1906, Proc. Acad. Nat. Sci. Phila., p. 561, fig. 4.

Shell similar to *P. petrophila* but very much larger, with sculpture of close, obliquely radial striae and grooves on the upper surface, the striae fine and close on the inner whorls, much coarser on the last; striae and intervening grooves about equal. Upper surface slightly convex, nearly flat. Whorls 5½, very slowly widening, the last very much wider, rounded peripherally, the base smoothish, not distinctly striate. Aperture as in *V. petrophila*. Umbilicus slightly smaller in proportion, contained 5.2 times in the diameter of the shell.

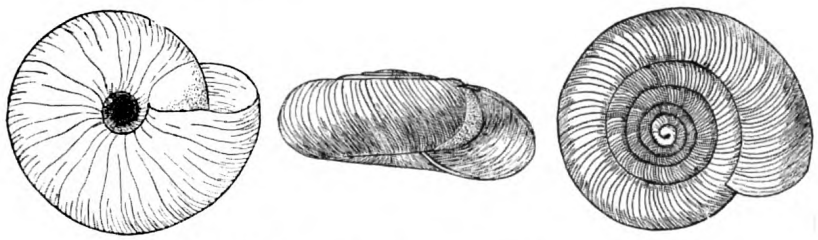

Fig. 203. *Paravitrea aulacogyra*, type × 4.

Height 3.3, diameter 8 mm., umbilicus 1.5 mm. wide.

Arkansas: Magazine Mountain, Logan Co., in talus on north side of summit, at about 2800 feet (Pilsbry). Type 91334 A.N.S.P.

This form evidently stands near *P. petrophila*, from which it differs in the close sculpture of all the whorls, the smaller umbilicus and the larger size. The maximum diameter of *petrophila* in the Ozarks, judging from over 30 specimens from various places, is 5½ mm., with 5½ whorls, the umbilicus 1.6 mm., contained nearly 3½ times in the diameter. The largest Tennessee specimen before us measures 5.6 mm., with 5½ whorls. Bland gave the diameter of *petrophila* as 6 mm., with 5½ to 6 whorls.

V. aulacogyra is rare. Only one specimen, perfect though bleached, was found. This shell was broken near the mouth by someone using it, since it was described and drawn in 1906, so that no entire specimen is now known to exist in collections.

Paravitrea (?) roundyi Morrison Fig. 204.

Paravitrea roundyi Morrison, 1935, Jour. Wash. Acad. Sci., 25: 546, figs. 1-3.

"Shell minute, depressed, smooth, with a channeled suture. Whorls (4 in type) slightly flattened above the periphery and well rounded below. Aperture as wide as high; constricted by teeth and the curve of the penultimate whorl to a tricorn shape. There are two low, callus-like teeth in a radial row, one basal and one palatal above the periphery. Umbilicus widely open, contained about 2½ times in the major diameter of the shell. Height, 0.7 mm.; maj. diam., 1.5 mm.; min. diam., 1.35 mm.;

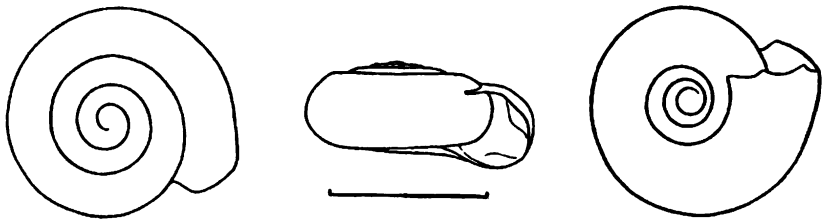

Fig. 204. *Paravitrea* (?) *roundyi*, type. (After Morrison.) Scale line = 1 mm.

height of aperture, 0.5 mm.; diam. of aperture, 0.5 mm.; umb. diam., 0.6 mm." (Morrison.)

OKLAHOMA: near Dewey, Washington Co. (P. V. Roundy), Type 365154 U.S.N.M. Also from Hickory Creek (P. V. Roundy), and Cleveland Co. (R. Frank Hedges, in U.S.N.M.).

"This species may be easily confused with *Hawaiia minuscula* from the same region, unless the height of the spire or the size of the nuclear whorls are carefully compared, or the teeth within the aperture are seen." (Morrison.)

The generic reference of this minute snail seems uncertain. The "channeled suture" and few whorls appear to deny it place in *Paravitrea*. Not seen by the author.

PILSBRYNA H. B. Baker

Pilsbryna H. B. Baker, 1929, Nautilus, 42: 91; Proc. Acad. Nat. Sci. Phila., 81: 260; 1931, 83: 86.

The shell is minute, umbilicate, depressed, similar to *Paravitrea* in form but possessing a long parietal and a columellar lamella, at least in the neanic stage, sometimes also a palatal tooth. Foot, jaw and radula as in *Paravitrea*. Genitalia similar to *Paravitrea*, but the penis with apical half armed internally with rows of thorn-shaped papillae, and the retractor, inserted laterally a short distance below apex, arises from middle of diaphragm.

TYPE: *P. aurea*.

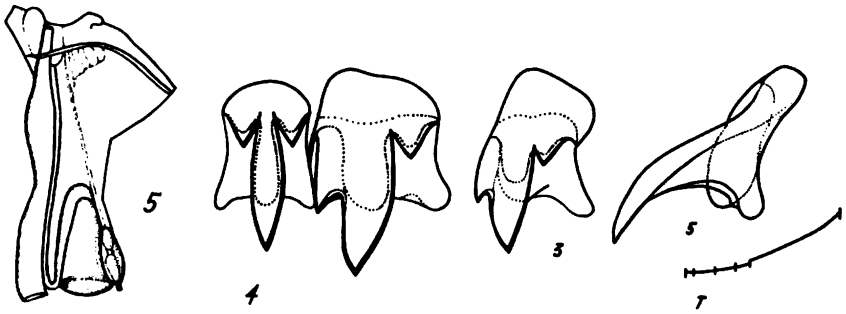

Fig. 205. *Pilsbryna aurea*, Limestone Cove, Tennessee. 5, pallial complex. 4. teeth; at *T*, shape of transverse row, showing widths of first 3 teeth. (After H. B. Baker.)

Distribution.—Southern Appalachian and Ozarkian regions.

"The anatomy of this genus is quite similar to that of *Paravitrea;* the peculiarly papillate penis of *Pilsbryna* is the principal distinction in its soft parts. However, its relatively short spermoviduct and the higher origin of its penial retractor (from middle of diaphram) is only equaled in *Pectovitrea* and approached by *Petrovitrea;* both of these groups have other distinctive features. The major distinction between them [*Pilsbryna* and *Paravitrea*] will remain the very different types of internal armature. In *Pilsbryna* the parietal and columellar lamellae are continuously elongated with new growth and simultaneously absorbed at their inner ends. In *Paravitrea,* on the other hand, the more primitive species have, on the palatal wall, discontinuous and recurrent series of radial barriers or similarly placed rows of teeth." (H. B. B.)

Key to species of Pilsbryna

A. Parietal and columellar lamellae only present.
  B. Shell with more rapidly expanding whorls, so that last one appears relatively prominent; umbilicus larger; internal armature (usually absent in adults) consisting of a scalloped, parietal lamella and a spiral row of short, basal lamellae; southern Cumberlands.....*P. castanea*
  BB. Shell with more gradually expanding whorls; umbilicus smaller; internal armature (reduced but rarely absent in adults) consisting of an evenly curved, parietal lamella and a heavy, columellar one; Limestone Cove, Appalachians proper.....*P. aurea*
AA. A palatal tooth also present; Oklahoma to northern Texas.....*P. tridens*

Pilsbryna aurea H. B. Baker Figs. 206; 207: 9-13; 208: 5.

Pilsbryna aurea H. B. Baker, 1929, Nautilus, 42: 91, pl. 3, figs. 4-8; Proc. Acad. Nat. Sci. Phila., 81: 260, pl. 9, figs 4, 5, anatomy of immature animals; 1931, Proc. Acad. Nat. Sci. Phila., 83: 112, pl. 19, figs. 9-13; pl. 20, fig. 5.

"Shell: minute, umbilicate, thin, translucent and with a bronze sheen; epidermis relatively heavy. Color: golden corneous, somewhat similar to *Z. arboreus.* Whorls: 5 (type shell has 4½), quite gradually increasing in diameter, well rounded but flattened above; suture distinct but shallow, appearing narrowly margined due to transparency of shell. Sculpture: incremental lines well impressed, quite closely and regularly spaced (so as to give somewhat the appearance of *Glyphyalinia sculptilis*); spiral lines sharply impressed, closely and regularly spaced, but exceedingly fine (nearest those of *Z. arboreus*). Umbilicus: about 8 times in major diameter. Aperture: broadly crescentic and nearly vertical. Peristome: sharp, continued on parietal wall by thin callus. Internal armature (figs. b, c): consisting of two, heavy, crescentic lamellae, one mid-columellar and the other mid-parietal in position; both begin just behind level of peristome and are dished so as to jut out obliquely, outward and slightly downward; columellar one about ⅓ whorl in length and attaining a breadth almost equal to its base; parietal one ½ whorl in length and with a maximum breadth of about ½ of last whorl.

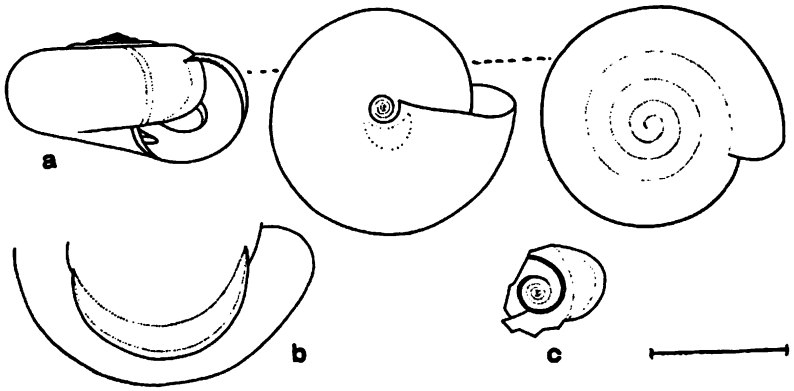

Fig. 206. *Pilsbryna aurea.* a, type shell; b, half of basal view of larger shell, with base (accidentally) broken away so as to expose parietal lamella; c, basal view of columella, broken out of same shell as in Fig. b, to show columellar lamella. (After H. B. Baker.) Scale line = 1 mm.

"Type: alt. .96 mm., maj. diam. 187 (1.79 mm.), min. diam. 172 (1.65 mm.), alt. apert. 82 (.79 mm.), diam. apert. 102 (.81 mm.); 4½ whorls. Larger, broken shells (figs. b, c): maj. diam. 2.17, min. diam. 1.98 mm.; 5 whorls." (H. B. Baker.)

Adult shells collected later measure:

Alt. 1.71 mm., diameters 189 (3.24 mm.), 170 (2.91 mm.), apert. 77 (1.32 mm.), 117 (1.54 mm.); umbilicus in diam. 6.1 times; 6 whorls.

Alt. 1.46 mm., diameters 188 (2.75 mm.), 164 (2.40 mm.), apert. 77 (1.13 mm.), 122 (1.38 mm.); umbilicus in diam. 6.2 times; 5½ whorls.

TENNESSEE: Big Springs, Limestone Cove, between Unaka and Stone Mountains, about 7 miles east of Unicoi, Unicoi County, altitude 2300 ft. Type A.N.S.P. 147189 Range of A.N.S.P. material: within radius of one mile from type locality (both near calcareous and non-calcareous outcrops). (H. B. Baker.)

"Superficially, its shell looks much like the young specimens of *Paravitrea capsella* which were collected with it. In texture and spiral sculpture, *Pilsbryna aurea* more closely approaches *Zonitoides arboreus*. In any case, its peculiar lamellae, especially the parietal position of the larger, warrant its separation as a distinct new genus, on shell characters alone.

"Animals which were obtained on a spring visit to the type locality (April 6-8) have quite mature male but under-developed female genitalia. Adult shells (Figs. 207:11-13; fig. 208:5) are considerably larger than the type; their internal armature may almost disappear although most specimens retain some traces of both parietal and columellar lamellae, even though they do not reach the margin of the peristome. The animals are most abundant on the lower layers of fallen leaves, in damp places near streams. Although specimens are present in the valleys east of the dolomite outcrops around the Big Springs, they appeared to be absent at the base of another, similar but slightly drier, calcareous outcrop, two miles farther up the Cove.

"Animal pearl-gray, tinged with bluish on dorsum of tail, head and mantle collar. Ovotestis consisting of 5 clumps of alveoli imbedded near base of apical lobe of liver. Free oviduct (Fig. 207:10) with slight, caecoid outpocketing on one side; longer than vagina. Penis (Fig. 207:9) with apical half swollen and armed internally by rows of thorn-shaped papillae; stalk relatively slender; penial papilla or verge (appearing at apex of everted organ) low and inconspicuous. Penial retractor inserting laterally a short distance below markedly recurved penial apex; right ommatophoral muscle free from genitalia." (H. B. Baker, 1931.)

"Animal: light-colored; head slightly darker; veins pigmented. Foot: high, with pebbled sides; sole long, slender and uniform, abruptly pointed posteriad; peripodial angle acute, slightly overhanging mucous crypt. Mantle collar (fig. 205:5): quite narrow, with mass of mucous glands invading lung wall; right neck lappet quite large, left one of medium size and trapezoidal. Lung: about 3 times as long as its base and 2½ times length of kidney; principal vein large. Kidney: 1¾ times as long as its base and 1½ times length of pericardium. Cloacal opening slightly in front of middle of visceral stalk.

"Jaw: as in *Paravitrea;* thin and delicate, with a weak median projection. Radular formula (fig. 205:4): 14-3-1-17; 48 transverse rows which are almost horizontal in lateral fields, break sharply at border lines with marginal ones, and then slope gradually anteriad. Forms of teeth: very similar to those in *Paravitrea* (H.B.B.; 1928: pl. 6, figs. 1, 7); central and laterals less elongate than *P. capsella* (fig. 7) but more so than in *P. multidentata* (fig. 1). (H. B. Baker, 1929.)

Pilsbryna castanea H. B. Baker Figs. 207: 1-8; 208: 4.

Pilsbryna castanea H. B. Baker, 1931, Proc. Acad. Nat. Sci. Phila., 83: 111, pl. 19, figs. 1-8; pl. 20, fig. 4.

"Shell slightly darker than that of *aurea;* other characters given in preceding key and table of dimensions. Internal armature absent in adults (type shell) but conspicuous in younger specimens (Figs. 207: 4 and 5)." (H. B. Baker.)

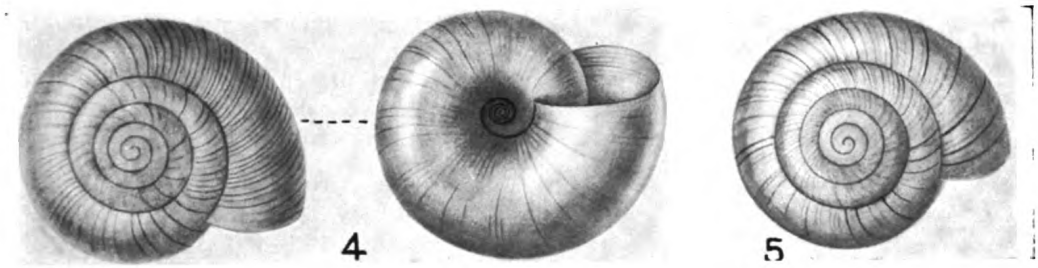

Fig. 208. 4, *Pilsbryna castanea,* type 5, *Pilsbryna aurea,* Unicoi Co., Tenn.

Height 1.71 mm., maj. diameter 3.64 mm., min. diameter 3.06 mm., aperture 1.34, 1.57 mm.; whorls 5½. Type.

TENNESSEE: (85° 47′, 35° 10′; altitude 800 ft.) in the deeper layers of leaf-humus, on west-facing hillside south of big spring which forms eastern source of Battle Creek, at Dove, Marion Co., Type A.N.S.P. 152468. Also at Cannon Creek, Bledsoe Co. (larger shells).

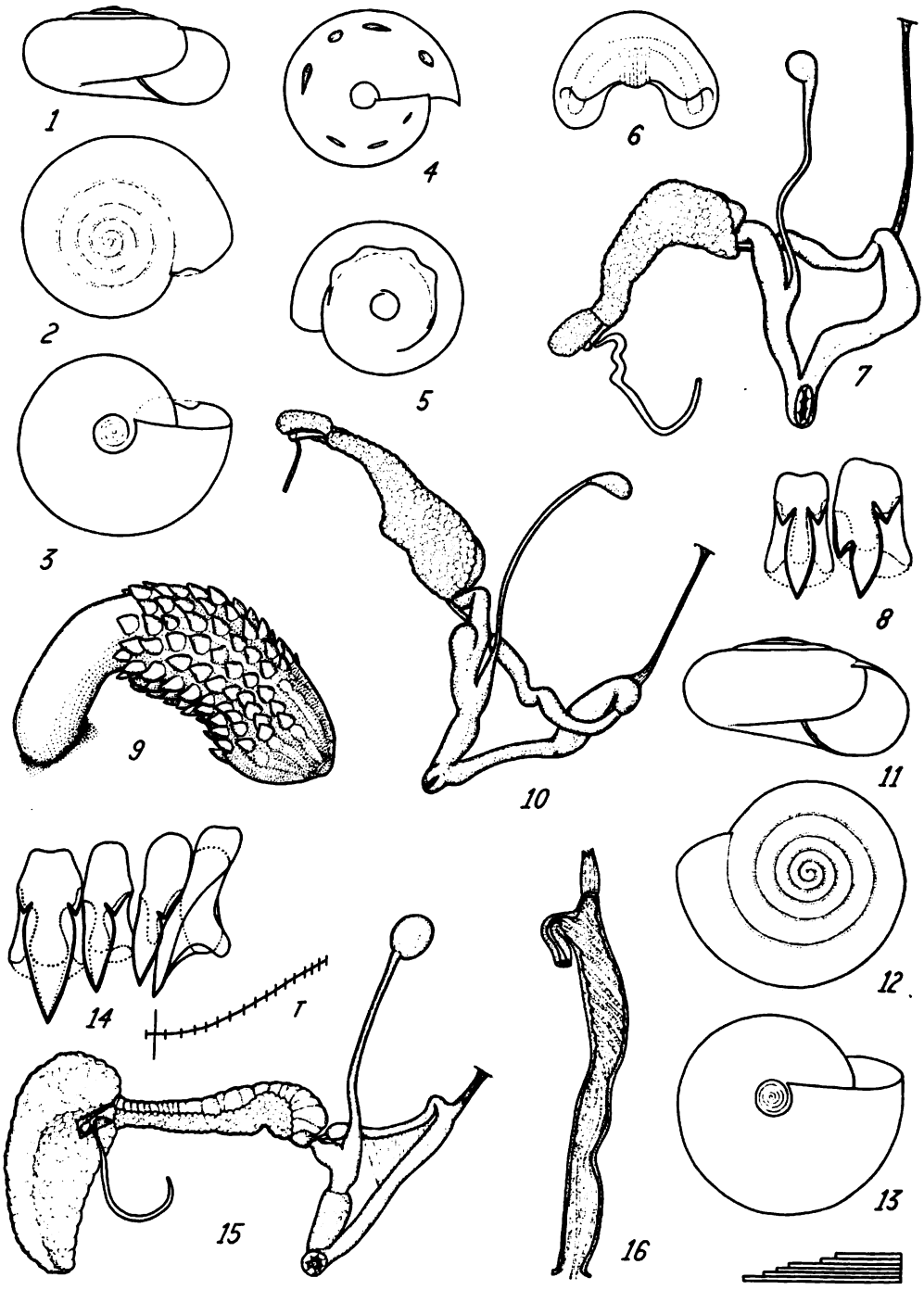

Fig. 207. See bottom of page 393 for legend.

"Animal lighter than in *P. aurea*. Mantle collar, lung and kidney similar; a very small distant, left accessory neck-lappet is present in both species. Talon (Fig. 207:7) small. Spermoviduct short. Free oviduct and vagina subequal; apparently without glandular zone. Prostate of long type. Epiphallus long-clavate, free from penioviducal angle; penial papilla small. Penis with basal half relatively stouter than in *aurea;* apical half with similar rows of thorn-shaped papillae (cf. Fig. 207:9), which are larger and less numerous, especially near lower ends of rows. Penial retractor inserting laterally near weakly recurved, penial apex. Atrium short. Jaw (Fig. 207:6) much as in *Paravitrea,* but cutting edge more markedly double than usual. Radular formula (Fig. 207:8) is 17 + 3 + 1 + 20, with 51 transverse rows; central and laterals more elongate than in *aurea*." (H. B. Baker.)

Pilsbryna tridens Morrison Fig. 209.

Pilsbryna tridens Morrison, 1935, Jour. Wash. Acad. Sci., 25: 546, figs. 8-10.

"Shell minute, umbilicate; whorls (4 in type) flattened above, well rounded below, regularly increasing in diameter; suture very shallow; growth lines not prominent, irregularly spaced. Umbilicus contained almost three times in major diameter of shell. The color is whitish (translucent)

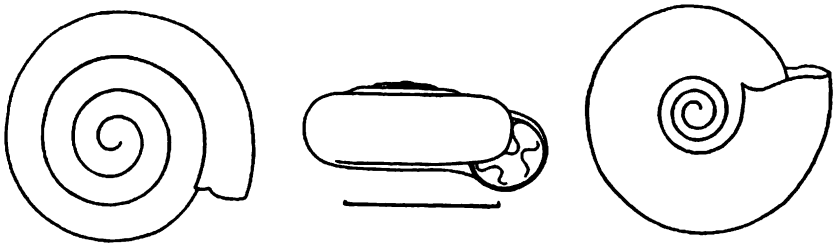

Fig. 209. *Pilsbryna tridens,* Type (after Morrison). Scale line = 1 mm.

in the specimens seen. Aperture reniform, greatly constricted by the three teeth just within the simple sharp lip. The mid-parietal lamella is scalloped as in *P. castanea* and extends as far as can be seen into the aperture; the basal and palatal teeth are blunt, very prominent, in a radial row (as in *Paravitrea*), with the palatal directly opposite the parietal lamella. Height, 0.67 mm.; maj. diam., 1.6 mm.; min. diam., 1.47 mm. Height of aperture, 0.5 mm.; diam. of aperture, 0.5 mm.; umb. diam., 0.57 mm." (Morrison.)

TEXAS: near Strawn, Palo Pinto Co. (P. V. Roundy). Type 359722 U.S.N.M. OKLAHOMA: Cleveland Co. (R. Frank Hedges, in U. S. Nat. Mus.).

Fig. 207. 1-3, *Pilsbryna castanea,* type and paratypes. 4, diagrammatic internal outline of basal wall of last whorl of a shell approaching maturity (about 5 whorls), with well developed series of palatal laminae. 5, diagrammatic internal (basal) outline of remainder of shell in fig. 4, with scalloped parietal lamella. 6, jaw. 7, dissected genitalia of a paratype in which the male genitalia are more nearly mature than the female organs (ovotestis omitted). 8, radula. 9, *Pilsbryna aurea,* topotypes, exserted penis. 10, genitalia. 11-13, shell of adult topotype. 14, *Retinella pentadelphia,* radula. 15, genitalia. 16, diagram of penis. (After H. B. Baker.)

"This species may be easily distinguished from others of the genus by the presence of a tooth on the palatal wall. Discovery of *Pilsbryna* in the Ozark region shows that the group more nearly parallels *Paravitrea* in distribution." (Morrison.)

PRISTILOMA Ancey

Pristina Ancey, 1886, Conch. Exch., 1: 20, not Ehrenberg, 1831.

Anceyia Pilsbry, after Dec. 28, 1886, Conch. Exch., 1: 26, substitute for *Pristina*. Not *Anceyia* Mabille 1886, Bull. Soc. Philom. Paris, (7), 10: 128.

Pristiloma Ancey, 1887, Conch. Exch., 1: 54, substitute for *Pristina* and for "*Anceya* Pils." Not *Anceya* of Bourguignat, 1885. Type by subsequent designation of H. B. Baker, 1930, Nautilus, 43: 122, *Zonites stearnsi* Bland.

Ogaridiscus Chamberlin and Jones, 1929, Bull. Univ. Utah, 19, no. 4: 96, monotype *Hyalina subrupicola* Dall.

Priscovitrea H. B. Baker, 1931, Proc. Acad. Nat. Sci. Phila., 83: 86, type *Pristiloma chersinella* (Dall).

Priscovitreops H. B. Baker, ibid., type *Pristiloma nicholsoni* H. B. B.

Pristinoides H. B. Baker, ibid., type *Pristiloma lansingi* (Bland).

Pristinopsis H. B. Baker, ibid., type *Pristiloma idahoense* Pils.

Shell small or minute, very or quite closely coiled, with polished, corneous or hyaline epidermis; growth-wrinkles weak (except in section *Pristiloma* s. s.) and crossed by very fine, closely spaced, spiral striae; internal armature absent (except in section *Pristinoides*). Aperture broadly or narrowly lunate; peristome simple and sharp.

Animal usually with scalloped border of black along sutural angle of liver mass. Foot with distinct, often relatively coarse tesselation; pedal grooves well developed; caudal mucous pore very small. Sole uniform; elongate with almost parallel sides; broadly rounded to abruptly pointed posteriad. Left neck-lappet wider than high, underlapping very broad but low left accessory. Ureter complete.

Ovotestis imbedded near base of apical lobe of liver; duct quite short. Free oviduct with rather vague, glandular zone. Vas deferens drawn towards penioviducal angle by right ocular retractor; epiphallus usually well developed; penial papilla present, often large, almost always with opening of vas deferens near its base. Penis usually quite large. Penial retractor arising from posterior margin of diaphragm (except in *P. subrupicola*); inserting on penial apex or epiphallus. Atrial external opening just behind base of right inferior tentacle.

Mantle retractor quite weak. Left columellar retractor gives off (1) buccal muscle which is almost free; (2, 3) heavy right and left free retractors soon afterwards and (4) continues as strong tail fan. Each free retractor gives off heavy tentacular retractor near posterior end of principal haemocoele and continues as heavy lateral retractor which is connected with its fellow and with tail fan. Right ommatophoral retractor in penioviducal angle; right inferior tentacular free.

Jaw stegognath (consisting of overlapping plates soldered together) to aulacognath (with free edges thickened so that low, flat ribs are formed). Radula with tricuspid central and laterals; innermost marginal transitional and commonly bicuspid. Buccal mass short ellipsoid. Salivary glands medium in size, lanceolate and not fused together; right one more anteriad.

Cerebral commissure short; genital nerve from right cerebral ganglion. Pedal and pleural connectives fairly long. Right and left parietal (pleuroparietal) and right visceral (parietovisceral) connectives distinct (not extremely short). Left parietal and visceral ganglia closely juxtaposed but distinguishable.

Distribution.—Pacific coastal region from Alaska to California, and inland to Montana and Utah. *Pristiloma japonicum* Pilsbry (Nautilus, 17:79), from the northern island of Japan, is the only species known beyond our limits. It appears by the shell to be related to *P. lansingi*, but has not been dissected.

Dr. H. B. Baker, whose definition of *Pristiloma* is quoted above, considers it to be more closely related to the palearctic *Vitrea* Fitzinger than to any American genus, but the anatomical differences which he has pointed out (1931, pp. 87, 88) seem sufficient for the retention of *Vitrea* and *Pristiloma* as distinct genera. He gave the following:

Key to Subdivisions of Pristiloma

A. Spermatheca of long type (sac beyond aortic loop and posterior margin of kidney); shell umbilicate to imperforate, usually hyaline (exc. *chersinella*); whorls more rapidly increasing.

B. Vagina with a long caecum containing a stimulator papilla; penial retractor inserting on looped epiphallus and arising from middle of diaphragm. Subgenus *Ogaridiscus* Chamb. & Jones

BB. Vagina without caecum; penial retractor inserting on or below apex of penis and arising from posterior margin of diaphragm Subgenus *Priscovitrea* H. B. B.

C. Spermathecal sac subspherical, imbedded between albumen gland and first limb of intestine; epiphallar entrance below penial apex; penial papilla small; radula with many (9) laterals that intergrade with marginals; shell greenish corneous.....Section *Priscovitrea* s. s.

CC. Spermathecal sac elongate, extending back along first limb of intestine; epiphallar entrance near penial apex; penial papilla large; laterals few (3-5), quite sharply demarcated from marginals; shell hyaline. Section *Priscovitreops* H. B. B.

AA. Spermatheca of short type; shell imperforate, corneous and with gradually increasing whorls.....Subgenus *Pristiloma s. s.*

D. Penial retractor inserting on penial apex, which extends considerably beyond entrance of epiphallus; jaw without markedly thickened riblets; shell with radial, denticulate barriers internally Section *Pristinoides* H. B. B.

DD. Penial retractor inserting on epiphallus, which enters near apex of penis; jaw with thickened riblets; shell without internal armature.

E. Free oviduct relatively short; shell smaller, with more rapidly expanding whorls and less prominent growth-lines Section *Prestinopsis* H. B. B.

EE. Free oviduct very long; vagina almost absent; shell larger, closely coiled and with prominent, impressed growth-lines Section *Pristiloma* s. s.

Key to Species of Pristiloma

A. Shell imperforate
  B. Sculptured above with distinct radial grooves
    D. Grooves crowded, not very deep; spire low-conic; whorls 6-7; diameter 3-4 mm.....*P. stearnsi*
    DD. Grooves deep, separated, giving appearance of a corona of low tubercles.....*P. pilsbryi*
  BB. Nearly smooth or with low growth striae below suture
    C. Lip with a denticulate rib.....*P. lansingi*
    CC. Lip thin, without rib
      D. Height decidedly exceeding ½ of diameter; spire low conoid; about 5-6 whorls
        E. Diameter 3-3.5 mm., about 6 whorls.....*P. idahoense*
        EE. Diameter 2-3 mm.; about 5 whorls
          F. Basal lip deeply concave.....*P. arcticum*
          FF. Basal lip less curved.....*P. a. crateris*
      DD. Height about ½ diameter; spire nearly flat; about 4 whorls
        E. Washington to Brit. Columbia; diameter about 2.5 mm. *P. johnsoni*
        EE. Utah to Oregon; diameter about 3 mm.....*P. subrupicola*
AA. Shell perforate, rimate to narrowly umbilicate
  B. Height decidedly more than ½ the diameter
    C. Diameter 3-4 mm.....*P. chersinella*
    CC. Diameter about 2 mm.....*P. wascoense*
  BB. Height little if any exceeding ½ the diameter
    C. Utah to Oregon; diameter about 3 mm.....*P. subrupicola*
    CC. California
      D. Umbilicus nearly closed by a lobe of columellar margin; diameter about 2 mm.; Marin Co.....*P. nicholsoni*
      DD. Columellar margin not so reflected over umbilicus
        E. Diameter 4 to 5.5 mm., otherwise like *subrupicola;* Calaveras Co.....*P. s. spelaeum*
        EE. Diameter 4-5 mm., 4½-5 whorls; San Gabriel Mts. *P. gabrielinum*
        EEE. Smaller, diameter about 2-3 mm., 3¾ whorls
          F. More lenticular; Catalina I.....*P. shepardae*
          FF Higher, more evenly rounded whorls; Palomar Mts., San Diego Co.....*P. orotes*

(Πρίστης, a saw, λῶμα, border; in allusion to the serrate marginal lip-rib of *P. lansingi,* which Ancey apparently considered the genotype.)

Subgenus **PRISTILOMA** s. s.

P. STEARNSI GROUP (Section *Pristiloma* s. s.)

Pristiloma stearnsi (Bland) Fig. 210.

Zonites stearnsii Bland, 1875, Ann. N. Y. Lyc. Nat. Hist. of N. Y., 11: 76, fig. 3.

Microphysa stearnsi Bland, W. G. Binney, 1883, Bull. Mus. Comp. Zool., 11: 147, pl. 2, figs. N, O (jaw and teeth); 1885, Man. Amer. Land Sh., p. 91, fig. 57.

Pristiloma stearnsi (Bland), Dall, 1905, Harriman Alaska Exped., 13: 44.—H. B. Baker, 1931, Proc. Acad. Nat. Sci. Phila., 83: 96, pl. 15, figs. 6-10 (anatomy).—Chace, 1934, Nautilus, 47: 112.

"Allied to *Z. lansingi*. It is larger, more elevated and more distinctly striated than that species, has seven whorls, with rather wider and more rounded aperture, but without the lamella within the outer margin of the peristome. The measurements are diameter maj. 4, min. 3½ mill., alt. 2½ mill." (Bland.)

Fig. 210. *Pristiloma stearnsi*, near Astoria. Scale line = 1 mm.

The imperforate shell is moderately depressed with low conic spire and convex base; transparent cinnamon colored, the apex pale; surface very glossy, the first 1½ whorls smooth, the rest with rather close, deeply impressed radial grooves which fade out on the periphery of the last whorl, leaving the base marked with rather close low wrinkles of growth; close, fine and mostly indistinct spiral striation is visible under a high power. The aperture is rather narrowly crescentic, lip thin, becoming thickened within near the columellar axis.

Height 2.4 mm., diameter 3.4 mm.; 6⅓ whorls. Near Astoria.
Height 2.7 mm., diameter 3.8 mm.; 7 whorls. Near Seattle.

OREGON: Astoria, type loc. (Stearns, H. B. Baker); Empire (Chace). WASHINGTON: numerous places in Clallam Co.; Seattle, King Co. (H. B. Baker). Lake Quiniault, Chehalis Co. (Berry). Olympia, Thurston Co. (Dall). BRITISH COLUMBIA: Comox, Union Bay and Salt Spring Island (Dall); Vancouver Island at Cameron Lake and near Union (C. M. Cooke, Jr.); near Duncan (A. W. Hanham). ALASKA: Killisnoo, Portage Bay, Anuk, Dyea Valley, Klehini and Klukwan (Dall).

"Individuals of this species appear quite solitary and are usually found in the upper and looser layers of fallen leaves. The following anatomical description is founded on topotypes (Aug. 6-11).

"Animal grayish; sole rounded posteriad. Mantle collar (Fig. 211:9) heavy and glandular; right neck-lappet moderate, left ones prominent. Lung wall elongate, 7 times as long as its base and about 4 times length of kidney. Kidney 2½ times as long as its base or 1½ times length of pericardium.

"Ovotestis (Fig. 211:10) consisting of 7 groups of irregularly clavate, often multifid alveoli; duct greatly swollen; talon elongate with whitish apical knob. Albumen gland relatively short, lenticular. Uterus quite slender and short. Free oviduct as long as uterus; apical third slender and convoluted; basal ⅔ swollen and thick-walled, with glandular zone at apex and a vague one near base. Spermatheca with elongate, acuminate sac and heavy, internally plicate stalk, which develops near its base a very thick-walled, glandular, lateral swelling. Vagina practically absent. Prostate

of long type. Vas deferens elongate, swollen apically to form a long, thick-walled, internally plicate epiphallus, which enters near apex of penis through base of large penial papilla (Fig. 211:7). Penis short and stout, attenuate basally; filled for over ⅓ its length by penial papilla, which is flattened on one side and has a white line around its base and others around margins between flat and rounded sides; also with two heavy pilasters. Penial retractor inserting on loop of epiphallus. Atrium very short.

"Jaw (Fig. 211:8) corneous and fairly heavy, median third with numerous, flat, rib-like thickenings; lateral ends with less relief. Radular formula (Fig. 211:6) is (10–11) + 4 + 1 + (15–16), with 70 transverse rows. Laterals rather elongate. Marginals long-aculeate; innermost bicuspid; 7th is largest. Buccal mass short; salivary glands or ducts twice as long." (H. B. Baker.)

(Named for Dr. R. E. C. Stearns.)

Pristiloma pilsbryi Vanatta Fig. 212.

Pristiloma pilsbryi Vanatta, 1899, Proc. Acad. Nat. Sci. Phila., 51: 120, fig. 1.—H. B. Baker, 1931, Proc. Acad. Nat. Sci. Phila., 83: 97, pl. 15, figs. 4, 5.

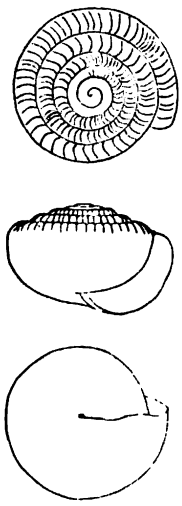

Fig. 212.

"Shell imperforate, translucent, light horn colored, polished; suture deep; spire depressed, composed of five and one-half slowly increasing whorls; the first two whorls are smooth, the remainder are deeply radially sulcate, the sulci fading out at the periphery, making the top of the whorls flatly nodulose. There are about fifty-two nodules on the last whorl. Base smooth, squarely convex, giving the shell the form of a thick rounded disc. Mouth narrowly lunate. Lip sharp, rather sinuous at the base, with a slight callus near the columella as in *Pristiloma stearnsi;* columellar lip slightly reflexed. Alt. 1.68 mm., greatest diam., 2.56 mm.; least diam., 2.4 mm." (Vanatta.)

Diam. 3.4 mm., 6½ whorls (Point Ellis).

OREGON: Portland (H. Hemphill). Type 56996 A.N.S.P. WASHINGTON: Point Ellis and Long Beach, Pacific Co. (H. B. Baker).

"The sculpture of the spire of this species is very much like *Macrochlamys* [*Taphrospira*] *diadema* Dall. It is distinguished from *Pristiloma stearnsi* Bld. by the very much deeper and more separated sulci, and the lower spire." (Vanatta.)

"This species is most abundant under the dense thickets of salal near the coast; it usually occupies the deeper, more rotten strata of decaying leaves. The anatomical notes are founded on specimens with immature but well developed male genitalia, which were collected about 100 yards from the ocean at the south end of Long Beach, Pacific Co., Wash. (Aug. 10-12). Only salient differences from the structure of *P. stearnsi* will be noted.

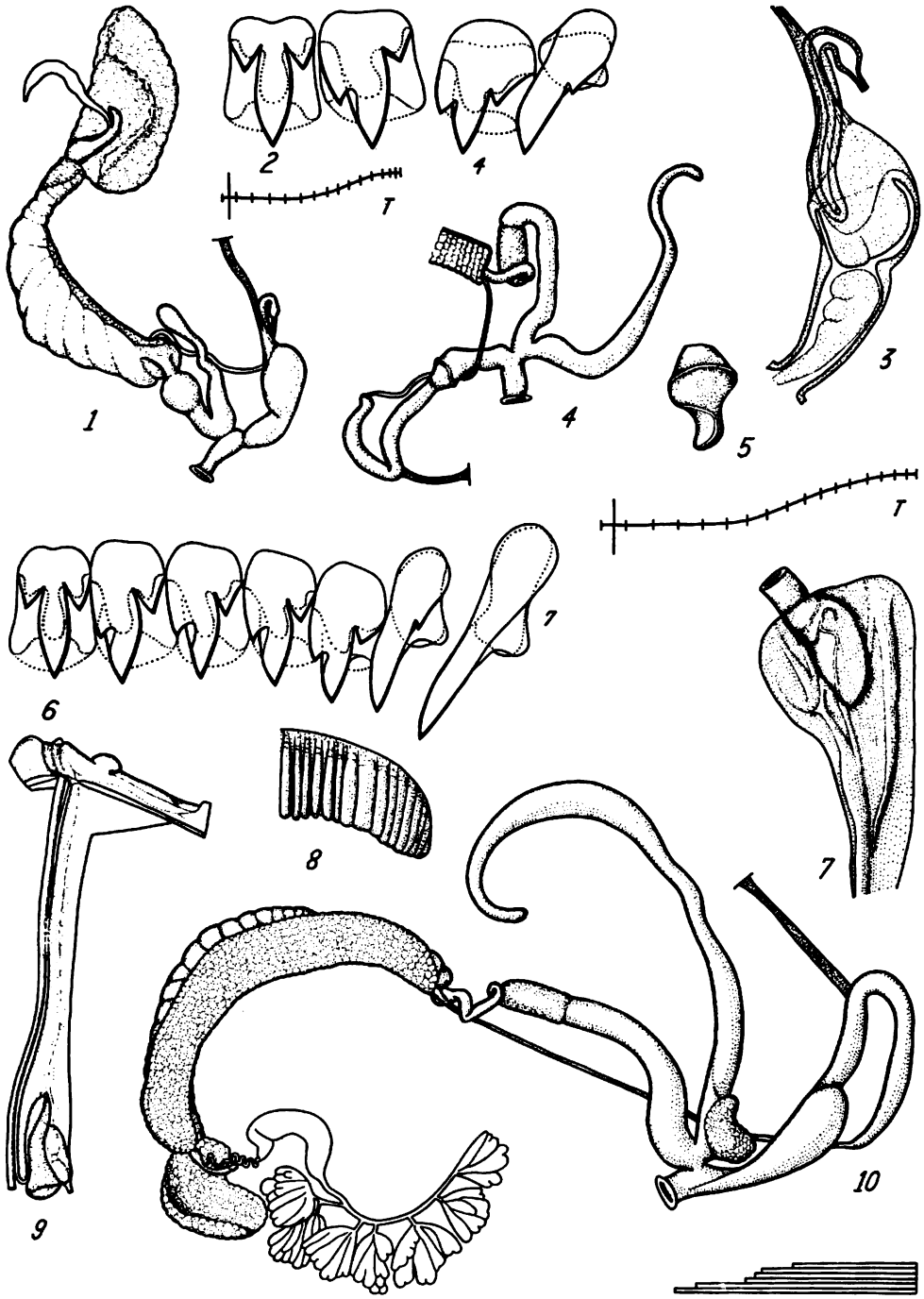

Fig. 211. *Pristiloma arcticum,* Mt. Rainier, genitalia. 2, radula. 3, diagram of penis and epiphallus. 4, *Pristiloma pilsbryi,* terminal parts of immature genitalia. 5, verge. 6, *Pristiloma stearnsi,* Clatsop Co., radula 7, penis cut open. 8, half of jaw. 9, pallial complex. 10, genitalia. (After H. B. Baker.)

"Animal with slightly less pigmentation. Lung wall 6 times as long as its base or 5 times length of kidney. Kidney 1½ times as long as its base or length of pericardium.

"Ovotestis consisting of 6 clumps of alveoli. Albumen gland and uterus still adolescent but prostate well developed. Spermathecal stalk (Fig. 211: 4) with some glandular tissue in enlarged base but without formation of a distinct organ as in *P. stearnsi*. Penis relatively small; penial papilla (Fig. 211:5) about ¼ length of penis. Jaw with low thickenings of lateral thirds relatively broader. Radular formula is 11 + 4 + 1 + 15, with 72 rows; innermost marginal unicuspid or with weak ectoconal angulation." (H. B. Baker.)

P. IDAHOENSE GROUP (Section *Pristinopsis* H. B. Baker)

Pristiloma idahoense Pilsbry Fig. 213.

Pristiloma idahoense Pilsbry, 1902, Proc Acad Nat. Sci. Phila., p. 593.

P. (Pristinopsis) idahoense Pilsbry, H. B. Baker, 1931, Proc. Acad. Nat. Sci. Phila., 83: 95, pl. 14, figs. 4-6.

"Shell imperforate, depressed, the spire low conoid, yellowish corneous, glossy, smooth except for faint growth-lines, stronger near the suture. Whorls 6, very narrow and slowly increasing, the last very obtusely angular at the periphery, very convex beneath, only slightly impressed at the axis. Aperture very narrowly lunate, the peristome simple and thin, the columellar margin thickened within, suddenly but minutely dilated at the axial insertion. Alt. 2.1, diam. 3.4 mm." (Pilsbry.)

Height 1.6 mm., diam. 3.2 mm.; 6¼ whorls.

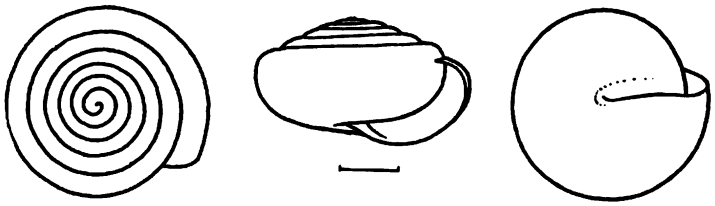

Fig. 213. *Pristiloma idahoense*, type. Scale line = 1 mm.

IDAHO: Stevens' Ranch, Weiser Canyon, Adams Co., Type 82353 A.N.S.P.; also Price Valley, in the same county and Big Payette Lake, Boise Co. (E. H. Ashmun). Gulches below St. Joe, Benewah Co.; Orofino Creek, Clearwater Co.; Rabbit Creek 2 miles south of Stites and valley of Elk Creek near Riggins, Idaho Co.; Cedar Creek Valley near Summit, Kootenai Co.; St. Joe River above Avery, between Dorsey and Twin Lakes, and along Coeur d'Alene River above Larson, Shoshone Co. (H. B. Baker).

This species resembles *P. lansingi* and *P. arcticum*. It differs from the latter in having more and narrower whorls, a higher periphery, and a narrower mouth. It differs from *lansingi* in the larger size, absence of any lip-rib, the less evenly rounded periphery, and the greater number of whorls.

"The following anatomical notes are largely based on specimens from near Meadows, Adams Co. (Sept. 12-15) but topotypes (Sept. 17) have also been examined. The structure of this species is fundamentally similar to that of *P. lansingi* and only salient differences will be noted.

"Mantle collar fairly heavy; right neck-lappet remarkably long and tongue-shaped; left one extensive. Lung wall over 6 times as long as its base and about 5 times length of kidney. Kidney about 1½ times as long as its base or length of pericardium.

"Ovotestis consisting of three trefoil groups of alveoli; talon (Fig. 217:6) stout and recurved. Uterus quite slender, sacculate. Free oviduct quite short, with median glandular zone. Spermathecal sac long lanceolate; stalk with bulbar enlargement which contains some glandular tissue. Vas deferens with short epiphallus (Fig. 217:4) which enters through base of apical penial papilla, that is longer than broad. Penis elongate; vergic capsule slightly swollen, less than ⅛ total length; remainder thin-walled, internally with weak, longitudinal folds. Penial retractor inserting near basal end of epiphallus. Atrium quite short.

"Jaw similar to that of *P. stearnsi* but less extensive and relatively deeper. Radular formula (Fig. 217:5) is 12 + 7 + 1 + 19 with 103 rows; central and laterals more quadrate than in *P. lansingi* and outermost tricuspid tooth less elongate." (H. B. Baker.)

Pristiloma arcticum (Lehnert) Fig. 214.

Hyalina arctica Lehnert, 1884, Science Record, 2: 172.

Pristiloma arctica (Lehnert), Pilsbry, 1899, Proc. Acad. Nat. Sci. Phila., p. 186, pl. 9, figs. 3-5.—Dall, 1905, Harriman Alaska Exped., 13:45.

Pristiloma arcticum (Lehnert), H. B. Baker, 1930, Nautilus, 43: 124; 1931, Proc. Acad. Nat. Sci. Phila., 83: 95, pl. 15, figs. 1-3.—Berry, Nautilus, 50: 87.

"Shell imperforate, globose-depressed, most minutely striate, uniform tawny-brown, glossy. Whorls 5½ to 6, convex, very narrow, the last

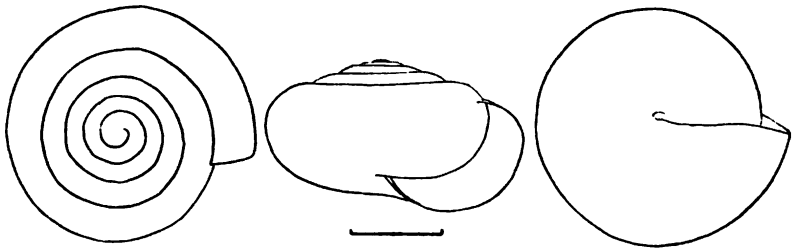

Fig. 214. *Pristiloma arcticum,* paratype. Scale line = 1 mm.

somewhat convex at base. Aperture depressed, lunar; peristome simple, acute, the basal margin arcuate. Width 2 mm., alt. 1.5 mm." (E. Lehnert.)

ALASKA: Point Barrow, Lat. 71° 25′ N.. Type 108228 U.S.N.M. Unalaska; Coal Harbor, Unga Island, Shumagins; Orca, Prince William Sound; Yakutat Bay (Dall). Dutch Harbor (G. D. Hanna). Kadiak (S. S. Berry). WASHINGTON: Paradise park (near timberline on Mt. Rainier) down to near Longmire (5000-3000 ft.), Pierce Co. (H. B. Baker).

"It occurs in the moss of the tundra near Point Barrow, where at most it can have but three months of activity out of the whole year." (Dall.)

It is a glossy shell with the general shape of *P. lansingi;* growth-striae faint, spire low-conic, whorls 4¾, slowly and regularly increasing, and last not disproportionately wide as in *P. johnsoni,* but about as in *P. lansingi.*

Aperture narrowly crescentic. The paratype figured measures, height 1.58; diam. 2.66 mm. The width of the spire a little exceeds two-thirds the greatest diameter of the shell.

It differs from *P. stearnsi* (Bld.) in surface sculpture and smaller size; from *P. lansingi* (Bld.), with which it agrees in the characters mentioned, as well as in the nearly vertical aperture, it differs in the lower, submedian position of the periphery, and in wanting the denticulate lip-rib of that species.

"Animals from Paradise Park near timberline on Mt. Rainier (Sept. 5-6) have been studied. Their anatomy is compared with that of *P. idahoense.*

"Sole broadly rounded posteriad. Mantle collar quite deep; right necklappet moderate; left and left accessory ones higher than usual. Lung wall 4½ times as long as its base and 3½ times length of kidney.

Ovotestis consisting of 5 clumps of alveoli; talon (Fig. 211:1) relatively smaller. Spermatheca sac ovoid; stalk short, gradually swollen towards base. Vagina practically absent. Epiphallus quite short and recurved terminally; entrance into penis lateral, through base of free portion of apical penial papilla (Fig. 211:3). Penis obovoid, relatively stout and large; apical half filled by large papilla, of which free part is relatively short; basal half with large, folded pilaster. Penial retractor inserting first on epiphallus, but with strands which continue to penial apex and side.

"Jaw very thin and transparent. Radular formula (Fig. 211:2) is 10 + 4 + 1 + 14, with 72 relatively straight, transverse rows. First marginal bicuspid." (H. B. Baker.)

Pristiloma arcticum crateris new subspecies Fig. 215.

The shell is imperforate, depressed, with quite low, conoid spire and rounded periphery, median in position; pinkish buff, glossy. Sculpture of weak but subregular ripples of growth below the suture, soon disappearing, leaving the peripheral region and base smooth except for very weak lines of growth; very fine, close spirals are seen on the upper surface. The

Fig. 215. *Pristiloma arcticum crateris,* type. Scale line = 1 mm.

whorls are regularly and rather closely coiled, the last not unduly wider. The aperture is narrowly crescentic, the outer and basal margins of the lip thin, columellar margin slightly spreading, thickened within, reflected

at the insertion in a small callus over the axis. Height 1.5 mm., diameter 2.75 mm.; 5⅛ whorls. H./d. index about 54.5.

OREGON: one mile south of Crater Lake, Klamath Co. (Junius Henderson). Type and paratypes 147788 A.N.S.P., others in Coll. University of Colorado.

This shell is smaller than *P. idahoense*, with the peripheral convexity median, not above the middle as in the Idaho snail. It is very similar to *P. arcticum*, but the base is more flattened, producing a less deeply concave basal lip and somewhat different shape of aperture, and there is a fraction of a whorl more.

P. LANSINGI GROUP (Section *Pristinoides* H. B. Baker)

Pristiloma lansingi (Bland) Fig. 216.

Zonites lansingi Bland, 1875, Ann Lyc. N. H. of N. Y., 11: 74, figs. 1, 2.

Microphysa lansingi Bland, W. G. Binney, 1885, Man. Amer. Land Sh., p. 90, figs. 55, 56.

Pristiloma lansingi (Bland), Pilsbry, 1899, Proc. Acad. Nat. Sci. Phila., p. 187, pl. 9, figs. 1, 2.—Dall, 1905, Harriman Alaska Exped., 13: 44.—E. P. & E. M. Chace, 1934, Nautilus, 47: 112.—Henderson, 1936, Univ. Colo. Studies, 23: 259.

P. (*Pristinopsis*) *lansingi* (Bland), H. B. Baker, 1931, Proc. Acad. Nat. Sci. Phila., 83: 94, pl. 14, figs. 7-11 (anatomy).

"Shell imperforate, orbicular-depressed, shining, dark horn-colored, smooth above, at the base substriate; suture impressed; whorls 5½, rather convex, the last not descending, obsoletely angular at the periphery, more

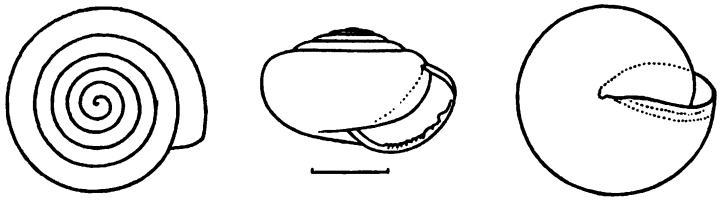

Fig. 216. *Pristiloma lansingi*, Riverdale, Oregon. Scale line = 1 mm.

convex at the base, excavated around the umbilical region; aperture narrow, lunate; peristome acute, the right margin thickened within by an obsoletely denticulated lamella, columellar margin scarcely reflected. Diam. maj. vix 3, min. 2½ mill., alt. 1⅓ mill." (Bland.)

Height 1.5 mm., diameter 2.5 mm.; 5½ whorls.

BRITISH COLUMBIA: Victoria and Nanaimo, Vancouver Island (Dall). WASHINGTON: Clallam Co.; Esperance, Snohomish Co.; King Co.; Pierce Co.; Point Ellis, Pacific Co. (H. B. Baker). OREGON: Astoria (type loc.) and elsewhere in Clatsop Co.; Multnomah Co.; Clackamas Co. (H. B. B.), Eugene, Lane Co. (Chace); Douglas Co. (Andrews). Empire, Coos Co. (Chace). CALIFORNIA: Endert's Beach and Klamath, Humboldt Co. (Chace).

The glossy surface has rather close unequally spaced wrinkles of growth, strongest near the suture, very much reduced on the nearly smooth base, which is a little impressed around the axis. The periphery is situated high, the greatest convexity being above the middle, but it is too much rounded to be called "obsoletely angular" in adult shells.

The callous rib within the basal and outer margins of the lip is special to this species. It is variously denticulate at the edge, and becomes very low near the columella and in the upper arc of the lip. It is formed in young shells of less than 3 whorls, 1.2 mm. diameter, which sometimes have two barriers nearly half a whorl apart. In adult shells the earlier lip ribs are completely absorbed. In young stages the rib is short, without the weak extensions to columella and posterior angle possessed by the adult.

" This species is the most omnipresent *Pristiloma* in its range, but is especially abundant in loose accumulations of dead leaves. The following anatomical account is mainly founded on topotypes (Aug. 6-11).

" Animal with whitish foot, grayish dorsum of head and black tentacles; also with some black pigment on anterior part of external lung wall and along sutural edge of liver; sole rounded posteriad. Mantle collar (Fig. 217:9) quite shallow, with glands invading lung wall; right and left neck-lappets prominent; left accessory extensive but low. Lung wall 6 times as long as its base and almost 4 times length of kidney; aerating surface thicker and more opaque than remainder of wall. Kidney about twice as long as its base and 1½ times length of pericardium.

" Ovotestis consisting of two groups of alveoli; talon (Fig. 217: 11) large and recurved. Albumen gland lenticular. Uterus swollen and quite simple. Free oviduct elongate with vague glandular zones near both ends. Spermatheca with elongate sac; stalk swollen near its base and developing complexly convoluted, longitudinal plication internally. Vagina moderate. Prostate almost as long as uterus. Vas deferens developing short, stout epiphallus which enters laterally between apical and middle thirds of penis. Penis (Fig. 217:8) elongate; apical ¼ containing penial papilla which is followed by a pair of short, rounded, internal bosses on each side of epiphallar entrance; basal ⅔ developing two, quite heavy, internal pilasters. Penial retractor mainly inserting on penial apex but with slender branch to base of epiphallus. Atrium quite long.

" Jaw (Fig. 217:7) consisting of quite heavy, overlapping plates, which appear to be firmly fused together and are somewhat thickened outside of underlap, *i. e.*, approaching condition in *P. stearnsi*). Radular formula (Fig. 217:10) is 10 + 6 + 1 + 17, with 79 transverse rows. Laterals intergrading with marginals; 1st marginal usually tricuspid; 2nd with weak ectoconal angulation. Salivary glands or their ducts about as long as buccal mass." (H. B. Baker.)

(Named for Mr. A. Ten Eyck Lansing, of Burlington, N. J., " a young student of mollusks " in 1875.)

Fig. 217. 1, *Pristiloma johnsoni*, Multnomah Co., Ore., genitalia, albumen gland cut open to show talon. 2, radula. 3, diagram of penis. 4, *Pristiloma idahoense*, diagram penial apex and epiphallus. 5, radula. 6, genitalia. 7, *Pristiloma lansingi*, Clatsop Co., half of jaw. 8, diagram penis and epiphallus. 9, pallial complex. 10, radula. 11, genitalia. (After H. B. Baker.)

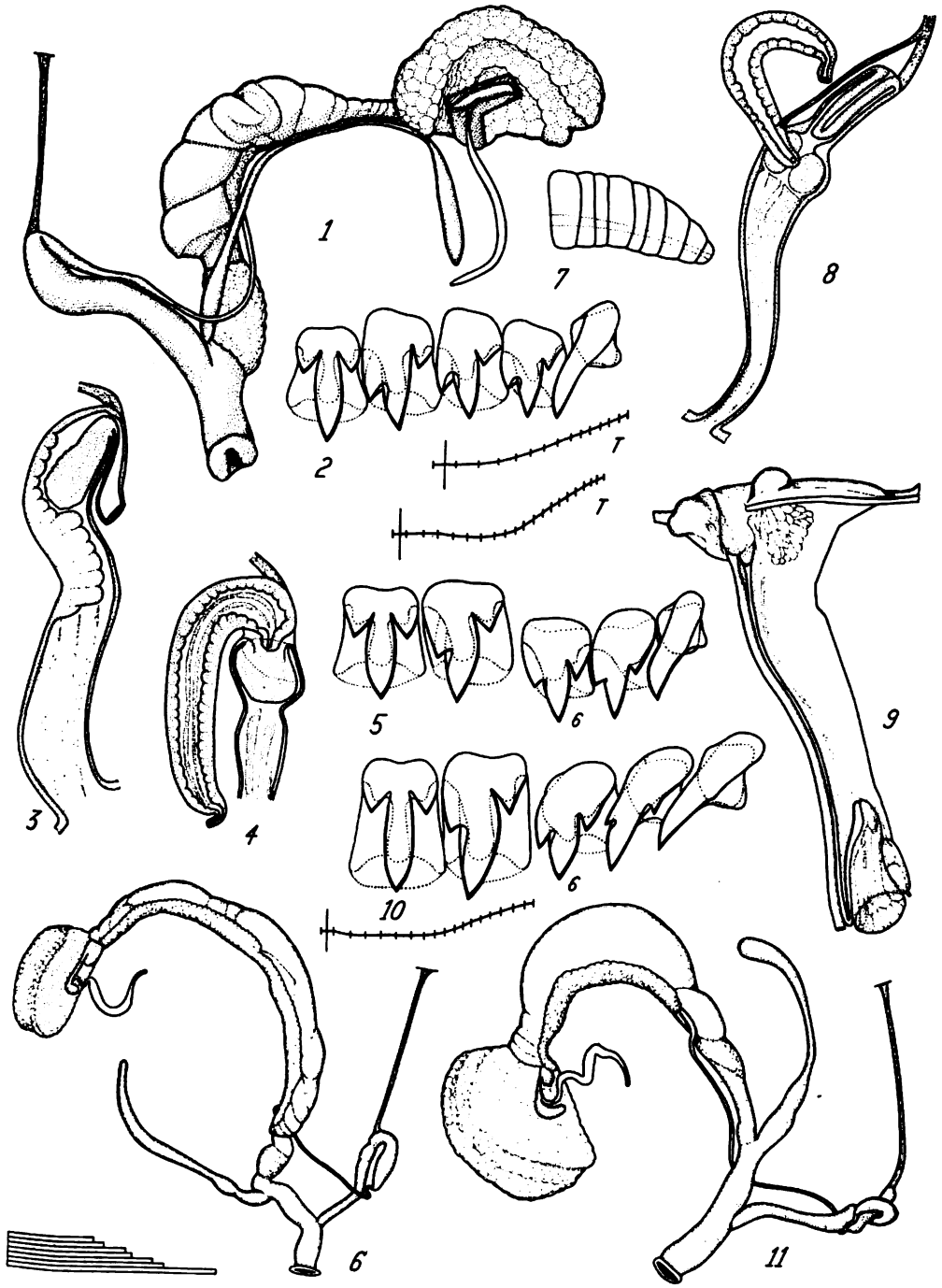

Fig. 217. See bottom of page 404 for legend.

P. NICHOLSONI GROUP (Section *Priscovitreops* H. B. Baker)

Pristiloma johnsoni (Dall) Fig. 218.

Vitrea johnsoni Dall, 1895, Nautilus, 9: 27. Seattle (immature).

Pristiloma (Priscovitreops) johnsoni (Dall), H. B. Baker, 1931, Proc. Acad. Nat. Sci. Phila., 83: 93, pl. 14, figs. 1-3.

Pristiloma taylori Pilsbry, 1899, Proc. Acad. Nat. Sci. Phila., 51: 185, pl. 9, figs. 6-8. Nanaimo, Vancouver I.

Retinella (Glyphyalinia ?) columna Morrison, 1937, Proc. Biol. Soc. Wash., 50: 57, pl. 4, figs. 8-10 (Olga, Wash.).

"Shell small, pale waxen-white or translucent, of three and a half whorls, rather rapidly enlarging, smooth except for delicate radial lines of growth which are occasionally visible; suture distinct, slightly impressed; spire hardly elevated but not flattened; periphery rounded, base convex. imperforate, the pillar lip strongly reflected close to the axis; aperture semilunar, sharp edged, the peristome hardly flexuous, the upper edge a little in advance of the lower; resting stages indicated internally by one or two narrow whitish streaks where the shell is slightly thickened, but which do not project internally. Height of shell 1, major diam. 2, minor diam. 1.5 mm." (Dall.)

Height 1.05 mm., diameter 2.35 mm.; 3¾ whorls.

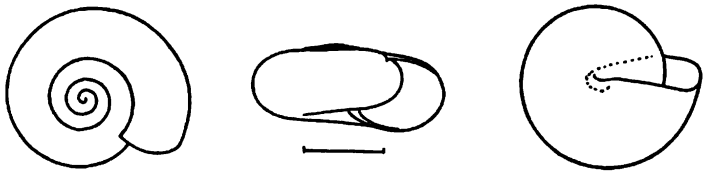

Fig. 218. *Pristiloma johnsoni,* Clallam Co., Washington. Scale line = 1 mm.

WASHINGTON: near Seattle (P. B. Randolph), Type 130622 U.S.N.M.; paratypes 67491, A.N.S.P. Clallam and Pacific counties (H. B. Baker); Olga (C. E. Engberg, type of *R. columna,* 362009 U.S.N.M.) OREGON: Clatsop, Multnomah and Clackamas counties (H. B. Baker). BRITISH COLUMBIA: Nanaimo, Vancouver I. (G. W. Taylor, type of *P. taylori*); near Duncan (A. W. Hanham).

The depressed shape and small spire, with wide last whorl, as seen in apical view, separate this species from others of the region.

"This species varies considerably in size at sexual maturity and in the relative magnitude of the last whorl. As a rule, the largest shells appear to have the most expanded last whorls. Animals from Riverdale, Multnomah Co., Oregon (Aug. 1-5) have been especially studied: they will be compared with those of *P. nicholsoni.*

"Animal white with small, black eye-spots; tessellae large but low; foot narrowly rounded, almost pointed posteriad. Ovotestis consisting of 2 clumps of alveoli; talon (Fig. 217:1) relatively large and completely buried in albumen gland. Uterus coarsely sacculate. Free oviduct stouter. Vas deferens with more slender epiphallus. Penis (Fig. 217:3) elongate. slightly swollen in apical half, which contains large penial papilla (about ½

as long as penis) and a very heavy, glandular pilaster; basal half thin-walled, internally with weak, longitudinal folds. Jaw still lower, narrower and with more numerous thickenings. Radular formula (Fig. 217:2) is 10+ 3 + 1 + 13, with 55 transverse rows; central and laterals more nearly equal in size." (H. B. Baker.)

(Named in honor of Professor O. B. Johnson.)

Dall described an immature individual. The adult form was described as *P. taylori* as follows:

" Shell imperforate, discoidal, thin, transparent, corneous, clearly showing the yellow soft parts when these are dried in it; surface smooth and glossy, with faint growth-striae. *Spire almost flat, comparatively narrow,* slightly more than half the greatest diameter of the shell; whorls four, the nucleus rather large, whorls slowly increasing, *the last wide, double the width of the preceding,* equably rounded at the periphery, flattened beneath, with a deep indentation around the axis. Aperture oblique, *broadly* lunate; peristome simple, thin and acute, *the upper termination inserted decidedly above the periphery,* baso-columellar margin straightened. Alt. 1.1; greatest diameter, 2.5; lesser, 2.16 mm." (Pilsbry.)

Retinella columna Morrison proves, by comparison of the types, to be the adult stage of *P. johnsoni;* Mr. Morrison concurring in this decision.

Pristiloma nicholsoni H. B. Baker Fig. 219.

Pristiloma nicholsoni H. B. Baker. 1930, Nautilus, 43: 121, pl. 5, figs. 5-7.
Pristiloma (Priscovitreops) nicholsoni H. B. Baker, 1931, Proc. Acad. Nat. Sci. Phila., 83: 92, pl. 13, figs. 5-7.

" Shell: minute, rimate, thin, vitreous. Color: light horn, almost white. Whorls: 4¼, quite rapidly increasing in diameter, well rounded, although slightly flattened above; suture beveled over each preceding whorl so as to appear broadly margined. Apical whorls: apparently smooth. Sculpture of later whorls: growth-lines irregularly spaced, faintly impressed, slightly stronger on umbilical side and very weakly arcuate at suture; spiral striae weak and closely spaced (somewhat like in *Zonitoides arboreus*). Umbilicus: small and rendered rimate by peculiarly expanded columellar angle of peristome. Aperture: narrowly crescentic and nearly vertical. Peristome: sharp and simple on palatal and basal sides, but expanded towards columellar angle, which is free from preceding whorl so that it forms a triangular tongue which almost hides the umbilicus.

" Cotype: alt. 1.08 mm., maj. diam. 187 (2.02 mm.), min. diam. 169 (1.82 mm.), alt. apert. 90 (.97 mm.), diam. apert. 101 (.98 mm.); apical whorls eroded. Another cotype: alt. 1.05 mm., maj. diam. 196 (2.06 mm.), min. diam. 175 (1.84 mm.), alt. apert. 89 (.94 mm.), diam. apert. 104 (.98 mm.); 4¼ whorls." (H. B. Baker.)

CALIFORNIA: Under pieces of wood on hillside near spring brook (first small branch below Big Carson Creek) about two miles south of Lagunitas, Marin Co. (John Nicholson and H. B. Baker), Type 149978 A.N.S.P.

" In general appearance, this species is most like *Vitrea johnsoni* Dall, from Seattle, Washington, which was named from incompletely developed

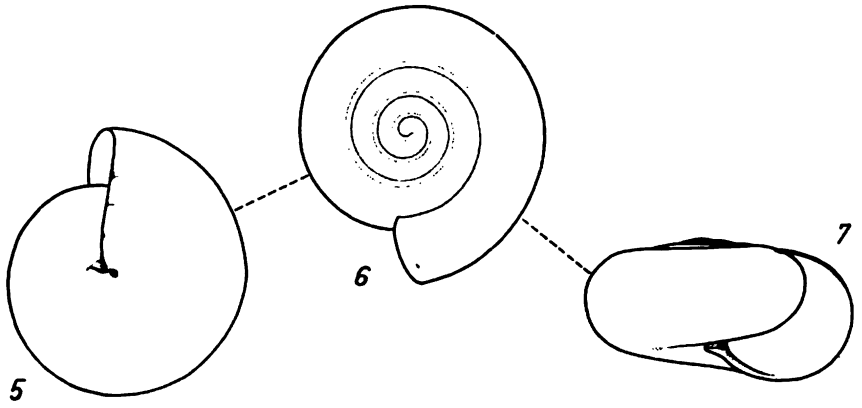

Fig. 219. *Pristiloma nicholsoni*, cotypes × about 18 (after Baker).

specimens (paratypes examined) of what was later much more recognizably described as *Pristiloma taylori* Pils., from Nanaimo, Vancouver Island. But, when adult, *P. johnsoni* has more rapidly expanding whorls than the Californian species and is imperforate, while the columellar expansion of *P. nicholsoni*, although similar in shape, is depressed below the umbilicus so as to leave an open rima." (H. B. Baker.)

"The following anatomical notes are based on two paratypes (July 19). Both specimens have immature female genitalia, but the male sexual organs appear to be fully developed.

"Animal whitish; eyes gray; foot with very coarse tessellation; sole abruptly pointed posteriad. Mantle collar deep; right neck lappet moderate; left ones low. Lung wall about 2½ times as long as its base or length of kidney. Kidney 1½ times as long as its base or length of pericardium.

"Ovotestis consisting of four groups of alveoli; duct (Fig. 225:5) moderately swollen; talon lanceolate. Free oviduct moderate in length, almost covered by glandular zone. Spermathecal sac clavate, imbedded parallel to posterior margin of diaphragm just in front of intestinal S-loops. Vagina short. Prostate well developed. Vas deferens enlarged terminally to form a short epiphallus, which does not loop beyond penial apex; terminal opening through base of penial papilla, very near penial apex. Penis exceptionally large (swollen in each of my specimens by what appears to be a larval trematode); internal structure otherwise similar to that in *johnsoni* (Fig. 225:3). Penial retractor inserting on apex of penis. Atrium very short.

"Jaw (Fig. 225:7) with broad, very low thickenings. Radular formula (Fig. 225:6) is 9 + 5 + 1 + 15, with 64 transverse rows; 1st lateral much larger than central or 2nd tooth; marginals relatively short and broad, innermost unicuspid." (H. B. Baker.)

Pristiloma shepardae (Hemphill) Fig. 220.

Zonites shepardi Hemphill, in W G. Binney, 1892, 4th Suppl., Bull. Mus. Comp. Zool., 22: 167.

[?] *Vitrea shepardi* Berry, 1930, Nautilus, 43: 113, lower center fig. (False Bay, Cal.).

Pristiloma (*Priscovitreops* ?) *shepardi* ("Hemphill" W. G. Binney), H. B. Baker, 1931, Proc. Acad. Nat. Sci. Phila., 83: 92, pl. 20, fig. 3.—M. W. Williams, Jour. Ent. and Zool., 32: 22.

"Shell umbilicated, very small, depressed; whorls 3 or 3½, shining, transparent, smooth, somewhat flattened; spire scarcely elevated above the body whorl; aperture oblique, oval; peristome simple, acute, its ends

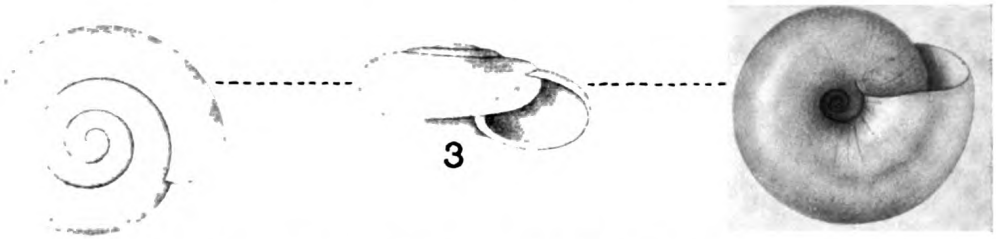

Fig. 220. *Pristiloma shepardae*, paratype, diameter 2.45 mm. (After H. B. Baker.)

hardly approaching; suture well impressed, umbilicus pervious, and moderately large for so small a shell. Great diameter 2 mm. Height 1 mm." (Hemphill.)

CALIFORNIA: Santa Catalina Island (Hemphill). Scorpion Harbor, Santa Cruz Island (Williams).

"This little shell belongs to the planulate forms, and somewhat resembles a minute *Z. whitneyi*. I dedicate it to Miss Ida Shepard [Mrs. Oldroyd] in recognition of her active services among the mollusks of Long Beach, Cal., where she resides." (Hemphill.)

A paratype (A.N.S.P. 86664) is figured. Height 1.04 mm., diameter 2.45 mm., width umbilicus 0.46 mm.; its aperture measures: altitude .85 mm., diameter 1.07 mm. Its umbilicus goes 5.3 times in the major diameter; 4 whorls.

Pristiloma orotis (Berry) **Fig. 221.**

Vitrea orotis Berry, 1930, Nautilus, 43: 113, [not upper 3 figs.]

Pristiloma (*Priscovitreops* ?) *orotis* (Berry), H. B. Baker, 1931, Proc. Acad. Nat. Sci. Phila., 83: 92.

"Shell small, thin, whitish horn-color, translucent. Whorls 3¾, moderately convex, regularly enlarging, smooth, except for the weak incremental lines, and the traces of spiral striation noted below. Surface highly polished, with a waxy luster; occasional whitish resting marks on most specimens, and sometimes also whitish spirals in the shell. Suture distinct, appressed; spire very low-conic; base convex, umbilicate; umbilicus wide

and with the earlier whorls perspectively visible within, contained about 5 times in the shell diameter; periphery rounded. Aperture rounded, moderately descending, the lip sharp, and with a slight subangulate reflection at the umbilicus. Spiral striation quite strong in umbilicus, and also very finely and delicately developed on the upper surface, where, however, it is not always easy to make out. Max. diameter of type 2.60, min. diameter 2.24, alt. 1.36, diameter umbilicus .52 mm." (Berry.)

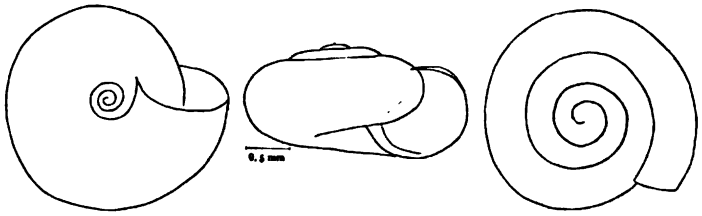

Fig. 221. *Pristiloma orotis,* type, drawn by S. S. Berry.

CALIFORNIA: Near the sawmill on south ridge of Palomar Mountains, east of Palomar resort, San Diego Co., California; in woodsy ravine under fallen logs and bark; 19 specimens (S. S. Berry and Willis G. Craig), Type 7095 of the author's collection. Paratypes No. 6552 of the same collection, others to be deposited in the San Diego Museum of Natural History and the Academy of Natural Sciences of Philadelphia (No. 150472).

" The umbilicus of this species is slightly larger (5.0 times in maj. diam.) than in *shepardi,* and the whorls increase a little more gradually in the paratypes of *orotis* examined." (H. B. B.)

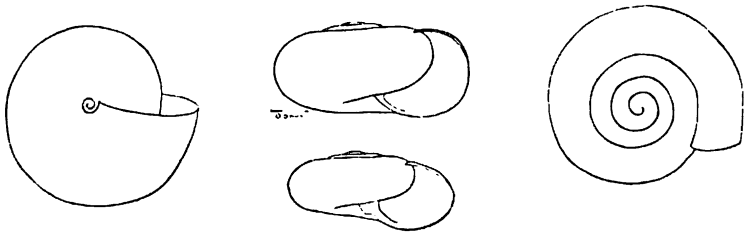

Fig. 221A. Upper 3 figs., species unknown; lower fig. *Pristiloma shepardi* (after Berry).

The figures furnished by Dr. Berry which appeared with the original description of *orotis* are reprinted here as Fig. 221A. They are clearly not that species, but something entirely different, though no one appears to have noticed the mistake hitherto. It was one of those exasperating errata which may sometime waylay any author and then slip by an editor. Fig. 221 is from later drawings of Dr. Berry's type.

" This minute but very beautiful snail, in form, color, and texture suggests *V. gabrielina* (Berry), its not distant neighbor to the north, and especially *V. shepardi* (Hemphill); but the much smaller size, the fewer whorls, and the wider, more perspective umbilicus serve amply to distinguish

it from the former, while if my single specimen of *shepardi* from False Bay (Fig. 221A lower fig.) be correctly identified, the latter is a flatter, more lenticular shell with a more oval aperture. In specimens taken alive the umbilicus was almost invariably occluded by a translucent film resembling dried slime, as in the preceding species.... Mr. H. B. Baker has kindly made direct comparison between paratypes of *V. orotis* and some of Hemphill's originals of *V. shepardi* from Santa Catalina Island (A.N.S.P. 86664). He writes that '*shepardi* is about the size of *orotis*, but is decidedly more lenticular, with more depressed, more rapidly increasing whorls (½ whorl less in similar diameter), with a relatively smaller umbilicus and with a slightly impressed suture.'" (S. S. Berry.)

"The specific name chosen is derived from oros mountain, + the suffix -tis, inhabitant of."

Pristiloma gabrielinum (Berry) Fig. 222.

Polita gabrielina Berry, 1924, Nautilus, 37:130, fig. 3.

Pristiloma gabrielinum H. B. Baker, 1930, Nautilus, 43:123; 1931, Proc. Acad. Nat. Sci. Phila., 83:91, pl. 13, fig. 12 (teeth).

"Shell small, thin, whitish horn color, translucent. Whorls 4½ to 5, regularly enlarging, smooth, except for the very weak and indistinct incremental lines; surface highly polished, with a waxy luster. Suture distinct, slightly impressed; spire scarcely elevated; base convex, umbilicate, the umbilicus narrow, being contained in the adult shell diameter about 8½ to

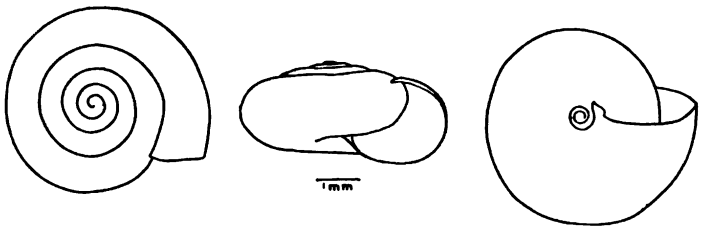

Fig. 222. *Pristiloma gabrielinum*, (after Berry).

9½ times, but deep and permeable; periphery smoothly rounded. Aperture oval, oblique, very slightly descending, the lip sharp and only a little reflected at the umbilicus." (Berry.)

Alt. 2.2 mm., greater diameter 4.3 mm., lesser 4 mm., diameter umbilicus 0.5 mm.; 4½ whorls. Type.

Two paratypes from Camp Estelle measure: 2, 3.6, 3.2, 0.36 mm., 4½ whorls, and 1.7, 3.2, 2.9, 0.43 mm., 4 whorls; one from above camp Baldy measures: 2.5, 4.8, 4.4, 0.5 mm., 5 whorls.

CALIFORNIA: near Camp Estelle, Upper San Antonio Canyon, San Gabriel Mountains, alt. 5100-5200 feet (E. P. & E. M. Chace), 3 specimens, Type 5033 Berry Coll., paratype 128347 A.N.S.P. Also from alt. 5,500 ft., Icehouse Canyon, San Gabriel Mts., from a wood rat's nest (George Willett, Oct. 3, 1918), 1 dead shell.

"The following anatomical notes are based on a sexually mature, preserved animal, which was collected Nov. 2, 1930, near Camp Baldy, Bear Canyon, San Gabriel Mts., Los Angeles Co., Cal., by E. P. and E. M. Chace, and which was very kindly sent me by the former.

"Animal white, but tips of ommatophores grayish and eyes black. Mantle collar heavy, with prominent neck-lappets; right and accessory left ones each produced externally into a triangular shell lobe. Lung about three times as long as its base and $2\frac{1}{3}$ times length of kidney. Kidney about twice as long as its base and $1\frac{1}{2}$ times length of pericardium.

"Ovotestis consisting of five groups of alveoli; duct swollen and convoluted; talon much as in *johnsoni*. Uterus plicate-sacculate. Free oviduct stout, almost as long as vagina; surrounded by glandular zone. Spermathecal sac much as in *nicholsoni*. Vagina quite short. Prostate complete. Epiphallus short and conical, entering penial apex much as in *johnsoni*. Penis very large, shaped like that of *johnsoni* but with apical $\frac{1}{3}$ recurved; apical $\frac{1}{6}$ smooth externally, demarcated by a basal constriction and containing large penial papilla; basal $\frac{3}{6}$ with glandular wall and with internal pilaster that extends almost to base. Penial retractor inserting near middle of recurved limb of penis at 135° angle (*i. e.*, attachment inverted). Atrium short.

"Jaw similar to that of *nicholsoni*. Radular formula of dried-in paratype (Fig. 225:12) is 13 + 5 + 1 + 18, with 64 transverse rows; innermost marginal bicuspid." (H. B. Baker.)

Subgenus **PRISCOVITREA** H. B. Baker

Pristiloma chersinella (Dall) Fig. 223 a.

Helix chersinella Dall, 1886, Amer. Jour. Conch., 2:328, pl. 21, fig. 4.

Zonites chersinellus Dall, W. G. Binney, 1883, Bull. Mus. Comp. Zool., 11:142, fig.; 1885, Man. Amer. Land Sh., p. 87, fig. 52.

Pristiloma (Priscovitrea) chersinella (Dall), H. B. Baker, 1931, Proc. Acad. Nat. Sci. Phila., 83:90, pl. 13, figs. 8-11.

"Shell small, somewhat elevated, smooth, except that the lines of growth are occasionally indented; umbilicus minutely perforate; aperture semilunar and slightly oblique; whorls rotund, $4\frac{1}{2}$ to 5 in number; suture

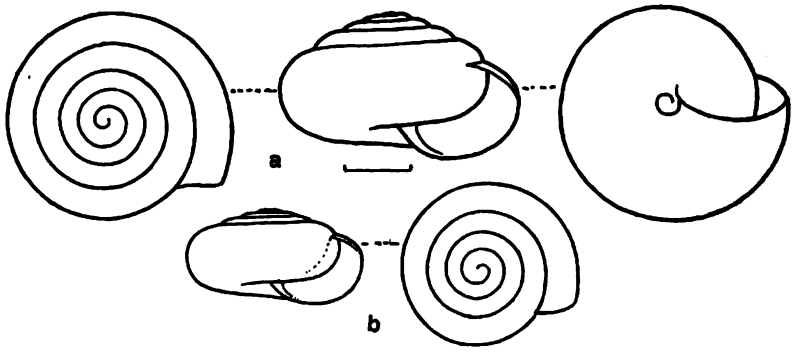

Fig. 223. a, *Pristiloma chersinella*, Palisade Meadow, Cal. b, *Pristiloma wascoense*, Big Payette Lake, Boise Co., Idaho. Scale line = 1 mm.

impressed, not deep; lip not thickened or reflected. Color yellowish, translucent. Maj. diam. 0·14 in., min. diam. 0·13 in., alt. (in type) 0·09 in." (Dall.)

CALIFORNIA: Calaveras Big Trees, north group, Calaveras Co., Type 109442 U.S.N.M. Many places in Calaveras, Mariposa, Mono, Fresno and Tulare counties (Hemphill, Ferriss, Lowe, H. B. Baker). OREGON: Ouxy, east shore Upper Klamath Lake, Klamath Co. (H. B. Baker).

The conic spire and the open, though very small, umbilicus, differentiate it from other species. The glossy surface shows only faint wrinkles of growth and no spiral lines. The umbilicus is contained about 9½ times in the diameter. Large shells measure:

Height 1.85 mm., diameter 3.25 mm.; 5 whorls.

Height 2.1 mm., diameter 3.55 mm.; 5¼ whorls.

"The following notes of anatomy are principally founded on animals from the Mariposa (July 2-6) and the Calaveras (July 12) Big Trees. Specimens near maturity from the east shore of Upper Klamath Lake (July 28) have also been examined.

"Animal with considerable black pigmentation on foot, mantle edge, over hindgut and along sutural edge of liver; sole narrowly rounded posteriad; caudal mucous pore a very short slit. Mantle collar extremely deep; right neck-lappet very large, left one low. Lung wall almost 3 times as long as its base or length of kidney. Kidney about 1½ times as long as its base or length of pericardium.

"Ovotestis (Fig. 225:10) consisting of three clumps of clavate alveoli; duct rather slender; talon obovoid. Albumen gland large; uterus coarsely sacculate. Free oviduct short; anterior half with glandular zone. Spermathecal sac subspherical. Vagina long and stout. Prostate without alveoli along apical half. Vas deferens thin-walled and swollen throughout most of its length; looped across below apex of penis; penial papilla (Fig. 225:11) small, projecting inward from a little, lateral lobe of penis. Penis elongate, thin-walled, with an attenuate apical extension beyond penial papilla and with two or three, longitudinal folds internally. Penial retractor inserting on penial apex. Atrium well developed, with a vaguely glandular exterior.

"Jaw (Fig. 225:8) consisting of large, irregular, overlapping plates which appear to be firmly soldered together. Radular formula of topotype (Fig. 225:9) is 11 + 9 + 1 + 20, with 88 rows; of a dried-in specimen from Fresno Co. 12 + 9 + 1 + 21, with 79 rows. First lateral not much larger than central or second tooth; laterals numerous and gradually intergrading with marginals; innermost marginal bicuspid or rarely tricuspid; second marginal usually bicuspid. Salivary glands about as long as buccal mass; ducts somewhat longer.

"The relatively weak penial and epiphallar development in my material may be seasonal condition, but the albumen glands and uteri are certainly mature. The specimen from the Mariposa Big Trees (animal figured) is the largest that I have seen." (H. B. Baker.)

Pristiloma wascoense (Hemphill) Fig. 223 b, 224.

Tonites (Conulus?) wascoensis Hemphill, 1911, Trans. San Diego Soc. Nat. Hist., 1:102. Wasco Co., Ore., also near Salem, Ore.

[?] *Polita chersinella* Dall, Berry, 1919, Proc. Acad. Nat. Sci. Phila., 71:196, 199, 203 Glacier Nat. Park, Montana.

Pristiloma chersinella wascoense (Hemp.), H. B. Baker, 1930, Nautilus, 43:123.

"Shell small, smooth, shining, transparent, perforate, consisting of 4½ or 5 convex whorls, the last a little more tumid than the penultimate whorl; striae of growth very fine, hardly perceptible under a strong pocket

Fig. 224. *Pristiloma wascoense,* type and paratype from photograph, actual size and enlarged.

lens. Suture distinct, well impressed; aperture moderately narrow, semilunar; outer lip simple, acute, not falling at its upper termination; columellar portion of the shell, very convex; base of shell convex, hardly excavated around the umbilicus; umbilicus small and deep. Great diam. 2, height 1 mm." (Hemphill.)

Oregon: Wasco County, also near Salem, Marion Co. (Hemphill).

"This small shell seems to be new. It has the aspect of *Tonites chersennellus* Dall, but is about half the size of that shell, with about the same number of whorls. The aperture is narrow and resembles that of *L. capsella* Gld." (Hemphill.)

Figure 224 is from photographs furnished by Mrs. Oldroyd, said to represent the type and paratype. The umbilicus appears to be partly covered, but the prints are rather indefinite. The difference from *chersinella* seems to be mainly a matter of size, as noted by Hemphill. While it is probably a small northern race of that Sierra Nevada species, as Dr. H. B. Baker intimated, the exact relation of *wascoense* and the following Idaho and Montana forms to *chersinella* remains to be seen when the types or topotypes of *wascoense* can be studied.

Specimens which are referred provisionally to *wascoense* have been seen from Idaho: along creek east of Meadows (old town), Adams Co.; A.N.S.P. 82339, Big Payette Lake, Boise Co. (Rev. E. H. Ashmun, Fig. 223b); A.N.S.P. 82367, Price Valley, Weiser Canyon, Washington Co. (Ashmun). East Fork Willow Creek, Shoshone Co. (H. B. Baker). Also in Oregon, Wallowa Valley above Wallowa Lake, Wallowa Co. (H. B. Baker).

The shell figured measures, height 1.25 mm., diameter 2 mm.; 4½ whorls. While these places are partly in about the same latitude as Hemphill's types, they are in a rather different snail association.

The shells from Glacier National Park, Montana, reported as *chersinella* by S. S. Berry, are larger, one given by him measuring, height 1.5 mm., diameter 2.6 mm., 4⅔ whorls. It may not be full grown. Berry writes: "I am unable to distinguish the present specimens from material taken in the California Sierras, in spite of the tremendous jump in range. Compared with a somewhat larger specimen of the latter taken near Lake Tahoe by Mr. Allyn G. Smith, the largest of the Glacier Park shells has about one-half a whorl more, has rather more evenly rounded whorls and aperture, and a rounder, flatter spire.... It has not been reported previously outside of California, where it is a characteristic alpine form."

Subgenus **OGARIDISCUS** Chamberlin & Jones

(*Ogarri*, Gosiute Indian name of the Oquirrh Mountains, + *Discus*.)

Pristiloma subrupicola (Dall) Fig. 226.

Hyalina subrupicola Dall in Packard, 1877, Bull. U. S. Geol. Surv. Terr., 3, no. 1, p. 163, fig. 7.—W. G. Binney, 1883, Bull. Mus. Comp. Zool., 11:139, pl. 4, figs. H., I., reprint of Dall's description and figures, as a synonym of *Zonites indentatus*.—Cooper, 1888, Proc. Cal. Acad. Sci., (2d. ser.) 1:14 (Alta, Placer Co. at 3600 ft., ident. by Dall).

Ogaridiscus subrupicola (Dall), Chamberlin & Jones, 1929, Bull. Univ. Utah, 19:96, fig. 42.

Vitrea subrupicola Dall, 1895, Nautilus, 9:27.

Pristiloma (*Ogaridiscus*) *subrupicola subrupicola* ("Dall" Packard), H. B. Baker, 1931, Proc. Acad. Nat. Sci. Phila., 83:89, pl. 13, figs. 1-4.

[?] *V* [*itrea*] *subrupicola*... var. *spelaea* Dall, 1895, Nautilus, 9:27 (Cave City, Cal.).

[?] *Pristiloma* (*Ogaridiscus?*) *subrupicola* (?) *spelaeum* (Dall), H. B. Baker, 1931, Proc. Acad. Nat. Sci. Phila., 83:90.

"This little shell is best described by a comparison of its various characteristics with those of *H. indentata* Say, as given by Dr. Binney in his Land and Freshwater Shells of the United States (part I, p. 35). "*H. subrupicola*, while exhibiting radiating lines of growth, some of which are more conspicuous than others, does not show any such well-marked grooves or indentations as are figured by Morse (Land Shells of Maine) in *indentata*, and which form its most striking specific character. The former has five and a half whorls, with a greatest diameter in the largest specimen of 0.14 inch, while *indentata* has but little more than four, with a diameter of 0.20 inch. The former is perfectly pellucid, while the latter has a peculiar whitish spermaceti-like luster. *H. subrupicola* has the last whorl smaller proportionally than *indentata*, and in fact the increment of the whorls in the former is much more regular and even. The umbilicus in both is precisely similar.

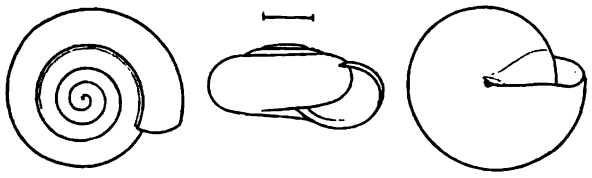

Fig. 226. *Pristiloma subrupicola*, topotype. Scale line = 1 mm.

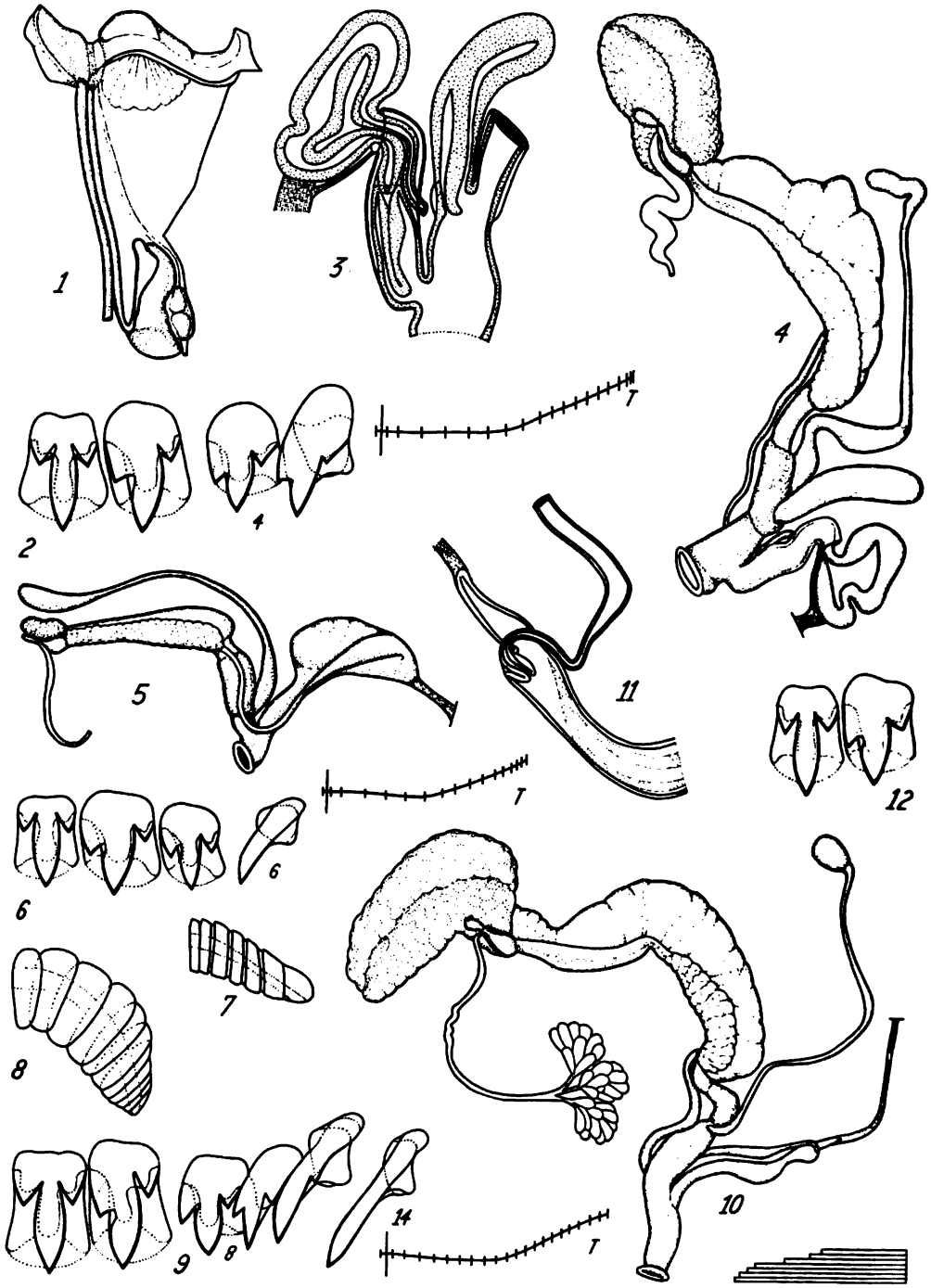

Fig. 225. See bottom of page 417 for legend.

"The animal of *subrupicola* varies from whitish to slaty; the granules of the upper surface of the foot are remarkably coarse and well marked. The tentacles are, as contracted in alcohol, hardly perceptible; the eye-peduncles, are from the same cause, not extended, but appear to be as usual in the genus, and to possess normal ocular bulbs." (Dall.)

UTAH: Clinton's Cave, east of Lake Point Station, Tooele Co. (A. S. Packard, E. Berry, H. B. Baker and others), paratypes 67356 U.S.N.M. IDAHO: east fork of Willow Creek, Shoshone Co. (H. B. Baker). OREGON: Pine Creek Valley, above Weston, Umatilla Co. (H. B. Baker).

The strongly depressed shell is nearly smooth, but on the latter half of the last whorl there are usually some unevenly spaced impressed grooves, and in places on the base very weak fine spiral striae can be seen. The umbilical perforation is very small, and in some specimens (Fig. 226) it is closed by a small expansion at union of columella with the parietal callus. Topotypic specimens collected by Dr. H. B. Baker measure:

Height 1.4 mm., diameter 2.9 mm., 4 whorls.

Height 1.55 mm., diameter 3.2 mm., 4⅛ whorls.

According to Dall, the largest shell in the type lot of *subrupicola* has 5½ whorls with a diameter of 0.14 inch (= about 3.5 mm.). Later he stated that a specimen of 2.7 mm. diameter has 4 whorls. A paratype, perhaps this same specimen, diameter 2.9 mm., has 3⅞ whorls. It may be doubted whether this species ever has 5½ whorls, as stated in the original description. That was probably an error for 4½. This original 0.14 inch specimen was probably returned to Packard for figuring, and is now lost, but three of the original lot, which I have seen through the courtesy of Dr. Bartsch, are preserved as 67356 U.S.N.M.

"Animal practically without pigment; sole narrowly rounded, almost pointed posteriad. Mantle collar (Fig. 225:1) heavy with well developed glands that invade lung wall (as commonly in small species); right neck-lappet small; left large and wide. Lung wall 3½ times as long as its base or 2½ times length of kidney. Kidney over twice as long as its base or length of pericardium.

"Ovotestis consisting of two groups of clavate alveoli; duct (Fig. 225:4) swollen; talon large, clavate. Uterus sacculate. Free oviduct medium in length, spermathecal sac long ellipsoid; stalk swollen near base where it contains high longitudinal plicae and some glandular tissue. Vagina quite long; receiving near middle an elongate caecum (Fig. 225:3) with heavy, muscular, externally polished wall and containing an elongate papilla (stimulator?). Prostate without distinct alveoli along apical third of seminal groove. Vas deferens elongate; passing through penial sheath so that epiphallus forms a closed loop; terminal opening near base of penial papilla. Penis relatively small, almost filled by large papilla. Penial retractor arising near middle of diaphragm and inserting on epiphallar loop. Atrium very short.

Fig. 225. 1, *Pristiloma subrupicola*, topotypes, pallial complex. 2, radula, central and 1st, 4th and 5th laterals, and diagram of transverse row, T. 3, diagram of penis, epiphallus, vagina and vaginal caecum. 4, genitalia. 5, *Pristiloma nicholsoni*, paratypes, genitalia, ♀ organs immature, penis swollen by enclosed parasite. 6, radula. 7, half of jaw. 8, *Pristiloma chersinella*, Mariposa Co., half of jaw. 9, radula, Calaveras Co. 10, genitalia. 11, apex of penis and end of vas deferens. 12, *Pristiloma gabrielinum* paratype, radula. (After H. B. Baker.)

"Jaw thin, narrow and transparent; structure much as in *P. chersinella*. Radular formula (Fig. 225:2) is 11 + 5 + 1 + 16, with 68 transverse rows; 5th tooth transitional but all marginals unicuspid." (H. B. Baker.)

Pristiloma subrupicola spelaeum (Dall)

"*Vitrea*" *subrupicola* var. *spelaea* Dall is known by the following notes only:

"It may be mentioned that the original types of *V. subrupicola* were collected at Clinton's Cave, Utah, by Dr. Packard; while much larger specimens, though with the same number of whorls, were collected later at Cave City, Calaveras Co., California, by Hemphill. After careful study I have found no characters except size to separate these from the Utah specimens, but in view of this difference the former may take the varietal name of *spelaea*. Neither form can be confounded with *V. indentata* by any one who critically compares good specimens. A specimen of *V. subrupicola* with four whorls has a major diameter of 2·7 mm.; one of the variety, with exactly the same number of whorls, measures 4·0 mm., and my largest specimen 5·5 mm." (Dall.)

HAWAIIA Gude

Hawaiia Gude, 1911, Proc. Malac. Soc London, 9:272, type by original designation *Helix Kawaiensis* Pfr. (= *Helix minuscula* Binney, teste H. B. Baker, 1930, Occ. Pap. Mus. Zool. Univ. Mich., 220:34). Type by subsequent designation by Gude, 1911, on undated and unpaged erratum issued with Proc. Mal. Soc., 9, "*Helix hawaiienses* Ancey" [? = *Vitrea hawaiiensis* Ancey, 1904, Proc. Malac. Soc. London., 6:120]—Cooke, 1921, Occas. Pap. Bishop Mus., 7:271 (nomenclature).

Pseudovitrea H. B. Baker, 1928, Proc. Acad. Nat. Sci. Phila., 80:24, 25, type *Helix minuscula* Binney from Emmet Co., Mich.; 1929, Proc. Acad. Nat. Sci. Phila., 81:261.

Pseudohyalina Morse, in part, and of some later authors.

[?] *Macgillivrayella* Preston, 1913, Ann. & Mag. Nat. Hist., (8) 12:532, for *M. crystallina* Preston (= *H. minuscula* according to Peile). Not *Macgillivrayella* Ashmead, 1899 (Hymenoptera)—Iredale, 1945, Australian Zool., 11:64.

The thin, light colored shell is openly umbilicate, depressed, with low, convex spire of few (4 to 5) whorls, the last tubular; sutures well impressed. Aperture broadly rotund-lunate, the peristome thin.

Sole undivided and according to Sterki showing no waves in progression. Genital orifice behind and below right ommatophore. Penis slender, longitudinally folded within, continued shortly above entrance of epiphallus, with terminal retractor. Epiphallus rather large, longer than penis. Spermatheca on a long duct. Radula: centrals with well developed ectocones, laterals bicuspid, marginals all unicuspid.

This North American genus was named for Hawaii, where the type species happened to be introduced many years ago and had been renamed as a native snail. The singularly inappropriate generic name *Hawaiia* was owing to the circumstances that its author had only a hazy idea of the shell he was naming, and knew nothing whatever about its long history in scientific literature, or its affinities. Dr. H. B. Baker has given the following account of the anatomy of *H. minuscula*.

"Animal: light-colored. Foot: rather small and not especially elongate; sole uniform with posterior end narrowly rounded; peripodial angle of tail rounded, slightly protruded over inconspicuous mucous depression. Mantle collar: quite wide and heavy; right and left neck-lappets medium in size. Lung: about 4 times as long as its base and a little over twice length of kidney; wall very heavy and muscular; pulmonary vein large, with broad muscle strands on either side; minor venation inconspicuous. Kidney: about 2½ times as long as its base or twice length of pericardium. Anus: carried forward to mantle edge.

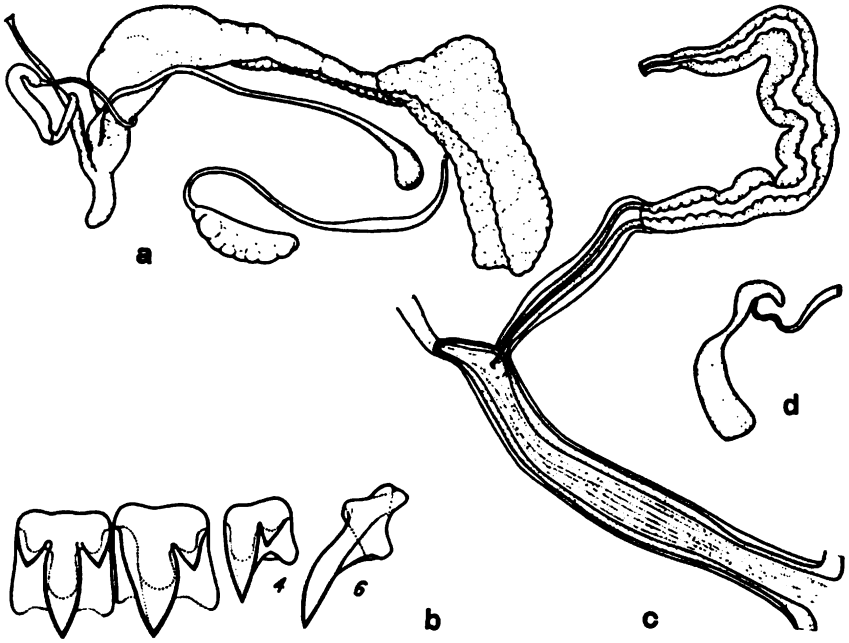

Fig. 227. *Hawaiia minuscula*, Michigan. a, left view of dissected genitalia. Vas deferens is straightened out from penioviducal angle and penial retractor is lifted above it. b, Radula: central, 1st, 4th and 6th teeth. c, penis and accessories. d, left view of carrefour and base of hermaphroditic duct after removal of albumen gland. (After H. B. Baker.)

"Ovotestis (Fig. 227a): a slightly lobate, ellipsoid body, embedded lengthwise in liver; duct quite long, swollen in basal half of its length; talon (fig. d) long-stalked, caecoid tip recurved; carrefour ellipsoid. (Both talon and carrefour are deeply imbedded in albumen gland.) Uterus: elongate, sacculate basally. Free oviduct: short, most of wall with yellow, glandular development. Spermatheca: elongate sac imbedded near base of albumen gland; stalk of long type, with thick-walled swelling at its base. Vagina: very short. Prostate: about ⅜ length of uterus. Vas deferens: attached to basal ⅜ of uterus; free region slender, carried into penioviducal angle by right ocular retractor. Epiphallus (Fig. 227c): twice as long as penis; apical ⅜ swollen, with thick, apparently glandular wall and large plicate lumen; basal ⅜ more slender, with heavy muscular wall and relatively

smaller lumen; penial papilla represented by a heavy pilaster which runs from apex of penis to just below epiphallar orifice. Penis: quite small and slender, with heavy wall and strong longitudinal folds; apex acuminate, continued above epiphallar opening to form a conical flagelloid portion. Penial retractor: slightly longer than penis; insertion at apex of flagelloid portion; intimate sheath complete. Cloaca: of medium length; opening a short distance behind and below base of right ommatophore.

"Columellar muscle gives off: 1) heavy buccal retractor which is almost completely separate; 2) left free retractor near origin; 3) right free muscle slightly below; and continues to 4) heavy tail fan. Free retractors: each divides near middle of its length into about equal lateral and tentacular muscles; both laterals slender and more nearly free from tail muscles than usual; right lateral with strand to base of cloaca; right ocular traversing penioviducal angle. Mantle retractor: exceptionally heavy.

"Radular formula (Fig. 227b): 13-4-1-17; 57 transverse rows counted, with shape as shown by Morse (l.c.). Central: base squarish, mesocone medium, ectocones well developed. Laterals: bicuspid, but with broad entoconal shelf; first slightly smaller than central, but fourth much smaller. Marginals: all unicuspid, with exceptionally broad bases and heavy, oblique blades; largest one not much longer than central. Salivary glands: triangular, about ⅓ as long as buccal mass; ducts twice as long as glands. Intestine: S-loops more deeply imbedded in albumen gland than usual, although accompanied by considerable liver tissue."

Hawaiia minuscula (Binney). Fig. 228 a. b.; 229: 1-3.

Helix minuscula Binney, 1840, Boston Jour. Nat. Hist., 3:435 (1841?), pl. 22, fig. 4.

Zonites minusculus Binn. W. G. Binney, 1878, Terr. Moll., 5:118, pl. 17, fig. 2; pl. iii, fig. H (teeth).—Dall, 1885, Proc. U. S. Nat. Mus., 8:270 (synonymy, distribution).

Zonitoides minusculus Binn., Pilsbry, 1898, Nautilus, 11:131.—Walker, 1928 Terr. Moll. Alabama, p. 99.—Dall, 1905, Harriman Alaska Exped., 13:43.—Henderson, 1924, Univ. Colo. Studies, 13:148.—Johnson, 1915, New England Fauna, Occas. Pap. Boston Soc. N. H. 7 (no. 13): 203.

Pseudohyalina minuscula Binney, Morse, 1864, Jour. Portland Soc. N. H., 1:16, fig. 34, jaw; pl. 7, fig. 35, teeth.

Chanomphalus minusculus Binney, Strebel, 1880, Beitrag etc., 4:19, pl. 4, fig. 10.

Pseudovitrea minuscula minuscula (Binney), H. B. Baker, 1928, Proc. Acad. Nat. Sci. Phila., 80:25, pl. 5, figs. 1-4; 1929, 81:261, pl. 10, figs. 1-3.

Hawaiia minuscula (A. Binney), H. B. Baker, 1941, B. P. Bishop Mus. Bull., 166:322, pl. 61, figs. 13-15 (Molokai, T. H.).—A. J. Peile, 1936, Jour. of Conch., 20:281 (synonymy).[88]

[*Zonites minusculus* var.] *alachuana* Dall, 1885, Proc. U. S. Nat. Mus., 8:270.

Pseudovitrea minuscula alachuana (Dall), H. B. Baker, Proc. Acad. Nat. Sci. Phila., 81:262, pl. 10, figs. 4-6.

Helix minutalis Morelet, 1851, Test. Noviss. 2:7, Palisada, Yucatan (= *minuscula* according to Fischer & Crosse).

Helix kawaiensis Pfeiffer, 1855, Proc. Zool. Soc. Lond. for 1854, p. 52.

---

[88] Major Peile has added to the synonymy of *H. minuscula: Charopa unicini* (Brazier) Hedley, from Lord Howe Island, and *Macgillivrayella crystallina* Preston, Norfolk Island, having examined specimens in the British Museum. I have not seen them. The names *Helix minutissima* Lea, *Helix apex* C. B. Adams, and *Helix blakeana* Tate, adopted from earlier authors in Peile's synonymy, are known to pertain to distinct species of other genera.

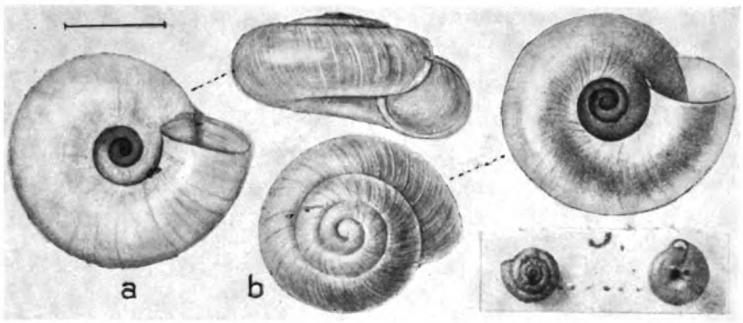

Fig. 228. a, *Hawaiia minuscula,* lectotype, Ohio. b, Buffalo, N. Y. Lower right, type figures of "*Hyalinia*" *permodesta* S. & P., after Strebel & Pfeffer. Scale line for basal figs. a and b = 1 mm.

Pseudohyalina kauaiensis Pfr., Sykes, 1900, Fauna Hawaiiensis, 2:279 (emendation).

Helix lavalleana Orbigny, 1845, Hist. fis., polit. y nat. de la isla de Cuba, Moluscos, p. 84, French edit. p. 161, pl. 8, figs. 20-23.

Pseudovitrea minuscula permodesta (Strebel & Pfeffer), H. B. Baker, 1929, Proc. Acad. Nat. Sci. Phila., 81:262, pl. 10, figs. 10-12. Not *Hyalinia permodesta* Strebel & Pfeffer, 1884.

The shell is minute, umbilicate, the umbilicus about one-third the diameter of shell; depressed, the spire low, convex; thin; pale gray, or often flesh colored above, from the contained soft parts. Whorls 4, strongly convex, slowly widening, the last tubular. Embryonic whorl smooth, the rest distinctly, unevenly striate above, nearly smooth beneath; spiral lines wanting or quite indistinct. Aperture rotund, the height and width about equal.

Height 1.2 mm., diameter 2.5 mm.; umbilicus 0.8 mm.

"Height 1.2 mm., diameters 2.03 and 1.85 mm., umbilicus 2.8 times in diameter, 4 whorls. N. Michigan" (H. B. B.).

Distribution.—North America from Alaska and Maine to Costa Rica; Cuba, Santo Domingo, Puerto Rico and St. Thomas, West Indies; Bermuda; also Japan, Hawaii, Pitcairn, Tahiti, and according to Kennard & Woodward, hothouses in England and Ireland. Type locality: Ohio.

BRITISH AMERICA: Victoria and Departure Bay, Vancouver I. (according to Dall.) Throughout Southern Ontario.

ALASKA: According to Dall, the Aleutian Is., Shumagin Is., Muir Inlet.

UNITED STATES: Maine to Florida and westward to the mountain states. MONTANA: Musselshell (Henderson), Wibaux (Elrod), Winnecook (Berry). WYOMING: near Laramie (Henderson). COLORADO: Trinidad (Pilsbry), near Boulder, Fort Collins and San Miguel Co. (Henderson). NEW MEXICO and northern and eastern ARIZONA: generally spread. CALIFORNIA: San Gabriel Mts., Los Angeles Co. (W. O. Gregg); Balboa Park (J. L. Baily); on False Bay, San Diego Co., and mouth of Mill Creek Canyon, San Bernardino Mts. (Berry); in greenhouses, San José (Mrs. A. E. Bush).

It is generally spread over every eastern and midwestern state, and in Florida as far south as Miami and Cape Sable, though not seen from the keys. It becomes rather local in the Rocky Mountain States, and has not been seen from Washington, Oregon, Idaho, Nevada and Utah, and only

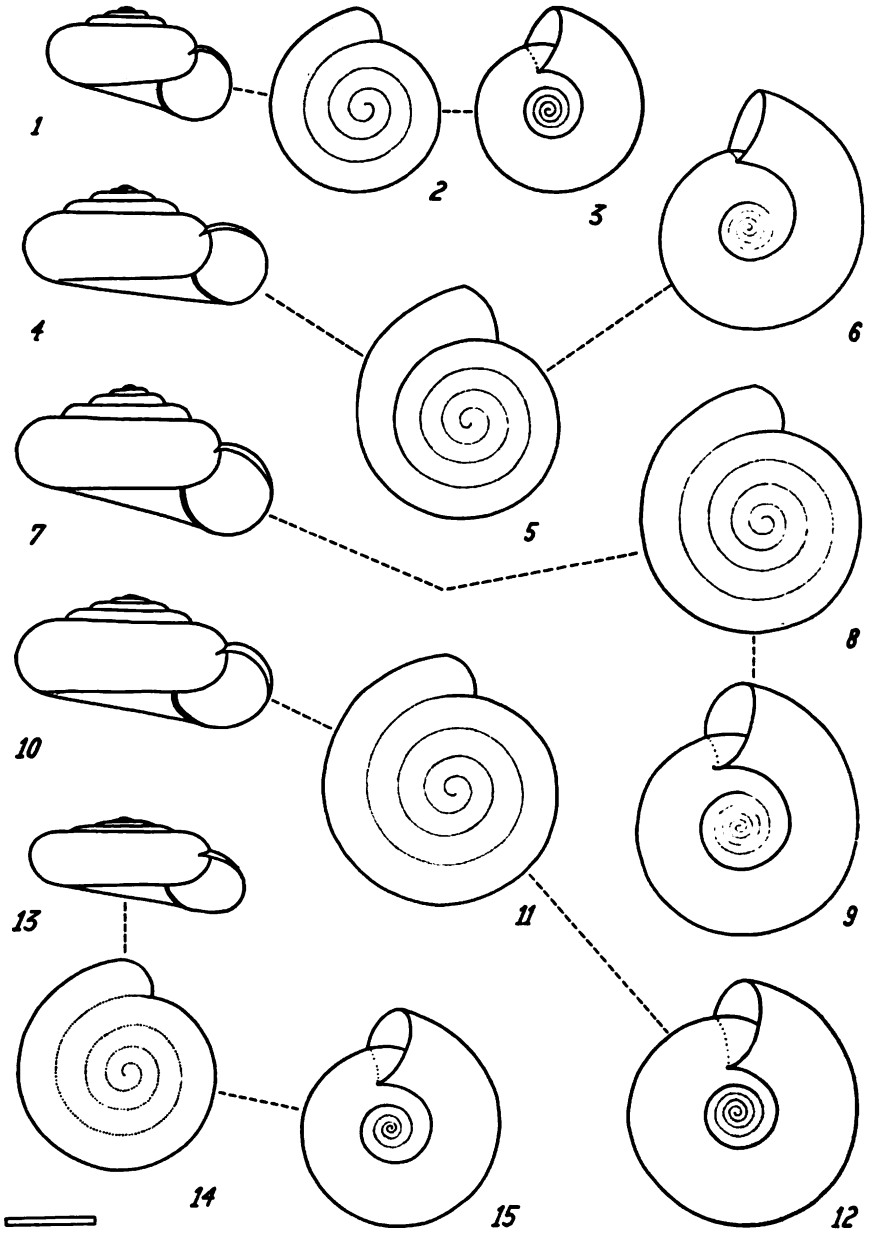

Fig. 229. 1-3, *Hawaiia minuscula,* Cheboygan Co., Michigan. 4-6, *H. minuscula alachuana,* Alachua Co., Florida. 7-9, *H. minuscula neomexicana,* Necaxa, Puebla, Mexico. 10-12, *H. minuscula permodesta* H. B. Baker (not of Strebel), Mirador, V. C., Mexico. 13-15, *Helicodiscus singleyanus,* type. (After H. B. Baker.) Scale line for apical views = 1 mm.

towards the south in California, where some of the records are probably owing to importation with plants. Its occurrence on several Pacific islands is doubtless traceable to accidental importation. Perhaps Japan and the West Indies also received it through commerce.

Figure 228a is from a specimen received from Dr. A. Binney, part of the type lot from Ohio,[89] representing the form which is widely spread in the Carolinian fauna. This is an intermediate form in characters as well as distribution. In the Canadian Zone especially, but also in the Carolinian in many places, the shells are more narrowly umbilicate, the umbilicus sometimes contained 3⅓ to 3½ times in the diameter (Fig. 228b, Buffalo, N. Y.), and they are often a little larger, up to diameter 2.7 mm.

Several Antillean and Central American species have been synonymized with *minuscula* in the literature. Of these, *Helix apex* C. B. Ad. of Jamaica is a *Helicodiscus*. *Helix saxicola* Pfr., from Cuba, is certainly distinct from *minuscula* and belongs to the Sagdidae. *Helix blakeana* Tate, 1864 (not of Newcomb, 1861), from Chontales, Nicaragua (= *Thysanophora tatei* Pilsbry, 1904, Proc. Acad. Nat. Sci. Phila. for 1903, p. 764), apparently belongs to the same family, but its generic place is uncertain, pending knowledge of the anatomy. I have not seen type material of *Helix minutalis* Morelet or *H. lavalleana* Orb., which have been referred to *H. minuscula* as synonyms.

Dr. H. B. Baker introduced the name "*Pseudovitrea minuscula permodesta* (Strebel & Pfeffer)" for No. 131753 A.N.S.P., two shells received from Strebel's collection in Hamburg as *Hyalinia permodesta* Strebel, from Mirador, V. C., Mexico, the type locality of that species. These shells are "somewhat similar in appearance [to *neomexicana*], but with smaller umbilicus, less markedly arched whorls, more depressed spire and practically no spiral sculpture.... What I take to be the same subspecies as the two smoother specimens (*permodesta*) appears to be quite frequent in Texas, New Mexico and Arizona, where it has been confused with *Helicodiscus singleyanus singleyanus* (Pils.)" Baker gave the dimensions of the Mirador specimen he figured (our Fig. 229:10-12) as: alt. 1.35 mm., greater diameter 2.7 mm., lesser 2.53 mm.; aperture .88 x .98 mm.; umbilicus contained 2.8 times in diameter; 4½ whorls.

[89] "In the Academy of Natural Sciences of Philadelphia is a lot (A.N.S.P. 74416) of three shells which bears the label: "*Helix minuscula* Binney. Jour. Bost. Soc. Vo. pl. 22. f. 4. Mr. Binney. Ohio & Vermont." Two of these are attached to a slip of cardboard with yellow wax and appear to be from the same lot, while the third is glued on with some black substance, is out of line with the others and has slightly different coloration. The first two agree very well with Binney's original figures; for instance, the one with its apical side exposed is slightly smaller than the other and is mounted with its apex slightly tilted, so that the last half whorl appears to be expanded. I suspect that these two may be Binney's type specimens from Ohio, while the third shell may be an example from Vermont, obtained at a later date." (H. B. Baker, 1929, p. 261.)

Hyalinia permodesta Strebel & Pfeffer, according to the original photographic figures reproduced in our Fig. 229, lower right, is 2.9 mm. in diameter. It has a far narrower umbilicus than the specimen drawn by Dr. Baker. From a study of Strebel's description and figures I conclude that our Mirador shells, once thought to be paratypes of *Hyalinia permodesta*, are not that species (which was described from two specimens), but a different one (a form of *minuscula*), subsequently collected by Strebel, or at least contained in his collection. Whether it will be found practicable to recognize the race indicated by Dr. Baker among our *minuscula* forms of the southwest is a question requiring further consideration.

(*Minusculus*, lesser.)

Hawaiia minuscula alachuana Dall Fig. 229: 4-6.

"A form which, at first sight, looks different from *minuscula* is rather larger than usual and above shows no differences. On the base in the type [of *minuscula*] the junction of the inner lip with the body whorl takes place, following the course of the whorl, inward from the middle line of the base of the whorl and generally about the inner third. This gives a peculiarly thimble-shaped umbilicus. In the variety under consideration the above-mentioned junction takes place outside of the middle line or even at the outer third, while the aperture is a little dilated. The result of this is to show a much larger portion of the base of the penultimate whorl and to alter the facies of the umbilicus. For this form, found in Alachua County, Florida, I would suggest the varietal name alachuana." (Dall.)

This mainly austroriparian form of *minuscula* is more openly umbilicate than *minuscula*, the caliber of the whorls is smaller, and there is often a half whorl more. The umbilicus is contained about 2½ times in the diameter in typical examples of *alachuana*. It occurs as far west as Arizona and north in the Carolinian fauna to New York. Specimens examined from Laurel Springs, Camden Co., N. J., Sea Cliff, L. I., Upper Red Hook, Dutchess Co. and Ithaca, N. Y., are clearly referable to *H. m. alachuana*.

The individual and local variation is so considerable that the separation of *minuscula* into races is frequently difficult, or even impracticable with "dead" or river drift material.

Hawaiia minuscula neomexicana (Cockerell & Pilsbry) Fig. 229: 7-9.

Zonitoides neomexicanus Cockerell & Pilsbry, 1900, Nautilus, 13:114. (Dripping Spring.)

Zonitoides minuscula neomexicana Ckll. & Pils., Pilsbry & Ferriss, 1906, Proc. Acad. Nat. Sci. Phila., 58:149.

Pseudovitrea minuscula neomexicana (Ckll. & Pils.), H. B. Baker, 1929, Proc. Acad. Nat. Sci. Phila., 81:262, pl. 10, figs. 7-9 (Necaxa, Mexico, anatomy).

Hawaiia minuscula neomexicana (Ckll. & Pils.) H. B. Baker, 1930, Occas. Pap. Mus. Zool. Univ. Mich., No. 220:35.

Punctum pygmaeum albeolum Dall, 1926, Proc. Cal. Acad. Sci., 15:481, pl. 35, figs. 18, 19. (Maria Magdalena I., State of Jalisco, Mexico).

"Shell minute, depressed, in form similar to *Zonitoides minusculus;* whitish corneous, somewhat translucent, fragile, the umbilicus wide, its width contained 2½ times in the greatest diameter of the shell. Surface marked with very fine but rather sharp growth striae, and *crowded, microscopic spirals* throughout. the spirals conspicuous *to the apex.* Whorls 3½, quite convex, the last everywhere well rounded. Aperture round-lunate, the penultimate whorl excising about one-fourth the circumference of the peristome; lip thin and acute, a little dilated at the columellar margin. Alt. nearly 0.8, greatest diameter 1.7 mm. Another specimen is slightly larger, diam. about 2 mm." (Pilsbry.)

Height 0.75 mm., diameter 1.75 mm., width umbilicus 0.5 mm. Fern Canyon.

New Mexico: Dripping Spring, Organ Mountains, at about 5700 ft. elevation (T. D. A. Cockerell). Texas: Galveston (Pilsbry); Fern Canyon, between Ft. Davis and Alpine (E. P. Cheatum). Mexico: Necaxa, State of Puebla, 3000 to 5000 ft., quite common in leaf humus (H. B. Baker). Maria Magdalena I.

On account of the apical sculpture I was at first inclined to think this form related to *Striatura,* later subordinating it to *minuscula;* but the anatomy of typical specimens remains to be examined.

In the specimen from western Texas the apical whorl appears to be spirally punctate; later whorls having sharp, somewhat unequal striae and microscopic spirals.

I have not seen the Necaxa specimens, one of which is drawn in Fig. 229:7-9. It is larger than the type, height 1.65 mm., diameter 2.8 mm., umbilicus 2.4 mm., with 5 whorls, and the spire is higher than in those seen from New Mexico and Texas.

Subfamily Gastrodontinae

Gastrodontinae Tryon, 1866, Amer. Jour. Conch., 2:242.—H. B. Baker, 1928, Proc. Acad. Nat. Sci. Phila., 80:32; 1941, B. P. B. Mus. Bull., 166, pp. 270, 323.

Janulinae Wenz, 1923, Foss. Catal. (1) 17:300.—Pfeffer, 1929, Geol. u. Pal. Abhandl., 17 (21) Heft 3, p. 33.

[?] *Poecilozonitinae* Pilsbry, 1924, Proc. Acad. Nat. Sci. Phila., 76:1.

Zonitidae in which the sole is plain, not tripartite; progression is arythmic (without muscular waves.) Genitalia having on the penis a dart sac containing a dart (which may be absent in some minute forms.) The penis terminates in an epiphallus and a short vas deferens. From a sheath around the base of the penis a duct runs to the free oviduct, either directly (as in *Gastrodonta* and *Janulus*), or indirectly by way of the anterior part of the spermathecal duct (as in *Zonitoides* and *Ventridens*). Penis, oviduct and spermatheca arise from the rather long atrium in close proximity, there being practically no vagina. The right ocular retractor passes to the left of the genitalia. Lateral teeth of the radula are without entocones, being bicuspid (except in *Janulus*); outer marginals unicuspid. The shell frequently has internal basal teeth or callus.

This subfamily now contains five Continental North American genera, together with *Poecilozonites* in Bermuda, and *Janulus* in Madeira and the European Tertiary.

Tryon's *Gastrodontinae*, though based upon *Gastrodonta* and forms now referred to *Ventridens*, contained also the unrelated genera *Conulus* and *Strobila*. About 1920, in the MS. of an unpublished work on New York mollusks, I revived the subfamily for Zonitidae having a uniform sole, arythmic locomotion, a peni-oviducal duct and a dart apparatus on the male side. Dr. H. B. Baker (1928) accepted the group in the same sense, making the important addition of the genus *Striatura*, of which the affinities had not been known; but his definition, "spermatheca with branch to penial sheath" is true only of part of the genera. The Janulinae of Wenz contained *Janulus* only. Pfeffer proposed Janulinae anew for two wholly unrelated genera, *Janulus* and *Pycnogyra*, having the irrelevant common characters of closely coiled whorls and narrow mouth. In 1924 I suggested the segregation of *Poecilozonites* in a subfamily Poecilozonitinae, in which the pedal furrows are apparently wanting, being inconspicuous, situated at the angle of the foot and thus forming no pedal band (or "foot fringe"), the foot being holopod; the genital orifice is submedian, below the visceral stalk, and the shell dull, opaque, and usually variegated, much as in some Endodontidae. The significance of this condition of the pedal grooves needs further study, but the group is doubtless closely related to Gastrodontinae.

The dart-sac with dart, and the branching of the spermathecal duct, characteristic of most Gastrodontinae, were first noticed by Joseph Leidy, who figured the genitalia of *Ventridens intertextus*, *V. suppressus* and *V. ligera* in Binney's Terrestrial Mollusks, I, 1851.

The function of the peni-oviducal duct is problematic. Actual communication with the cavity of the penis appears to be absent in some forms, but is present in others, such as *Zonitoides arboreus*, according to H. B. Baker. That it is an apparatus for self-fertilization seems unlikely in view of its close proximity to the openings of all male and female ducts into a common cloaca.

The type in which the duct runs directly from penis to oviduct, either free or lightly tied to the spermathecal duct by connective tissue, appears to be the primitive condition. This is the case in *Gastrodonta* and *Janulus*. In other and more evolved genera the duct from the penis reaches the oviduct indirectly. It actually communicates with the spermathecal duct, which thus appears forked, with anterior insertions on both penis and oviduct. The lower part of the spermathecal duct takes the place of a direct connection with the oviduct, such connection becoming much reduced or entirely absent. Whether the course of the peni-oviducal duct is direct or indirect apparently is of little functional importance. Hugh Watson mentions finding specimens of *Zonitoides nitidus* in which the duct "opens into the oviduct, its apparent connection with the receptacular duct consisting merely of connective tissue or muscle-fibres."

As six of the seven genera of Gastrodontinae are North American, it appears that the main evolution of the group has been here; yet as the highly evolved Gastrodontoid genus *Janulus* was present in central European Oligocene and Miocene, and still exists in Madeira, it is clear that we have much to learn of the history of this subfamily and the place of its origin.

Artificial key to genera

1. Aperture having teeth within 2
   Aperture without teeth 4
2. Teeth short, formed in successive sets during growth 3
   Teeth laminar, continuous in growth, progressively absorbed at the inner ends *Ventridens*
3. Shell perforate, with conic, rib-striate spire, about 7 mm. in diameter, of about 8 whorls; 2 teeth within basal lip ..... *Gastrodonta*
   Shell broadly umbilicate, with flat or convex spire, about 2 to 2½ mm. diameter; several teeth ..... *Clappiella*
4. Shell small or minute, depressed, diameter 1.5 to 3.5 mm., of few, 2 to 3½ whorls *Striatura*
   Shell small, depressed, diameter 4 to 7 mm., of 3½ to 4½ whorls; aperture without internal callus ..... *Zonitoides*
   Shell larger, depressed or conic, with more whorls, the lip calloused within *Ventridens*

GASTRODONTA Albers

Gastrodonta Albers, 1850, Die Heliceen, p. 88; 1857, Malak. Blätter, 4:91, *Helix interna* designated type.

The shell is perforate, conic with convex base, of many (about 8) very closely coiled whorls, the first two microscopically granulose, the rest with regular, close retractive riblets above, the base smooth. Aperture narrowly lunar, obstructed by two teeth on a callous ridge within the basal margin. Young shells have two or three radial series of two teeth each, at intervals of a fourth of a whorl, the innermost series being absorbed when a new one is formed.

The pedal grooves are well developed. No caudal pit seen. Opening of the reproductive system is near the right tentacle. The kidney is about double the length of the pericardium and rather narrow. The lung shows no venation except the vein to the heart.

Reproductive organs, Fig. 230. The atrium is long. Penis stout, with terminal retractor muscle, the rather short epiphallus inserted well below the apex. Internally the penis contains a fleshy pilaster, the upper part of which is shod with an asymmetrical calcareous plate of irregular shape, bent over along one edge (Fig. 230B, C, view of the attached side, with transverse section). The vas deferens is moderately long. The dart sac is inserted just at the origin of the penis, is very long and abruptly recurved distally. The two long, slender coronal glands attach at the inner face of the bend, and outwardly a band of tissue connects distally with the thin

membrane covering the uterus. The dart (Fig. 230D) is not over half as long as the sac. The free oviduct is long and slender. Spermatheca small, oval. The long spermathecal duct in its upper third or more is closely bound to the columellar or prostatic side of the genital mass. It is perfectly simple, without a branch to the base of the penis as in *Ventridens* and *Zonitoides*, but there is a slender duct (Fig. 230F) running from the oviduct to the base of penis and dart sac, which evidently is homologous with the branches from spermathecal duct to penis and oviduct in *Zonitoides*, though in *Gastrodonta* this duct is wholly free from the spermathecal duct.[90]

Jaw slightly arcuate with a median projection and the ends tapering. Teeth, according to W. G. Binney, 24-4-1-4-24, the centrals tricuspid, laterals with ectocones.

Distribution.—Southern Indiana and Ohio to Alabama.

W. G. Binney has figured the teeth (1878, pl. iii, fig. Q). No further anatomic account of *Gastrodonta* has been published up to this time, but the results of a dissection I made about 25 years ago (Fig. 230A) have been communicated to malacological friends. I have now opened a second specimen,[91] drawn in Fig. 230C, to confirm the special characters of the genus. It differs from *Ventridens* by the internal armature of the shell: the laminae of *Ventridens* grow continuously forward, and are progressively absorbed at the inner ends, while in *Gastrodonta* new pairs of teeth are formed at intervals, the inner pairs being successively absorbed. This is like *Paravitrea, Polygyrella,* and the Madeiran *Janulus stephanophora.* Further and more important differences from other Gastrodontinae are the absence of a branch from the spermathecal duct to the sheath around the base of the penis, a duct from the oviduct replacing it, as in *Janulus;* and the attachment of the apex of dart sac is to the uterus, while in *Zonitoides* and *Ventridens* it attaches to the spermathecal duct.

(Γαστήρ, οδούς. belly tooth.)

Gastrodonta interna (Say) Fig. 230.

Helix interna Say, 1822, Jour. Acad. Nat. Sci. Phila., 2:155.—Binney, 1851, Terr. Moll., 2:247, pl. 30, fig. 4.—W. G. Binney, 1858, Proc. Acad. Nat. Sci. Phila., p. 202, with var. *albina,* nude name.

Zonites internus Say, W. G. Binney, 1878, Terr. Moll., 5:132, pl. iii, fig. Q (teeth). —Call, 1900, Indiana, Dept. Geol. Nat. Res., 24th Ann. Rep., p. 377.

Zonites internus form (animalis) *pallidus* Cockerell, 1893, Brit. Nat., 3:80.

Gastrodonta interna Say, Sterki, 1907, Proc. Ohio State Acad. Sci., 4:373.—Walker, 1928, Terr. Moll. Alabama, p. 107.

Helix pomum-adami Green, 1834, Doughty's Cabinet of Nat. Hist. and Amer. Rural Sports, 3:35, footnote (banks of the Ohio).

[90] Hugh Watson has recorded a similar condition in some individuals of *Zonitoides nitidus* (1934, Jour. of Conch., 20:33). Cf. also *Janulus.*

[91] Though it is found over a considerable area, I never happened to collect *G. interna,* and know the whole animal only from two adult and several young individuals collected by the ornithologist Witmer Stone.

The shell is minutely perforate, depressed, with convexly conic or dome-shaped spire of about 8 to 9 closely coiled whorls; the central part of the base strongly impressed around the perforation. Color cinnamon-brown or a paler tint and with little gloss above, the base polished and some tint of buff or pale brown. First 1½ whorls smoothish, the rest with regular retractive curved riblets separated by spaces of about twice their width, extending to the periphery, the base having faint, fine growth striae only. The aperture is narrow, obstructed by two teeth in the basal margin, standing on a callous ridge, the inner tooth tubercular, the outer either tubercular or compressed laterally. Lip is either sharp or a little blunt.

Height 5 mm., diameter 7.4 mm.; 8½ whorls. Talladega Co., Ala.
Height 5.4 mm., diameter 7.8 mm. Cincinnati, O.
Height 4.5 mm., diameter 6.5 mm. Macon Co., N. C.

INDIANA: Madison, Jefferson Co. New Albany, Floyd Co., Wyandotte, Crawford Co., and Cannelton, Perry Co. (Goodrich & Van der Schalie). OHIO: Cincinnati (Wetherby); Columbus (Sterki) WEST VIRGINIA: Gassaway, Braxton Co., (S. T. Brooks); Wirt Co. (Wm. J. Fox). KENTUCKY: Pine Mt., Harlan Co. (Witmer Stone); Quicksand, Breathitt Co. (C. R. Crosby); Warren Co. (Miss S. F. Price). TENNESSEE: Bledsoe, Cumberland, Davidson, Hamilton, Marion, Monroe, Morgan, Polk and Roane counties. NORTH CAROLINA: Buncombe, Cherokee, Clay, Graham, Jackson, Macon, Madison, Pickens and Swain counties. GEORGIA: Fannin, Franklin, Gwinnett, Meriwether, Murray, Rabun and Towns counties. ALABAMA: Bibb, Blount, Chambers, Cleburne, Colbert, Cullman, DeKalb, Etowah, Franklin, Hall, Jackson, Jefferson, Lauderdale, Lee, Madison, Marion, Marshall, Randolph, St. Clair, Shelby, Sumter, Talladega, Tuscaloosa and Walker counties; also, according to Bryant Walker, Calhoun, Cherokee, Choctaw, Clay, Fayette, Marengo, Mobile, Perry and Tallapoosa counties.

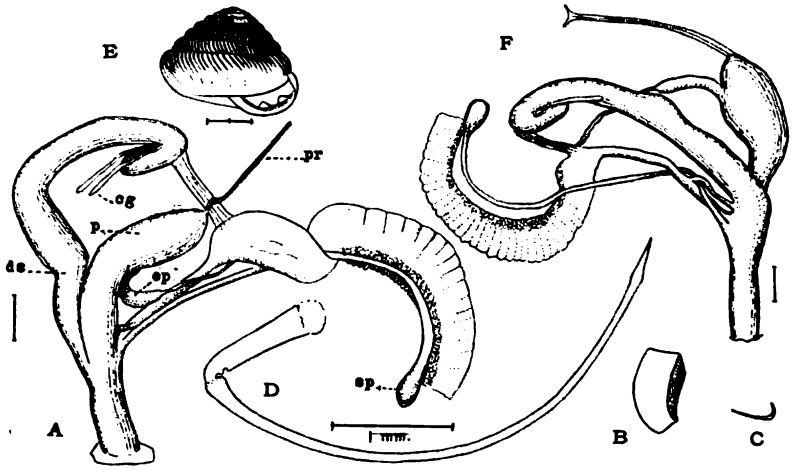

Fig. 230. *Gastrodonta interna*, Pine Mt., Kentucky. A, F, genitalia, posterior part omitted. B, C, penial plate, attached side and section. D, dart. E, shell. cg, coronal glands; ds, dart sac; ep, epiphallus; p, penis; pr, penial retractor; sp, spermatheca. Scale line for fig. E = 2 mm.; for figs. A, F, D = 1 mm.

It is a narrowly or scarcely perforate, compact, convexly-conic shell of about 8 narrow whorls, strongly and closely ribbed above, smooth below; in color brown to yellowish. Among all snails of the United States this species is strikingly distinct by the form and sculpture of the shell.

Say's locality " Lower Missouri " has not been confirmed by later work. His specimens were probably picked up at some stop along the Ohio River in the course of his journey by boat to St. Louis, and the locality supplied later from memory. Green's *H. pomum-adami* was also indefinitely localized. Cincinnati, Ohio, is now selected as type locality of *G. interna*. Cannelton, Perry Co., in southern Indiana, is, I believe, the western record for the species.

" Animal: Head, neck, and tentacles bluish-black, or slate-color, margin and posterior part of foot white. Superior tentacles very long, inferior very short; body narrow and delicate; in length not much exceeding the diameter of the shell." (Binney.)

Albino shells were found by J. G. Anthony many years ago. " About one-seventh of all the specimens collected by him in the neighborhood of Cincinnati are colorless. The animal is sometimes cream-colored throughout, but in such instances the shell is usually colored." (Binney.) On Dr. Binney's account of this form with cream-colored animal, Cockerell based the name *pallidus*. W. G. Binney proposed " var. *albina* " apparently for the albino shells, but without definition other than implied by the name.

Gastrodonta interna (as *Zonites internus*) has been reported twice from New York: Albany County, labelled as from T. H. Aldrich (W. B. Marshall, 48th Ann. Rep. N. Y. State Mus., p. 642); and " A few live specimens and a number of dead ones on hills opposite Poughkeepsie," taken by Gilbert Van Ingen,[92] were recorded by Teator (1890, Nautilus, 4:66). These places are so remote from the well known range of the species that although the records are from reliable sources, I think that some confusion of specimens or labels is indicated. I have seen the Albany specimen.

(*Internus*, relating to the internal teeth.)

CLAPPIELLA H. B. Baker

Clappiella H. B. Baker, 1929, Nautilus, 42: 90, as a subgenus of *Gastrodonta*, for *Vitrea* (*Paravitrea*) *aldrichiana* Clapp.

The shell is minute (diam. 2 to 3.5 mm. in known species), broadly umbilicate, depressed, the spire flat or convex, of about 5 whorls. Aperture crescentic with thin lip. Last half of the last whorl with a series of several successive vertically lengthened palatal teeth, alternating with smaller teeth in a columellar series.

---

[92] Dr. Van Ingen of Princeton University collected extensively around Poughkeepsie some fifty to sixty years ago. His collection, which I examined, contained also some Tennessee shells, though none of this species.

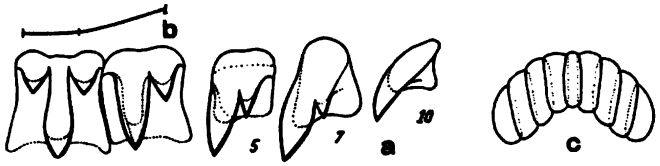

Fig. 231. *Clappiella aldrichiana*, a, central and 1st lateral teeth in natural relations, also 5th, 7th and 10th; b, shape of right half of a transverse row, with positions of central axis, outer edge of 4th tooth and edge of ribbon indicated; c, jaw (after H. B. Baker).

"The jaw (Fig. 231c) is of the plaited type and consists of 9 plates, which are firmly soldered together and which overlap each other slightly from the center out. It is quite heavy and the free outer edges of the plates give almost the appearance of ribs. The radular formula (Fig. 231a, b) is 13-1-13. The central is the largest tooth, bears three cusps and has a squarish base. The inner 4 teeth (laterals) are bicuspid but also have squarish bases. The 5th tooth begins to elongate into the marginal form but the bicuspid condition is retained out to the 9th and sometimes even to the 10th tooth. The 11th and 12th teeth appear to be always unicuspid, while the 13th is vestigial. Thus, all of the principal marginals are bicuspid." (H. B. Baker.)

The small size and different shape of these shells, their different internal armature, as well as the different jaw, like that of *Pristiloma*, make a generic separation from *Gastrodonta* expedient. Cf. also Morrison's notes under *C. aldrichiana*. The two genera do not seem closely related, but further anatomic information will be most interesting. The internal armature of the shell while in general resembling that of *Gastrodonta* and also the type occurring in *Paravitrea*, differs by the alternation of columellar and palatal denticles. As Dr. Baker noted, "The radula is distinctive, but its extreme extension of the bicuspid condition out into the marginal field is only approached, among American *Zonitidae*, by the *Gastrodontinae*."

Dr. Baker writes: "This new subgenus is founded on a single specimen taken from the aperture of a shell of *Gastrodonta gularis*, which was collected at the base of limestone ledges on the south side of Prior Cove, near Jasper, Marion County, Tennessee. Although smaller than the dimensions given by Clapp, it agrees so closely with his description in every other character that it can scarcely be anything else. Also, *Glyphyalinia cumberlandiana* (Clapp) and *Paravitrea pilsbryana* (Clapp) occur at this same place. As my shell contained a dried animal, I can describe the jaw and radula."

Clappiella aldrichiana (Clapp) Fig. 232.

Vitrea (*Paravitrea*) *aldrichiana* Clapp, 1907. Nautilus, 20:109, pl. 5, figs. 8-11.
Gastrodonta (*Clappiella*) *aldrichiana* (Clapp), H. B Baker, 1929, Nautilus, 42:90.
Clappiella aldrichiana (Clapp), Morrison, 1942, Bur. Amer. Ethn. Bull., 129:377.

"Shell small, widely, perspectively umbilicate, flattened, slightly convex above and below, the periphery well rounded; greenish-white almost transparent, highly polished with very faint growth lines and on the body-whorl a few impressed lines spaced irregularly. Whorls five, those of the spire rounded at the well-impressed suture; umbilicus contained about three times

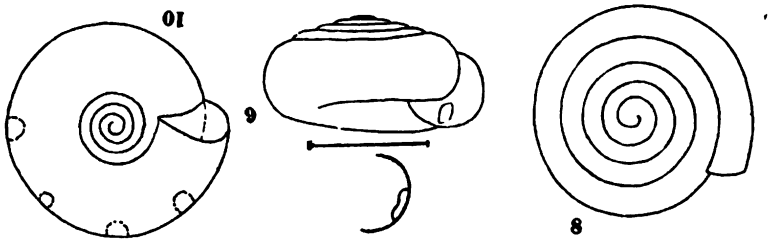

Fig. 232. *Clappiella aldrichiana,* type, after Clapp. Scale line = 1 mm.

in the diameter of the shell and showing all of the volutions; peristome forming two-thirds of a circle; lip simple. Slightly below the periphery, and in the last half of the body whorl are about four teeth which are longer, vertically, than wide, and, apparently, project at both the upper and lower ends; *i. e.,* they are double pointed. Greater diam. 2, lesser 1.9, alt. 1 mm." (Clapp.)

ALABAMA: Type from the slope of the Cumberland Plateau in Jackson County, close to the state line, and about 2 miles S. E. of Anderson, Tenn. Collected by Herbert H. Smith, who found but four specimens of this excessively rare species, the others being from Buck Creek Cove, Franklin County, a cove in Valley of Little Crow Creek, and Bennett's Cove, near State Line, both in Jackson County. Type in Clapp collection; the other specimens in the collections of Bryant Walker, John B. Henderson, Jr., and T. H. Aldrich. Tennessee River flood plain in the Pickwick Basin, Lauderdale Co. (Morrison). TENNESSEE: Prior Cove, near Jasper, Marion Co., 147188 A.N.S.P. (H. B. Baker).

"The species is so distinct from all others of the genus that it can not be compared with any of them. The fact of finding four specimens at different places and all of practically the same size, shows that it is not likely to be the young of a larger species.

"I take great pleasure in naming it after Hon. T. H. Aldrich so well-known by his work on the fossil Mollusca of the South." (Clapp.)

Dr. J. E. P. Morrison found it abundant in shell mounds of the Pickwick Basin of the Tennessee River. He writes:

"The exterior of the shell is as described by Clapp (1928 p. 84), with the following additions: Full-sized adults (from the 3- to 4-foot level of the mound at site Lu° 5) measure 2.9 mm. in maximum diameter and 1.2 mm. in height. The figure given by Clapp is misleading as to the height of the spire; *aldrichiana* is nearly plane above, appearing much like a miniature *Helicodiscus parallelus.* In basal view, the umbilicus is widely funicular, with a flat bottom; the base of the body whorl is rounded near the umbilicus and peripherally, but, nevertheless, distinctly flattened so as

to suggest its continuity in a single plane. The aperture of some adult shells is slightly flared peripherally, as in fully adult shells of *Paravitrea multidentata.*

"The internal armature as seen in many specimens is, as suggested previously, composed of an alternating pattern of barriers. The palatal barriers are double, with the upper end slanted or bent toward the aperture; the basocolumellar barriers (not noticed by Clapp in fresh, semitransparent shells) are smaller than those of *saludensis,* reduced to low, subacute points directed upward and toward the aperture. They arise from the margin of a more or less continuous basal callus, and give this callus a scalloped appearance, when seen from above in broken shells.

"The possession of such a distinct, alternating pattern of internal barriers seems to the writer to necessitate the separation of this group from *Gastrodonta* as a distinct genus. As now known, it must be a valley or cove species, since such ample confirmation of its occurrence on the flood plain is found in the mound material. Its occurrence as far west as 4 miles west of Waterloo, Lauderdale County [in an aboriginal mound known as "site Lu° 72"], suggests that it has a wider distribution than previously suspected."

Clappiella saludensis (Morrison) Fig. 233.

Gastrodonta (*Clappiella*) *saludensis* Morrison, 1937, Proc. Biol. Soc. Wash., 50:58, pl. 4, figs. 1-4.

"Shell small, greenish, discoidal about twice as wide as high. Spire almost flat; whorls five, tightly wound, practically in one plane, slowly and regularly increasing, well rounded above and below but somewhat flattened peripherally and separated by deep sutures on the spire and in the umbilicus. The last whorl is deflected slightly. Umbilicus wide, shallow, exhibiting all the whorls to the apex. Sculpture remarkable, consisting of regular rows of oval beads, projecting outward from the surface of the

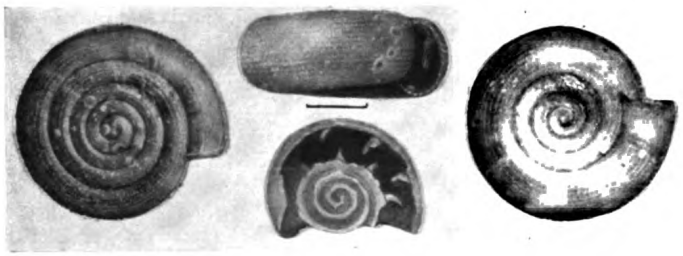

Fig. 233. *Clappiella saludensis,* enlarged (after Morrison).

whorl, with the longer dimension radial, the whole giving the appearance of the grains on an ear of corn. The rows of beads, about 25 in number,

extend from suture to suture. Nuclear whorls with the beaded ribs narrower than the interstices, but the ribs are gradually transformed into prominent rows of beads on later whorls, with the interstices inconspicuous. Aperture subcrescentic, higher than wide; peristome nearly vertical, a little sinuous above. Lip thin, but showing the beads along its edge. Internal lamellae complex, consisting of 3 or 4 pair of lamellae in the last third of the last whorl. The smaller basal lamella is high, triangular, with a sinuous radial base, the inner corner bent over toward the aperture, the peripheral end upright but strongly hooked toward the aperture. At a little greater distance within is the larger, chisel-like and somewhat double, peripheral lamella, which forms a transverse barrier, with the upper end strongly bent toward the aperture. Alternating at equal distances beyond are the remaining 4 to 6 lamellae seen. Apparently these lamellae are progressively resorbed as new ones are added with new shell growth. The type measures: Height 1.5 mm.; major diameter 3.5 mm.; minor diameter 3.2 mm.; aperture height 1.3 mm.; aperture width 0.9 mm.; whorls 5.0." (Morrison.)

SOUTH CAROLINA: The type (U.S.N.M. 423597) was collected by J. E. P. Morrison on the south side of Walnut Mountain, on a slope along Fall Creek, a tributary of the Saluda River, in the Saluda Mountains, Greenville County. This locality is about a mile south of the North-South Carolina boundary on U. S. route 25.

Eight paratypes (U.S.N.M. 423598) of which Morrison gave measurements, are from 1.6 x 3.5 mm., 5.4 whorls, to 1.2 x 2.4 mm., 4 whorls.

"This interesting little form was taken from the lower layers of leaf-mold on a steep slope in company with: *Polygyra albolabris* (Say), *P. wetherbyi* (Bland), *P. christyi* (Bland), *P. inflecta* (Say), *P. hirsuta* (Say), *Mesomphix inornatus* (Say), *M. perlaevis vulgatus* (H. B. B.), *Retinella indentata paucilirata* (Morelet), *Zonitoides elliotti* (Redfield), *Z. limatulus* (Ward), *Gastrodonta interna* (Say), *Helicodiscus parellelus* (Say).

"Although the anatomy of this new species has not been examined, the unique arrangement and shape of the apertural lamellae, which match those seen in the single (immature) specimen of *Gastrodonta* (*Clappiella*) *aldrichiana* Clapp in the National Museum collections, indicate its close relationship thereto. To the unaided eye, this form is almost if not identical with *Helicodiscus parallelus;* under magnification the differences are at once apparent." (Morrison.)

VENTRIDENS W. G. Binney

Ventridens W. G. Binney, Dec. 9, 1863, Smiths. Misc. Coll., 000,[93] p. 9, for "*Zonites* (*Ventridens*) *suppressa* Say."—Binney and Bland, 1869, Land and Fresh Water Sh. of N. A., 1:292, for *H. suppressa* and *H. gularis*.—G. Nevill, 1878, Handlist Moll. Ind. Mus., 1:59, type *H. suppressa* Say.—H. B. Baker 1929, Proc. Acad. Nat. Sci. Phila., 81:257, as subgenus of *Zonitoides*.

Mesomphix Tryon, 1866, Amer. Jour. Conch., 2:254, not of Rafinesque.

[93] Although described as "a mere proof," this pamphlet was widely circulated and to be found in most conchological libraries made in the XIX century. It is absurd to regard it as not published.

The shell is subperforate or umbilicate, biconvex or with conic spire, yellow or brown, glossy or dull, obliquely striate, composed of 5 to 8 whorls. Aperture lunate, the lip simple, acute; last whorl having a white callous deposit or one or more lamellar teeth near the aperture within the basal wall; the callus or laminae when present are found in the young shell, and are continuous in development, being absorbed behind and growing in front with growth of the shell.

Sole undivided, showing no waves in movement, locomotion being arythmic. The pedal furrows and granulation of the integument are strongly developed. There is a caudal pore in form of a slit across the foot-margin. The reproductive orifice is near the right tentacle.

The jaw is arched, with a strong median projection, as in *Gastrodonta* and *Zonitoides*. The teeth are about as in *Zonitoides*. Laterals rather numerous, bicuspid, without entocones. Marginals simple.

Reproductive system, Fig. 234, *V. acerra:* The atrium is long, there being practically no vagina. Free oviduct long. The lower part of the penis bears the dart sac, which is reflexed and enlarged at the tip, where it attaches to the spermathecal duct by a muscular connective band. One or two coronal glands are present. The penis is broad above, with several short pilasters in the cavity, and a larger one shod with a calcareous plate. In *V. acerra* this plate is toothed at the lower end. It is convex towards

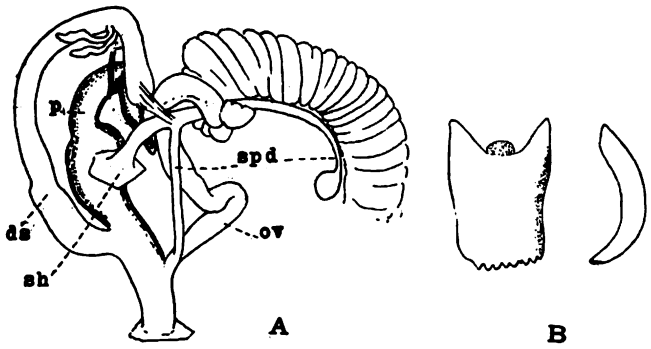

Fig. 234. *Ventridens acerra.* A, genitalia, posterior parts omitted. B, calcareous penial plate. ds, dart sac; ov, free oviduct; p, penis; sh, part of penial sheath, cut loose; spd, spermathecal duct.

the cavity in transverse, concave in longitudinal section (Fig. 234B). Epiphallus is short, bearing the retractor muscle near its base. The spermathecal duct is long, at its lower third giving off a branch which opens into a sheath surrounding the basal part of the penis (shown torn loose in the figure).

Type *V. suppressus* (Say).

Distribution.—The eastern United States and Canada (Ontario). It is especially characteristic of the Appalachian mountain system; but a few forms occur west to the Ozark-Ouachita region, and in northeastern Texas.

Ventridens differs from *Zonitoides* only in characters of the shell, and one species, *Z. elliotti,* could be placed in either group with about equal

propriety. However, the different specializations of the shell, and the distribution, indicate old branching of a stock which has diverged very little in anatomic structure. To allow *Ventridens* generic rank seems an aid to clear conceptions, though its genitalia are admitted to be like *Zonitoides*. The essential difference from the shell of *Gastrodonta* is in this, that the growth of the laminae or callus is continuous in *Ventridens*, their inner ends being absorbed at the same time, while in *Gastrodonta*, and also in *Paravitrea*, successive sets of internal teeth are formed during the growth of the shell.

Internal laminae are wanting at all stages of growth in some of the species; in others they decrease in number or in size, or entirely disappear in the adult stage, but are well developed in the young. Rarely there is no basal callus and no laminae at any stage observed (as in *V. intertextus volusiae*) but usually at least a columellar callus is present.

The laminae within the last whorl of *Ventridens* of the *suppressus* type pass through a series of transformations which are here somewhat fully described and illustrated for *V. suppressus* (q.v.); but for other species they are more briefly noticed. In some, such as *V. gularis* (Say), the evolution has not progressed so far, the adult stage having the structure of the midneanic stage of *V. suppressus*. Other species are more advanced than *V. suppressus*, becoming wholly toothless in the adult stage, or sometimes in the gerontic or old age stage only. Species of the *V. ligera* group are probably to be looked upon as still further evolved forms, in which the laminate phase has been eliminated.

Most lots of these shells in collections lack the early stages, which are often essential to a thorough understanding of the species. By sieving the loose material under leaves or wood where adult shells are found, young of all sizes may usually be obtained.

Ventridens appears to have been evolved in the Appalachian system. Though doubtless in pre-glacial times ranging much farther north than at present, the absence of related forms in the Columbia River valley appears to indicate that it did not have an extended northwestern range such as *Anguispira*, *Allogona* and *Triodopsis* once had. Southwestward it barely reaches Texas, being unknown in eastern Mexico.

Various Cretaceous and Tertiary snails have been referred to *Ventridens* and *Gastrodonta* on account of some resemblance in general shape only; none being known to possess teeth or laminae. Such similarity to these genera is not to be taken seriously. At present we have no definite knowledge of Tertiary or older precursors of the Gastrodontinae in America. Notes on species which have been referred here follow.

Straparollus lens Gabb, 1864, Paleont. Cal., 1:120, 226, pl. 20, figs. 77a-e; 2:224. —*Ventridens lens* (Gabb), Stewart, Proc. Acad. Nat. Sci.

Phila., 78:442, pl. 24, fig. 13, is apparently a land snail, with the size, closely coiled whorls and general figure of *Ventridens lawae* or *lasmodon*, but the base is not preserved sufficiently to show the aperture, or whether laminae are present. It is from the Cretaceous, Chico group, Texas Flat, Placer Co., California.

Helix evanstonensis White has been referred with doubt to *Gastrodonta* (Amer. Mus. N. H. Bull., 31:321). It is probably a helicid snail.

Gastrodonta evanstonensis sinclairi Cockerell (Amer. Mus. N. H. Bull., 31:231) was referred later to *Grangerella*.

Gastrodonta coryphodontis Cockerell, 1914 (Amer. Mus. N. H. Bull., 33:105, pl. 9, fig. 4-6), from Clark's Fork Basin, Wyoming, probably from base of the Wasatch formation. The generic reference of this fossil depended mainly upon a comparison of the sculpture with recent shells identified as "*Gastrodonta*" *intertexta* (Binn.), but which on examination prove to be immature *Mesodon elevatus* (Say).[94] It may be a helicid snail.

Gastrodonta imperforata Hanna, 1920 (Kansas Univ. Sci. Bull., 13, 5), of the John Day Miocene, Oregon, has some resemblance to *Ventridens intertextus*, but Dr. Hanna considered its classification doubtful. As the basal lip is slightly expanded, it is possibly a helicid snail.

On account of the variability of closely related species, and their changes with age, it is not easy to construct a key which will be of much use.

(*Ventridens*, belly tooth.)

Key to species of Ventridens

1.	Umbilicus a narrow perforation or closed	2
	Umbilicus wider, more than one-tenth of the diameter	12
2.	Aperture toothless in the adult stage	3
	Aperture with one or two laminae in adult stage	7
3.	Larger, generally 12 to 20 mm. in diameter; no laminae at any stage of growth	4
	Smaller, generally less than 11 mm. diameter; young laminate, adults with basal callus in aperture	6
4.	Periphery from rounded to angular; spire somewhat conic	5
	Periphery sharply carinate; form biconvex	*V. intertextus eutropis*
5.	Upper surface rather sharply striate	*V. ligera*
	Upper surface sharply striate and with spiral lines	*V. intertextus*
	Upper surface with coarser, rounded striae; glossy	*V. acerra*
6.	Shell rather elevated, about 7 × 9 mm.	*V. percallosus*
	Shell lower, diam 7.5 to 10.5 mm.	*V. demissus*
	Shell about 5 × 8 mm.	*V. gularis theloides*
7.	Striation of upper surface sharp and distinct	8
	Striation weaker, the striae rounded, glossy	9
8.	No spiral lines	*V. collisella*
	Spiral lines in places	*V. gularis decussatus*
9.	Diam. about 6 or 7 mm.; depressed	*V. suppressus magnidens*
	Shell larger	10
10.	Diam. about 7 to 9 mm.; Eastern	11
	Diam. about 10 to 14 mm.; Transmississippian	*V. demisus brittsi*
11.	Typically with 2 laminae; Appalachian	*V. gularis*
	Laminae often replaced by a callus; Coastal Plain	*V. cerinoideus*
12.	Aperture with laminae in, or nearly to, the adult stage	13
	Aperture without laminae at any stage	14

[94] I am indebted to Professor Hugo G. Rodeck for opportunity to examine these shells, No. 3580 Univ. of Colo. Mus.

13. Umbilicus contained 3 to 4 times in diameter .....*V. lasmodon*
Umbilicus contained 5 to 6 times in diameter .....*V. lawae*
Umbilicus contained 6 to 7 times in diameter .....*V. coelaxis*
Umbilicus contained about 8 times in diameter .....*V. suppressus*
14. Umbilicus minute; form conic; diam. 10 mm. or more .....*V. ligera*, var.
Umbilicus widely open; form depressed; diam. 7.5 to 9 mm. .....*V. elliotti*

V. SUPPRESSUS GROUP (Section *Ventridens* s. s.)

In the neanic stage the aperture has a columellar lamina or tubercle and an outer-basal lamina; one or both may disappear in the adult stage.

Ventridens suppressus (Say) Fig. 235 a-e.

Helix suppressa Say, July, 1829, The Disseminator of Useful Knowledge, 2:229 (Germantown, Pa.).—Binney, 1851, Terr. Moll., 2:253, pl. 37, fig. 1.

Zonites suppressus Say, W. G. Binney, 1878, Terr. Moll., 5:130, pl. 3, fig. J (teeth). —Sterki, 1893, Nautilus, 7:14 (mouth armature).

"Shell subglobose, depressed, pale horn colour, polished, somewhat pellucid; body whorl opake whitish near the aperture: volutions six, wrinkled: spire convex: aperture sublunate, narrower beneath; within, a prominent tooth near the base, distant from the margin: labrum simple: umbilicus rather small, orbicular, profound: region of the umbilicus indented. Greatest breadth more than one-fifth of an inch." (Say.)

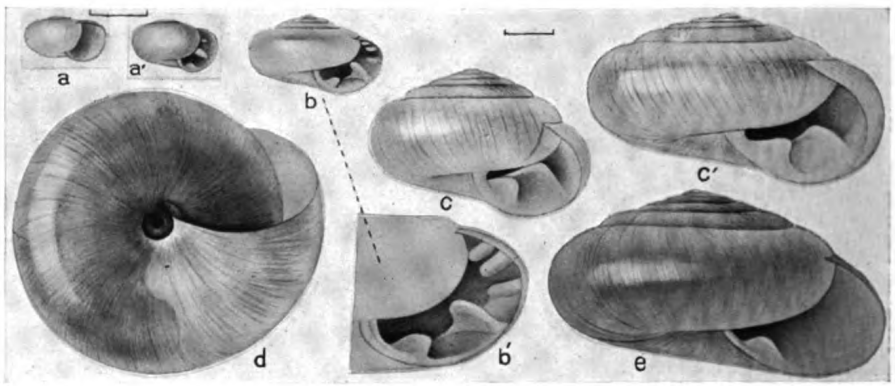

Fig. 235. *Ventridens suppressus*, near Philadelphia. a, end of embryonic stage. a', first neanic substage. b, second or middle neanic substage, at b' the aperture more enlarged. c, c' third neanic substage. *d*, *e*, ephebic or mature stage. Figures b, c, c', d, e drawn to same scale. Scale lines = 1 mm.

The retractive striation is rather coarse below the suture, or like quite low folds, elsewhere fine and indistinct, and on the base, near the umbilicus, there are more or less distinct but superficial spiral striae. In the adult stage there is a tubercular or somewhat lengthened tooth a short distance within the base of the columellar margin, and no other teeth. The umbilicus is small, contained about 8 times in the diameter.

Height 4 mm., diameter 6.1 mm.; 6 whorls. Germantown, Pa.
Height 3.7 mm., diameter 6.3 mm.; 6 whorls. Germantown, Pa.
Height 4.1 mm., diameter 7 mm.; 5¾ whorls. Livingston Co., Mich.
Height 3.5 mm., diameter 5.8 mm.; 6 whorls. Culpepper Co., Va.

ONTARIO: Hamilton (Hanham). NEW YORK: Peekskill, Westchester Co. Richmond, Staten Island. Reported also from Monroe, Herkimer and Ulster counties. NEW JERSEY: Burlington, Camden, Cape May, Cumberland, Gloucester, Sussex and Warren counties. PENNSYLVANIA: Adams, Berks, Bucks, Chester, Cumberland, Delaware, Franklin, Fulton, Lancaster, Lehigh, Monroe, Montour, Montgomery, Northampton, Philadelphia, Westmoreland and York counties. Type and paratypes Germantown, Philadelphia Co., 56981 A.N.S.P. DELAWARE: New Castle Co. MARYLAND: Alleghany, Baltimore, Cecil, Harford and Washington counties. DISTRICT OF COLUMBIA: Washington. VIRGINIA: Arlington, Culpepper and Rockbridge counties. WEST VIRGINIA: Harpers Ferry, Jefferson Co. OHIO: Columbiana Co. (and according to Sterki, Cincinnati, and Portage and Tuscarawas counties). MICHIGAN: Livingston and Washtenaw counties (and Walker adds Genesee and Kent). KENTUCKY: Big Bone Lick, Kenton Co. (A. H. Lea).

V. suppressus is smaller than related species, and the northern typical form differs from them by possessing only the columellar tooth in the adult stage.

It has been reported from New England by W. G. Binney and from Connecticut by Johnson, but without definite localities; its occurrence in any New England state thus remains in need of verification, though probable.

W. G. Binney's statement that the umbilicus "exists only in young specimens, it being closed in the full-grown shell" is erroneous. It is open in *suppressus* proper at all stages of growth, but in the southern subspecies *V. s. magnidens* it is very narrow or almost wholly closed. This race was probably what Binney had in view.

Very rarely the columellar tubercle has been absorbed in adult, or perhaps aged, shells, which are thus wholly toothless. Such specimens as I have seen occurred singly in lots otherwise normal. Cf. Sterki, Nautilus, 7:14.

STAGES OF GROWTH.—The shell has a toothless aperture in (1) the EMBRYONIC STAGE of somewhat less than 1 mm. diameter, but in some cases it remains toothless up to a diameter of 1.5 mm. (Fig. 235a).

(2) The NEANIC STAGE is divisible into three substages. (a) a columellar and a rather short, high outer-basal fold appear in shells of 1.1 mm. diameter, $1\frac{3}{4}$ whorls, or a little larger; a small peripheral palatal fold is then added (Fig. 235a′). This leads to substage (b), which culminates at about 2.25 mm. diameter, $3\frac{1}{3}$ whorls. There are 5 folds or laminae, a strong, short subcolumellar one, a higher, longer outer-basal lamina, its summit often bending towards the columella, and above it 3 quite small folds, the last near the suture (Figs. 235b, b′). There is little or no callus deposit diffused between the folds or laminae at first in this stage, but by the time the shell reaches a diameter of 4 mm., with nearly 5 whorls, the intervals between laminae have become copiously calloused, and the three low palatal laminae above are diminishing, to be wholly submerged later in the callous lining. (c) In the final neanic substage, immediately preceding maturity, the columellar and outer-basal laminae are large, the small folds above having become wholly merged in a smooth white callous deposit (Fig. 235c). This substage has its climax at about 5 mm. diameter, $5\frac{1}{2}$ whorls. After this the laminae diminish in size (relative to that of the aperture), and the callous lining becomes thinner (Fig 235 c′).

(3) ADULT STAGE, Figs. 235d, e. All laminae have been absorbed except the columellar, which is more or less reduced in size. The callous lining becomes very thin. The shell has a diameter of 6 to 6.5 mm., with 6½ whorls.

Since growth of the teeth forward is continuous it will be understood that any lot may contain forms transitional in structure between the stages described. There is also a rather wide range of variation in the size at which any stage may begin, and the amount of growth before the next stage replaces it. In stage 2b the number of small parallel folds in the upper arc of the lip varies from 1 to 3, and 4 have been seen in a few shells.

These notes apply to typical *V. suppressus*, in the vicinity of Philadelphia and Germantown, but appear to be equally applicable, so far as material seen serves, to the species in Ontario, New York, Michigan, Delaware and Maryland; also south to Virginia, where typical *suppressus* occurs as far south as Rockbridge County, at Harpers Ferry, W. Va., and elsewhere. Farther south *suppressus* is replaced by the subspecies *magnidens*.

Although I am here leaving *virginicus* and *magnidens* subordinate to *suppressus*, it is possible that they will eventually be considered separate species; but as yet the anatomy has not been compared.

The foot of *V. suppressus* is long and narrow, its length, in the moving animal, about five or six times the width. The sole is slate gray or lead-gray, sprinkled with white dots more profuse near the edges but without other longitudinal division. The back and tentacles are nearly black, the sides tesselated with large polygonal spots darker than the blue-gray ground. There are sometimes some white flecks on the sides. Pedal grooves not very conspicuous. The caudal foss is rather indistinct in the living animal. The collar is pale gray speckled with white. The shell is carried with its apex tilted a little towards the right, or more rarely level.

Ventridens suppressus virginicus (Vanatta) Fig. 236 a-c.

Zonitoides suppressus virginicus Vanatta, 1936, Nautilus, 49:99.

"The adult stage has a long nodule within the columellar lip and a rather short, obtuse horizontal lamella within the outer lip, more remote from the columellar nodule than is the case with the outer tooth of *suppressus*. Other characters as in *Z. suppressa*. Alt. 3.4 mm., diam. 6 mm.; slightly over 6 whorls." (Vanatta.)

In the neanic stage the columellar tooth is conspicuously bifid (rarely trifid), and the summit of the outer-basal lamella (peripheral in position) curves towards the columella (Fig. 236c).

Height 3.8 mm., diameter 5.7 mm.; 6 whorls, Cedar Creek, Va.

VIRGINIA: near Endless Caverns, New Market, Shenandoah Co. (J. B. Clark), type and paratypes 145074 A.N.S.P. Cedar Creek, Frederick Co. (Clench, Rehder & Archer). Berryville, Clarke Co. (G. H. Clapp and others) Near Snowden, Amherst Co. (H. B. Baker). Staunton, Augusta Co. (Clark). 5 miles S. W. of Fairfield, Rockbridge Co. (Archer). WEST VIRGINIA: Morgan Co. opposite Hancock, Md. (Pilsbry). Franklin, Pendleton Co. and Dunmore Spring, Pocohontas Co. (G. K. MacMillan). MARYLAND: foothills of Martin's Mt., Cumberland Co. (Pilsbry). MICHIGAN: open country on the south edge of George Reserve near Patterson Lake, Livingston Co., (A. F. Archer, 169400 A.N.S.P.). NEW YORK: Woods in Mendon Ponds Park, Monroe Co. (C. L Blakeslee, Nov., 1943).

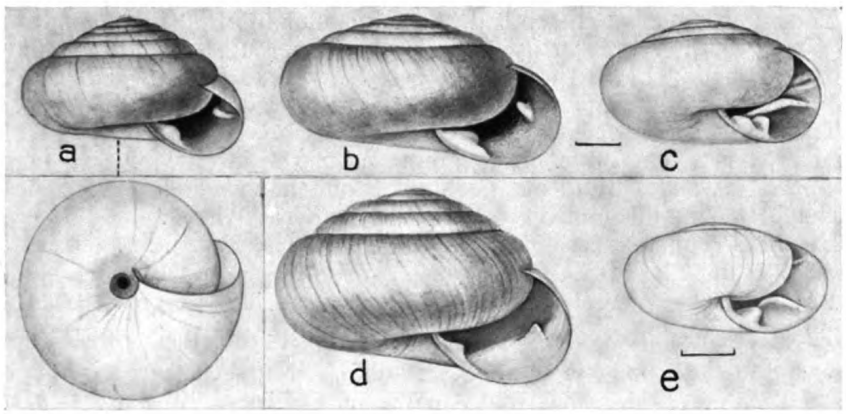

Fig. 236. a, b, c, *Ventridens suppressus virginicus,* type and paratypes. d, e, *V. s. divisidens,* Marlinton, West Virginia. Scale lines = 1 mm.

" In some individuals this two-toothed stage is seen in somewhat smaller shells, but the strong callous lining of the throat is usually not well developed. At an earlier stage, diam. 4.3 mm., more or less, the columellar tooth is conspicuously bifid, or in some shells trifid; there is a long and high entering lamella within the outer lip with generally one or two small laminae above it, and the callous lining is heavy. In old individuals of *Z. suppressus* there is no tooth within the outer lip, only the columella nodule remaining. The small laminae above the large outer tooth of the young stage disappear in *suppressus* at a much earlier age than in *virginicus.*" (Vanatta.)

In the adult stage this race is like *V. s. divisidens,* but the earlier stages differ by the divided columellar tooth.

It was first found by the writer, 1892, in West Virginia and Maryland, but was not then considered distinct and was listed as *suppressus* (Proc. Acad. Nat. Sci. Phila., 1894, p. 17). It was first recognized as a new race in 1906 by G. H. Clapp, who sent specimens, from Berryville, Va., calling attention to the bifid columellar tooth. On receiving others collected by J. B. Clark in 1927, Vanatta described it, his account appearing some years later.

The Michigan and New York localities are rather remote from the other known range of the species, but immature specimens have the characteristic bifid tooth. Typical *suppressus* was taken by Archer near Greenoak Lake in the same Michigan county. The published Pennsylvania records for *virginicus* (Nautilus, 53:85), prove to have been based on immature *suppressus;* but its occurrence in this state is not improbable.

Ventridens suppressus divisidens new subspecies Fig. 236 d, e.

The adult stage is two-toothed, the columellar tooth as in *V. suppressus*, the outer tooth very shortly lamellar or tubercular, remote from the columellar, being situated within the periphery as in *V. s. virginicus*. The sculpture, color and shape are about as in typical *suppressus*.

The neanic stage of specimens from Marlinton, W. Va., of 3 to 4 mm. diameter, has a long outer-basal lamina as in the last neanic substage of *V. suppressus*, and a blunt but not bifid columellar tubercle (Fig. 236e).

Height 3.5 mm., diameter 5.4 mm.; 6 whorls. Type.
Height 4 mm., diameter 6.4 mm.; 6½ whorls. Franklin.

West Virginia: Marlinton, Pocahontas Co. (G. K. MacMillan), Type 167076 A.N.S.P., from a lot in Carnegie Mus. Also Franklin, Pendleton Co. (MacMillan).

The teeth are farther apart than in the two-toothed stage of *V. suppressus*, and the outer one is small. It differs from *V. s. virginicus* by the simple, not bifid, columellar tooth in the neanic stages, uniform in half a dozen young shells examined.

Although not quite satisfied that this form is distinct from *V. s. virginicus*, it seems best to put the data thus on record rather than to expand the definition of *virginicus* to cover these shells with simple columellar tooth in the neanic stage; but it is true that the adult stage of *divisidens* does not seem separable from that of *virginicus*. Further lots containing immature stages in greater numbers are needed for a definite decision.

The name refers to the widely divided or separated teeth.

Ventridens suppressus magnidens new subspecies Fig. 237.

The shell is usually larger than *V. suppressus*, with a smaller, quite minute, umbilical perforation. The aperture has a well developed short columellar lamella and a long, strong, outer-basal lamina. The color is

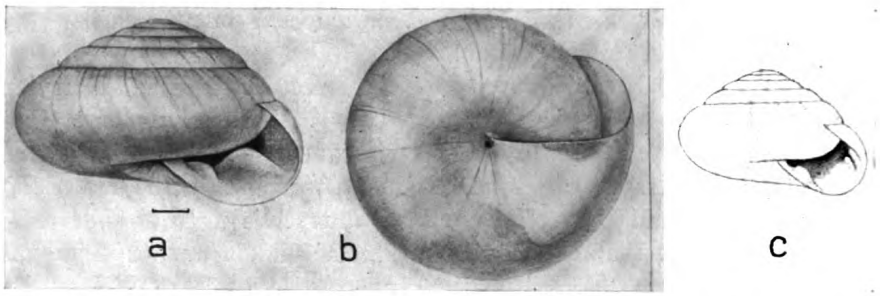

Fig. 237. *Ventridens suppressus magnidens*. a, b, Cherokee National Forest, Polk Co., Tenn. c, Natural Bridge, Va. Scale line = 1 mm.

transparent light yellowish olive, with an opaque colonial buff area behind the basal lip. Surface glossy, showing distinct (to faint) traces of spiral striae on the base, the upper surface weakly subplicate below suture, as in *V. suppressus*.

Height 5. mm., diameter 7.75 mm.; 7 whorls. Type.
Height 4.7 mm., diameter 7.8 mm.; 6¾ whorls. Jackson Co., Ala.
Height 4.3 mm., diameter 6.8 mm.; 6 whorls. Cleburne Co., Ala.

NORTH CAROLINA: Cherokee and Clay counties. TENNESSEE: Cumberland, Knox, Marion and Monroe counties; the Type 170228 A.N.S.P. from the Cherokee National Forest, Polk Co., in a ravine 9.5 mi. east of Parksville (A. F. Archer). ALABAMA: Cleburne, Jackson, Jefferson, Madison, St. Clair, Talladega and Tuscaloosa counties.

Additional counties of Alabama are cited for *suppressus* by Walker (1928): Bibb, Calhoun, DeKalb, Elmore, Fayette, Lauderdale and Shelby. Doubtless these refer to *magnidens*, as *V. suppressus* proper is not known to me from Alabama. It is "apparently of general distribution in the northern half of the state." Bryant Walker (Proc. Acad. Nat. Sci. Phila., 1902, p. 433) reported *suppressus* from Town Mt., near Asheville, N. C., and Spence's cabin at the top of Thunderhead, Blount Co., Tenn.; these should probably be *magnidens*, but I have not seen them. According to Dall, 1885 (Proc. U. S. Nat. Mus., 8:271), Hemphill collected "*Zonites*" *suppressus* Say at Fernandina, Florida. This seems remote from localities recorded above; probably he had young *demissus*.

Virginia should apparently be added to the range of this race. In the ravine at the Natural Bridge a peculiar form is found having the two teeth and the minute perforation of *magnidens*, but the outer-basal lamina is somewhat shorter than in that, and the size is much smaller: diameter 5.2 mm., 6½ whorls (Fig. 237c). A similar form occurs at Talcott, Summers Co., W. Va.

On the hills around Natural Bridge Dr. Baker found typical *V. suppressus*, the shells rather small, diameter 5 to 5.8 mm., the round umbilicus larger than in *magnidens*.

V. s. magnidens is a less evolved race than *V. suppressus*, the adult stage having two teeth like the last neanic substage of *suppressus*.

The youngest specimens seen, diameter 3.4 mm., 4½ whorls, show two parallel laminae within the upper arc of the lip in addition to the two basal laminae. The name alludes to the large outer-basal lamina.

Ventridens gularis (Say) Fig. 238 a-g.

Helix gularis Say, 1822, Jour. Acad. Nat. Sci. Phila., 2:156 (Ohio and Pennsylvania).—Binney, 1851, Terr. Moll., 2:250, pl. 37, figs. 3, 4 (east Tennessee, north Alabama).

Zonites gularis Say, W. G. Binney, 1878, Terr. Moll., 5:129, pl. iii, fig. K (teeth).

Gastrodonta gularis (Say), Pilsbry, 1900, Proc. Acad. Nat. Sci. Phila., p. 142.—Walker & Pilsbry, 1902, Proc. Acad. Nat. Sci. Phila., p. 434.—Daniels, 1915, 39th Ann. Rep. Dep. Geol. Nat. Res. Indiana, p. 319.—Walker, 1928, Terr. Moll. Alabama, p. 104.

Helix bicostata Pfeiffer, 1846, Symbolae ad Hist. Hel., 3:69 (Hab. unknown); 1848, Monogr. Hel. Viv., 1:182 (Tennessee); Conchyl. Cab., Helix, p. 196, pl. 100, figs. 21-23.

[*Zonites cerinoidea*] var. *cuspidata* James Lewis, 1875, Proc. Acad. Nat. Sci. Phila., pp. 335-6 (Knox and Monroe counties, Tenn.).

Zonites cuspidatus Lewis, W. G. Binney, 1883, Suppl. Terr. Moll., Bull. Mus. Comp. Zool., 11:143, pl. 2, fig. c; 1885, Man. Amer. L. Sh., p. 226, fig. 243; 1890, Bull. M.C.Z., 19:188.

" Shell subglobose, pale yellowish-horn colour, polished, pellucid, beneath near the aperture whitish-yellow opake; volutions six or seven, with prominent somewhat regular wrinkles; spire convex, a little elevated, suture moderate; labrum not reflected; throat far within upon the side of the labrum bidentate, teeth lamelliform, of which one is oblique and placed near the middle, and the other less elongated placed near the base; umbilicus none. Breadth more than $\frac{1}{4}$ of an inch.

" Inhabits Ohio and Pennsylvania. In general form it resembles *H. ligera,* but may be distinguished by the absence of umbilicus, and upon particular examination, by the teeth, which are situated far within the aperture. In the collection of the Academy." (Say.)

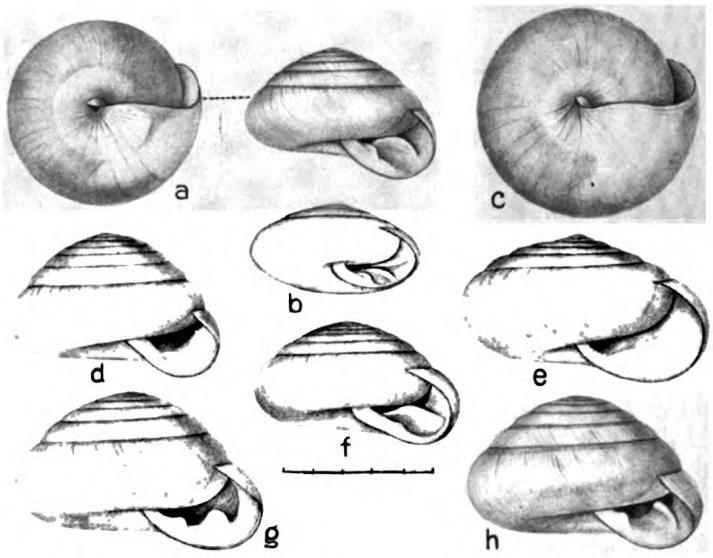

Fig. 238. *Ventridens gularis.* a, b, Jasper, Tenn. c, Roanoke, Va. d, Forma *nodus,* West Pikeville, Tenn. e, Harriman, Tenn f, Neotype of *V. gularis,* Allegheny Co., Pa. g, Cade's Cove, Blount Co., Tenn. h, Forma *cuspidatus,* Tellico Gorge, Monroe Co., Tenn. Scale line = 5 mm.

Height 6 mm., diameter 8 mm.; $6\frac{3}{4}$ whorls. Tuscarawas Co., O.
Height 6 mm., diameter 9 mm.; 8 whorls; umbilicus 0.35 mm. Cades' Cove.
Height 5 mm., diameter 7.8 mm.; $7\frac{1}{4}$ whorls; imperforate. Jasper, Tenn.
Height 5.4 mm., diameter 8.2 mm.; $7\frac{1}{2}$ whorls; umbilicus 0.1 mm. Jasper.
Height 5.2 mm., diameter 8 mm.; 8 whorls; umbilicus 0.25 mm. Parkesville, Tenn.
Height 6.3 mm., diameter 8.3 mm.; 8 whorls Jackson Co., Ala.
Height 5.3 mm., diameter 8.7 mm.; $7\frac{1}{2}$ whorls. Jackson Co., Ala.

PENNSYLVANIA: Allegheny Co. (J. A. Shafer in Carnegie Mus.). OHIO: Tuscarawas Co. (V. Sterki, in Carnegie Mus.). INDIANA: "The Knobs" near New Albany, Floyd Co. (L. E. Daniels). WEST VIRGINIA: Jackson Co. KENTUCKY: Barren, Breathitt, Pulaski and Wayne counties. NORTH CAROLINA: Avery, Cherokee, Clay, Graham, Haywood, Jackson, Macon, Madison, Mitchell, Swain, Transylvania and Warren counties. TENNESSEE: Berkeley, Blount, Carter, Cumberland, Davidson, Franklin, Green, Knox, Marion, Monroe, Polk, Sewanee, Unicoi and Washington counties. GEORGIA: Near Lake Toccoa, Fannin Co.; North of Hiawassee, Towns Co. (Archer). White Sulphur Springs (H. H. Smith). ALABAMA: Blount, Choctaw, Clarke, Colbert, Cullinan, Franklin, Jackson, Lee, Madison, Marshall, Randolph, St. Clair, Sumter. (Walker gave additional localities for *gularis* in Alabama: Baldwin, Bibb, Conecuh, Dallas, DeKalb, Fayette, Geneva, Jefferson, Lauderdale, Mobile, Perry, Morgan, Tuscaloosa, Walker and Wilcox counties.)

The spire in high examples is convexly conic, dome-shaped in lower ones, both high and low usually found in the same lots; the periphery is rounded and the base convex, but deeply impressed around the very minute umbilical perforation. The glossy surface has, after 1½ smooth apical whorls, low retractively curved wrinkles on the upper surface, but becoming very weak or extinct on the base, where occasional individuals show also some weak spirals in the impressed axial region, others having none. The aperture has a callous lining within the lip. The columellar margin is somewhat straightened, with a strong callus within, upon which is an entering lamina (often reduced to a low nodule). In some lots this lamina is rather deeply placed, not visible in direct front view; or it may be wholly obsolete. In the outer-basal position there is an erect entering lamina, which is long in young and some adult shells, short in others (and in various forms noted below, it is wanting in the adult stage).

At an early neanic stage, diameter 2 mm., 2½ whorls, the two basal laminae are well developed and there is a very slender lamina in the upper arc, above the periphery. There is no columellar callus or callous lining between the laminae. The lamina above the periphery disappears soon in most lots examined, but in some lots, such as Jasper, Tenn., I have seen it in shells of 6 mm. diameter, 6 whorls (fig. 238b).

In the early stages the umbilicus is as large, or often larger than in the adult shell, in which it varies in different lots from closed to minutely perforate, which is the prevalent condition. In a few lots the perforation is as wide as half a millimeter (Hayesville, N. C.) but usually is less, as in the measurements given above.[95] The size of the shell and of the umbilicus are rather constant in the individuals of most lots, though varying in different localities.

V. gularis differs from *V. collisella* chiefly by the lower striation, *collisella* having sharper, more deeply cut sculpture. *V. cerinoidea* has a smaller and smoother shell, the striation weak; also, the two-toothed form is usually restricted to an earlier stage of growth.

---

[95] The measurements for showing the size of the cavity in the axis in this species were taken across the hole, not to the insertion of the columellar lip.

Say's specimens were from "Ohio and Pennsylvania." Two known localities in these states are represented by specimens in the Carnegie Museum, which Dr. Stanley T. Brooks has kindly allowed me to see: Tuscarawas Co., O., No. 62.21012, collected by Dr. Sterki, May, 1902, and Allegheny Co., Pa., No. 62.6780, collected by J. A. Shafer, 7-1-1938. This shell (Fig. 238f) is selected as a neotype, Say's specimens being lost. It is not quite fully adult. It resembles those from Jasper, Tennessee closely in shape, color, surface and perforation, but the columellar lamina is lower and more receding, so that it is not visible in a direct face view. Height 4.2 mm., diameter 7.3 mm., 7⅛ whorls.

The specimen from Tuscarawas Co., Ohio, is similar in having a receding columellar tubercle and minute perforation, but the last whorl is higher.

It appears that *gularis* extends northward in a rather narrow lobe west of the mountains, and the type thus came from this northern border of its range. At present these places are rather widely separated from the known Kentucky localities, the gap being occupied only by a specimen from Jackson Co., West Virginia, collected at least 70 years ago by the geologist W. M. Gabb. It should be looked for elsewhere in western West Virginia.

Pfeiffer's *H. bicostata* was said to be "almost closed perforate," 5 to 6.5 x 9.5 mm., with 7 whorls. As he called it "Die zweifelhafte Schnirkelschnecke," he seems to have had doubts as to its specific validity, and he afterward considered it a synonym of *H. gularis*.

Gratacap, in his catalogue of the Binney & Bland collection (Bull. Amer. Mus. N. H., 14:352), states that "A superb specimen from Kentucky, marked *major*, is five-eighths of an inch (15.87 mm.) in height." His adjective "superb" seems quite inadequate for such a monster; why not say "incredible"?

Ventridens gularis form *cuspidatus* (Lewis). Fig. 238h. "Very like Anthony's *cerinoidea* with this difference—the shells have two internal lamellar teeth, in some cases arising *obliquely* within the aperture and *pointing outwardly*, differing somewhat from the teeth of *gularis*." (Lewis.) "The internal tooth-like processes, strongly curved one towards the other, form almost an arched space. The umbilicus is entirely closed." (W. G. Binney.)

Lewis' description, reprinted above, is singularly insufficient, but Binney, who considered it a form of *gularis*, defined it briefly a few years later. As in typical *gularis*, the umbilicus is very minute or almost wholly closed. The outer basal lamina is high, its summit curving towards the basocolumellar lamina. However, there are so many lots in which the lamina is erect in some, curved in other examples, and the degree of curvature is so variable, that I cannot satisfactorily assort the series into *gularis* and *cuspidatus*. The latter seems to be merely a form which *gularis* may

assume in an area nearly coextensive with the species. It occurs in many lots from east Tennessee, from the region of Roan Mountain south to western North Carolina, northwestern Georgia and northern Alabama. Also in Pulaski Co., Kentucky.

Miss Law thus wrote from Philadelphia, Tenn., of this form: "Unlike *gularis* it seems to be a rare shell, and I find it only by scraping off the surface of the ground in the vicinity of damp mossy rocks. Its habits are more like *placentula* than *gularis*. Neither Miss Clara Bacome nor I ever mistake one for a *gularis*, even before picking it up; the thickened yellow splotch near the lip, and the thinner spot behind, showing the dark animal through it, as well as its more globular form, particularly on the base, make it look very different when alive."

A form of *gularis* which has a heavy callus but not laminae, with the closed umbilicus of typical *gularis*, is before me from Harriman, Roane Co., Tenn., measuring 6 x 9.1 mm., 7 whorls. These shells do not have the straightened columellar lip of *theloides*, and the umbilicus is more reduced, minute or closed. Further collections are needed for the elucidation of this form. (Fig. 238 e).

Form *nodus* (Fig. 238d), new form, has the aperture similar to *V. g. theloides*. It was taken in abundance by Dr. H. B. Baker on the Walden escarpment around Pikeville, Bledsoe Co., Tennessee. By the straightened columellar lip and thick toothless internal callus it would seem identical with *theloides*, except that the umbilicus is reduced to a very minute perforation. A high specimen (A.N.S.P. 165566) measures 5.7 x 8 mm., 8¼ whorls, many being lower. Two basal laminae are present in a young shell of 6.2 mm. diameter, 6¾ whorls. On account of its distribution and the reduced perforation this form is regarded as a modification of the *gularis* stock parallel to *theloides* rather than directly related to the latter. Similar shells are found at Pine Mountain, Harlan Co., Kentucky (W. Stone) and at Quicksand, Breathitt Co., Kentucky. Forms having a short outer-basal lamina but no columellar, noticed above, serve to connect it with *gularis*.

(*Gularis*, pertaining to the throat.)

Ventridens gularis theloides (Walker & Pilsbry) Fig. 239.

Gastrodonta gularis theloides A. D. Brown, Walker & Pilsbry, 1902, Proc. Acad. Nat. Sci. Phila., p. 434, pl. 25, figs. 1-4.

"Shell glossy, yellow, perforate, with moderately raised, dome-shaped spire, composed of 7½ to 8 narrow, closely coiled whorls; the last hardly angular at the periphery in adult shells; rather strongly striate above, nearly smooth beneath, with faint traces of spiral striae near the umbilicus, where the base is rather conspicuously excavated. *Aperture somewhat triangular, the sloping basal lip being straight.* The peristome is acute, strengthened within by *a rather wide, low callous rim. Adult shells are without teeth or laminae.* Alt. 4.5-5, diam. 7.5-8 mm.

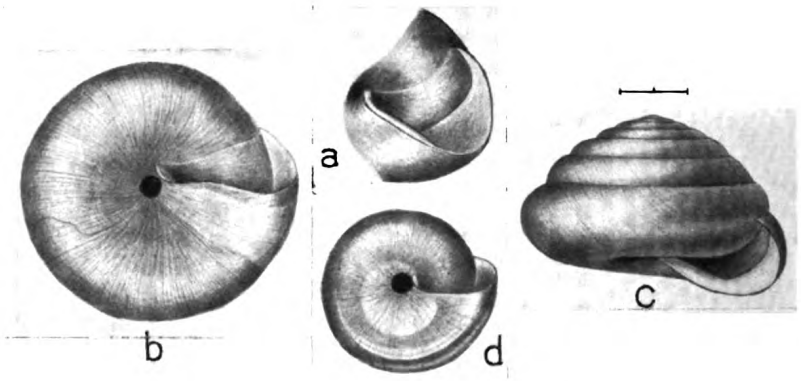

Fig. 239. *Ventridens gularis theloides*. b, c type, Bluff Mt., N. C. d, young topotype. a, aperture of specimen from A. D. Brown's collection. (Drawn by E. G. Vanatta.) Scale line = 2 mm.

"Young shells 5 to 6 mm. diam. [Fig. 339d] are nearly discoidal, with the umbilicus as wide as in adults, base glossy, sculptured like the adult shells, the aperture armed within with two long strong lamellae, the summit of the outer one curving toward the inner; there is also, in early stages, a smaller lamella peripheral in position." (Walker & Pilsbry.)

In a shell of 8 mm. diameter the umbilicus measures 0.8 mm.; and a young shell of 6 mm. also has an umbilicus of 0.8. The umbilicus is contained from 10 to 12 times in the diameter in adults.

North Carolina: Black Mountains, on Bluff Mountain, Type 83263 A.N.S.P. Also Meadow Cove, Wilson's, Cat-tail and Mt Mitchell (Walker & Ferriss). Georgia, without definite locality (Bland). Alabama: Roanoke, Randolph Co. (H. H. Smith).

This race was recognized by A. D. Brown many years ago and named in his collection (now 56914 A.N.S.P.), but it was never characterized by him. Fig. a is from one of his specimens; figs. b, c, d are from Bluff Mountain shells, collected by Walker.

It differs from *V. lawae* (W. G. B.) in the much narrower umbilicus; from *V. gularis* in being toothless in the adult stage, and with a more excavated base, straighter basal lip, and a wider umbilicus. No adult shell, in a large number examined, possessed internal laminae.

Many specimens from Roanoke, Alabama, seem to belong to this race, which is therefore to be looked for in the intermediate territory.

(Θηλοειδής, breast-shaped.)

Ventridens gularis decussatus (Walker & Pilsbry) Fig. 240.

Gastrodonta gularis decussata "Pilsbry & Vanatta," Walker & Pilsbry, 1902. Proc. Acad. Nat. Sci. Phila., p. 436, pl. 25, figs. 5-9, 13.

Ventridens gularis decussata Pils., G. S Banks, 1932. Nautilus, 44:139.

"Shell somewhat dull, brownish, *narrowly umbilicate,* with moderate or high, dome-shaped spire, composed of 8 flat whorls, the *last angular at the periphery.* Closely, sharply and strongly striate above, less so beneath, where there are usually *traces of spiral striae* near the periphery. Aperture lunate, peristome thin and acute, armed within with a blunt tooth on the middle of the columella, and *a high, short, erect lamella* within the outer-basal margin. Alt. 5.5, diam. 7.8 mm. Alt. 5, diam. 8.2 mm.

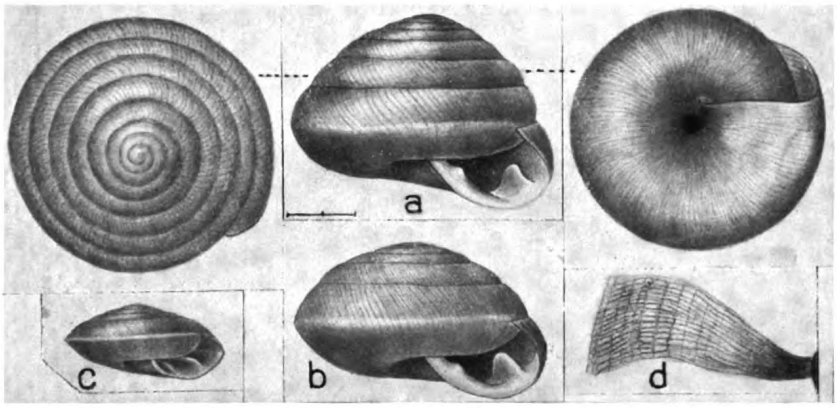

Fig. 240. *Ventridens gularis decussatus.* a, type, Mt. Mitchell, N. C. b, lower topotype. c, young shell from Bluff Mt., N. C. at d, a more enlarged segment of base. (Drawn by E. G. Vanatta.) Scale line for figs. a, b, c = 2 mm.

"Young shells (Fig. 240c, d, diam. 6 mm.) are biconvex, depressed, acutely angular or carinate, more strongly striate beneath than adults, and with the striae on the outer half of the base *decussated by many impressed spirals* (fig. d). The internal lamellae are long, as in the young of other forms of the *gularis* group." (P. & W.)

The width of the perforation is contained about 11 times in that of the shell.

North Carolina: Black Mountains, on Mt. Mitchell, Type 83265 A.N.S.P. Found at Tyson's and Wilson's coves, Potato Top, Cat-tail, Ivy River, Bee Tree Cove and on Bluff Mountain (Walker and Ferriss) Mountain N. W. of Waynesville, Haywood Co. (J. B. Clark). Recorded by Banks from Grandfather Mt., about 20 mi. east of Roan Mt.

This variety was recognized several years ago by Mr. Vanatta and myself among specimens collected by Hemphill, labeled "Black Mts., N. C." On account of the small number of specimens (two adult and one young), it was not defined at that time. The abundant material taken in 1901 by Walker and Ferriss placed the subspecies upon a secure basis. It differs from *G. gularis* and the racial forms subordinated to that species in the strong sharp sculpture, comparatively dull surface, the decussation and acute carination of the young shells, and the short, high, erect lamina of

the adult stage. Compared with *V. collisella* Pils., *decussatus* is seen to differ in the closer and flat whorls of the spire, flattened instead of swollen base, angular periphery, and larger umbilical perforation, but the sculpture of the spire is practically the same. Young shells resemble *V. intertextus* in sculpture.

Ventridens collisella (Pilsbry) Fig. 241.

Gastrodonta collisella Pilsbry, 1896, Nautilus, 9:123.—Walker, 1928, Terr. Moll. Alabama, p. 104.

Shell rather solid, minutely perforate, above elevated and somewhat dome-shaped, below rather flattened, the periphery rounded. Surface glossy, especially beneath, the base being radially finely wrinkled, and with faint traces of spiral striation in the slightly excavated umbilical region; upper surface sharply sculptured with irregular, arcuate wrinkle-riblets in the direction of growth-lines, and stronger toward the suture. Whorls $7\frac{1}{2}$, slightly convex, separated by very shallow sutures, which, under the lens, seem margined below by the partial transparence of the shell in some specimens.

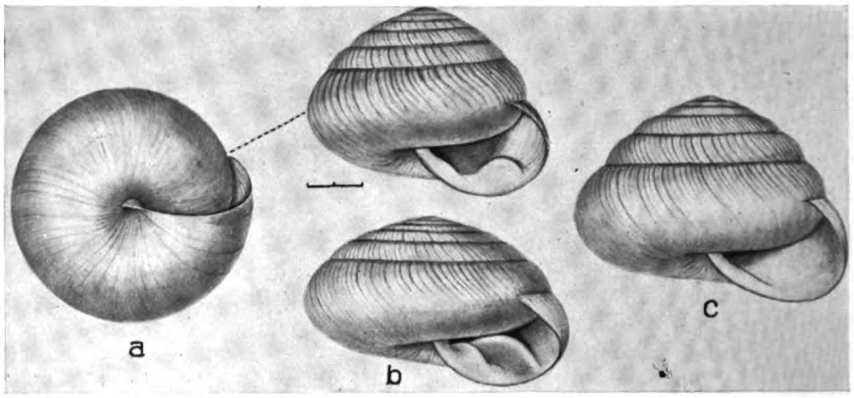

Fig. 241. *Ventridens collisella*. a, b, Knoxville. c, Elizabethton, Tenn. Scale line = 2 mm.

Aperture mainly basal, lunate, with a lining of white callus a short distance within, heavier and bearing a small tooth (often wanting) on the columellar slope, and a rather short white entering lamina toward the outer part of the base. Lip-edge thin and acute, suddenly expanded at the columellar insertion, half covering the umbilical perforation.

Height 7.2 mm., diameter 8.7 mm.; $7\frac{1}{2}$ whorls. Type.
Height 7.4 mm., diameter 9.1 mm. Huntsville.
Height 8.1 mm., diameter 9.6 mm.; $7\frac{1}{2}$ whorls. Elizabethton.
Height 7.1 mm., diameter 8.5 mm. Citico.
Height 6 mm., diameter 8.4 mm. Harriman.
Height 6 mm., diameter 9.1 mm. Harriman.

VIRGINIA: Lexington and Natural Bridge, Rockbridge Co.; 4 mi. E. of Blackwater, Halifax Co. TENNESSEE: Elizabethton and Valley Forge, Carter Co. Johnson City, Washington Co. Citico, Monroe Co. Knoxville, Type 67594 A.N.S.P., and elsewhere in Knox Co. Harriman, Roane Co. Lookout Mt., Hamilton Co. South Pittsburgh, Marion Co. ALABAMA: Huntsville, Madison Co. (and, according to Walker, Paint Rock, Jackson Co., Gurley and Monte Sano, Madison Co.).

This snail is known by its sharp striation, which almost alone separates it from *V. gularis;* but the distinction remains constant in a large number seen. The minute size of the half-covered axial perforation is also constant. It has often been identified as *V. gularis.*

The columellar callus may bear a blunt entering lamina or a small node, or there may be no prominence, merely a thick columellar callus. In the lot from Elizabethton, Carter Co., Tennessee (B. Walker, 1904), the largest shells may have a well developed outer-basal lamina, or it may be represented only by a low ridge on the basal callus, as in Fig. 241c, measuring 8.4 x 10 mm.

A single shell (diam. 7.6 mm.) specimen from Mt. Mitchell, N. C., 1901, was found among shells received from Mr. Ferriss; but as Bryant Walker failed to notice this species in his paper on that expedition, I hesitate to add Mt. Mitchell to the range of *collisella.*

This is probably the *Zonites* Sterki discussed in 1893, Nautilus, 7:14, paragraph 3.

(Name a diminutive of *collis,* a hill.)

Ventridens cerinoideus (Anthony) Fig. 242.

Helix cerinoidea Anthony, 1865, Amer. Jour. Conch., 1:351, pl. 25, fig. 4.

Zonites cerinoideus Anthony, W. G. Binney, 1878, Terr. Moll., 5:111, fig. 30, pl. iii, fig. B, teeth.

Shell narrowly unbilicated, orbicularly convex, thin, of a waxy horn-color, closely and finely ribbed; whorls 7, convex, the last one inflated; umbilicus narrow, nearly covered by the columellar lip; aperture semi-circular; lip not reflected, margins connected by a thin white callus. *Habitat.*—North Carolina. (Anthony.)

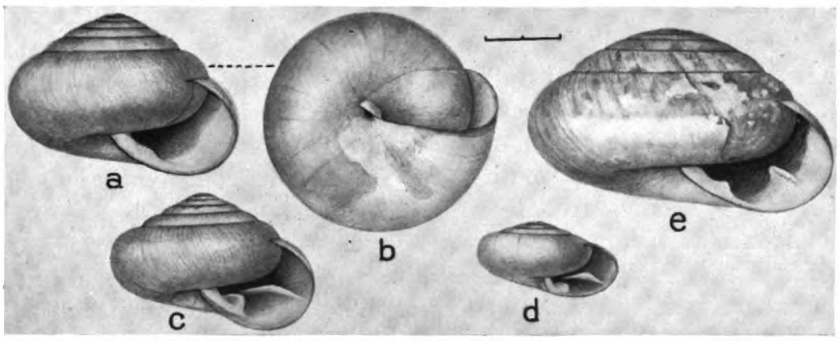

Fig. 242. *Ventridens cerinoideus.* a, b, c. Southport, N. C. d, Gainesville, Fla. e, Yemassee, S. C. c and d immature shells. Scale line = 2 mm.

The shell is very minutely perforate, depressed, with conic spire, rounded periphery, the base a little impressed around the axis; pale yellow, somewhat translucent except in a segment near the aperture, which is opaque buff. Surface glossy, closely marked with fine growth-wrinkles, which are much weaker on the base, where there is superficial spiral striation, varying from distinct to very weak. The aperture is lunate; the sharp lip is minutely dilated at the axial insertion, partly closing the perforation. Inside there is a white callous lining extending inward about the fifth of a turn.

Height 5.3 mm., diameter 7.3 mm., 7 whorls; Southport, N. C.
Height 4.8 mm., diameter 7.2 mm., 6¾ whorls; Columbia, S. C.
Height 5.5 mm., diameter 9 mm. Yemassee, S. C.

In immature shells there is an entering outer-basal lamina and a stout, outwardly leaning columellar fold. (Fig. 242c).

North Carolina: 1½ mi. inland from Southport, Brunswick Co.; near Greenfield Pond, Wilmington, New Hanover Co. (Pilsbry); Beaufort, Carteret Co. (W. E. Barnett). South Carolina: Charleston (Clench & Rehder); Yemassee, Beaufort Co. (J. B. Henderson); Columbia, Richland Co. (S. N. Rhoads). Georgia: Savannah (Pilsbry); base of Stone Mountain near Atlanta (J. M. Clark). Florida: Callahan, Nassau Co. (Hemphill); Imri, Hamilton Co. (E. B. Chope); Ochlockonee River, Leon Co. (C. W. Johnson); Quincy, Gadsden Co. (Van Hyning); near Wakulla River, Wakulla Co. C. B. Moore); Gainesville and elsewhere in Alachua Co. (Van Hyning). Alabama: Wetumpka, Elmore Co. (H. H. Smith). W. G. Binney gives additional localities: Norfolk, Va., New Bern, N. C. and Jacksonville, Fla.

It is nearly always smaller than any form of *V. gularis*, the spire is lower and the striation of the glossy surface quite fine.[96] Teeth have not before been mentioned for this snail, but they are present, though rather small, in one of the two specimens we have from Anthony, and are to be seen in all lots containing immature individuals. In some lots they occur in shells up to a diameter of 5 mm., 5 whorls (Savannah), in others only up to about 4 mm., but rarely up to the full size attained by the species, as in a giant of 9 mm., from Yemassee (Fig. 242e), other adults of 8 mm. diameter in the same lot being toothless.

Anthony's locality for *H. cerinoidea* was North Carolina. The source of his material was not stated. We select Southport as the type locality.

V. cerinoideus is the coastal plain *Ventridens*. Its line of contact with the montane *gularis* group has not been ascertained, as with the possible exception noted below, the known localities are rather remote. In Florida it appears to be abundant south to Alachua County, but hardly enters the peninsula. It was not recorded from Alabama by Walker, but was taken in abundance at Wetumpka. A few specimens from Blount Springs, Cullman and Valley Head (H. H. Smith), appear referable to *cerinoideus*, but the basal callus is heavier, and I would like to see more material before extending the range of the species into northern Alabama.

(*Cerinus*, wax color.)

[96] Certainly not "ribbed" as Anthony's very poor description has it.

Ventridens lawae (W. G. Binney) Figs. 243, 244.

Zonites placentula (Shuttl.), W. G. Binney, 1878, Terr. Moll., 5:124, pl. 3, fig. 1 (teeth) and remarks, not the description.

Zonites (Hyalina) placentula Shuttl., Gratacap, 1901, Bull. Amer. Mus. N. H., 14:350.

Zonites lasmodon var.?, W. G. Binney, 1879, Ann. N. Y. Acad. Sci., 1:358, 362, pl. 15, fig. E.

Zonites lawi W. G. Binney, 1883, Bull. Mus. Comp. Zool., 11:142, pl. 2, fig. E; 1885, Man. Amer. Land Sh., p. 221, fig. 235.

Zonites lawae W. G. Binney, 1892, 4th Suppl., Bull. Mus. Comp. Zool., 22:167 (first description).

Gastrodonta gularis lawae (W. G. B.), Walker & Pilsbry, 1902, Proc. Acad. Nat. Sci. Phila., 54:435, pl. 25, figs. 10-12.

"Shell small, umbilicated, globose, flatter below, shining, light horn-colored, marked with coarse wrinkles of growth; spire rounded; whorls 8, gradually increasing, slightly convex, the last excavated below around the umbilicus; aperture oblique, rounded; peristome simple, acute, thickened with callus within. Greater diameter 9 mm., lesser 7 mm.; height 4 mm." (W. G. Binney, 1892.)

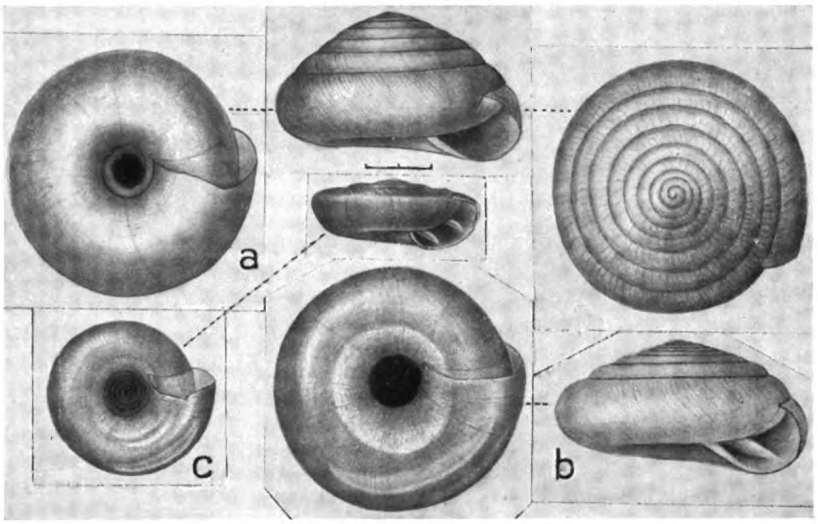

Fig. 243. *Ventridens lawae*. a, type, 294 B. & B. coll., Amer. Mus. N. H. b, adult of laminate form, N. side French Broad river, Paint Rock, N. C. c, young shell of same lot. (Drawn by E. G. Vanatta.) Scale line = 2 mm.

"The shell is yellow, glossy, with moderately elevated, dome-like spire, composed of 8 closely coiled whorls; surface rather closely wrinkle-striate, the striæ strongest near the suture, weaker below, where a few faint spiral striæ may be traced. Last whorl rounded, hardly angular, even in front. *Umbilicus wide, open, deep and well-like*, the bases of the first whorls visible in its depth. Aperture small, irregularly lunate; peristome acute, strengthened within by a rather thin, diffused white callus, which becomes heavier

within the columellar margin, making a slight convexity or low boss near the axis. Columellar margin somewhat straightened. Alt. 4.7, diam. 7.8 mm., width of umbilicus 1.3 mm." (Walker & Pilsbry.)

TENNESSEE: Cherokee Nat. Forest, Polk Co. (A. F. Archer). Monroe Co. (Annie M. Law), Type 294 B. & B. Coll., Amer. Mus. Thunderhead Mt., Blount Co. Gatlinburg, Sevier Co. NORTH CAROLINA: Paint Rock, on both sides of the river, Madison Co. Bluff Mt. (Walker & Ferriss). Near Warne, Clay Co. (A. F. Archer).

V. lawae has a wider umbilicus (contained typically 5 or 6 times in the diameter) than any of the forms referred to *gularis*, and it is not so wide as in *V. lasmodon*.

The above descriptions and figures 243a represent the type shell No. 294 of the Binney and Bland collection, American Museum of Natural History, the same specimen which Binney figured in 1879, 1883 and 1885. This differs from most others seen in being without internal laminae. Another specimen from Monroe County, also collected by Miss Law, differs by having a small outer-basal lamina on the rather heavy callus within the basal lip. The columellar callus also is rather heavy but not toothed or laminate. This is probably the normal adult form, the toothless specimen taken as a type being rather in the gerontic stage, or past the ordinary condition of maturity. The toothless form is from Monroe County, Tennessee, where it was collected by Miss Annie M. Law, together with specimens provided with an internal lamina. These were distributed to Mr. Binney, Dr. James Lewis, and probably others. The Lewis collection was sold, and there are specimens from that source in the collections of George H. Clapp, G. K. Gude, the Academy of Natural Sciences, and others.

Shells from the northern part of the range of *lawae*, around Paint Rock, Madison Co., N. C., are drawn in Figs. 243 c, young, and 243 b, adult specimens. All seen have a long outer-basal lamina, and usually there is a small, deeply placed lamina on the columellar callus about at its lower third. This is immersed too far to show in Fig. b, and in some shells it is obsolete, leaving the columellar callus plain. The umbilicus is variable, contained from about 4.2 to 6.4 times in the diameter of adult shells. In young ones it is relatively wider, as it is rather well-like, not " perspective " as in *lasmodon*. Height 4.7 mm., diameter 8.3 mm.; 8 whorls.

The young shells (Figs. 243 c, diameter 5 mm.) have a long outer lamina, a shorter baso-columellar lamina, and in an earlier neanic stage, a small upper-palatal fold. The umbilicus is broad, and the periphery situated high on the last whorl.

A lot from 2 miles southeast of Gatlinburg, Sevier Co., Tennessee (Archer), consists of smaller laminate shells, about 4.1 × 7 mm., the umbilicus contained 5 times in the diameter. In specimens from Ocoee Gorge east of Parksville, Polk Co. (Cherokee National Forest), the shells are less widely umbilicate than other *lawae* seen, umbilicus (measured to insertion

of lip) contained 6.4 times in diameter. Most of the large specimens, 8 to 8.3 mm. diameter, have a long outer-basal lamina and a small one on the columella, Fig. 244 b, but one large shell, height 5 mm., diameter 8.5 mm., 8 whorls, has only a short lamina, none on the columella.

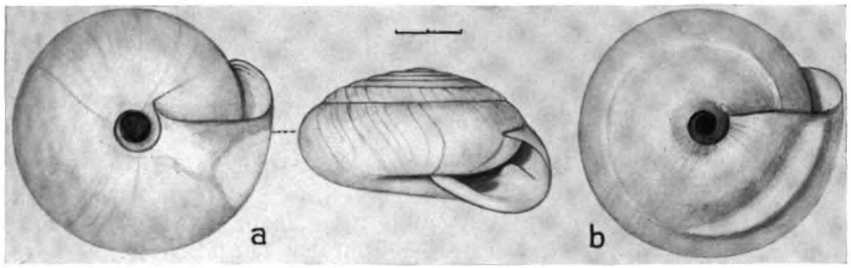

Fig. 244. *Ventridens lawae*. a, west of Warne, Clay Co., N. C. b, Cherokee National Forest. Scale line = 2 mm.

In the adjacent Clay Co., N. C., 3 miles west of Warne, Dr. A. F. Archer collected a less narrowly umbilicate form in abundance. In the fully adult stage there is a rather narrow callus in the lip, bearing a short outer-basal lamina, the columellar border either plain or with a small nodule. The umbilicus, measured to insertion of lip, is contained 6 times in the diameter. In immature shells the outer-basal lamina is long and there is a small columellar lamina. Height 4.5 mm., diameter 8.2 mm.; $7\frac{2}{3}$ whorls (Fig. 244 a).

Bryant Walker and the writer, about forty years ago, thought that *lawae* might be a subspecies of *V. gularis;* but in the absence of an intergrading series in the far larger collections now at hand, the specific status seems indicated, though their close relationship is obvious.

(Named for Annie M. Law, schoolteacher, musician and naturalist, who discovered this together with other beautiful snails of the southern Appalachians. Nautilus, 17:86.)

Ventridens lawae cumberlandicus new subspecies Fig. 245.

The shell is umbilicate, the umbilicus contained 5.8 to 6.2 times in the diameter, of somewhat translucent olive lake or more yellowish color, with an opaque buff area behind the basal lip. The closely coiled spire has the shape of a low dome (but varies in elevation as in the figures); the last whorl is rounded peripherally, rather deeply impressed around the umbilicus. The surface is glossy, striate about as in *V. lawae.* The lunate aperture is rather strongly oblique, in the adult stage rather heavily calloused within, without laminae; the columella margin somewhat straightened, thickened within. Lip edge sharp, as usual.

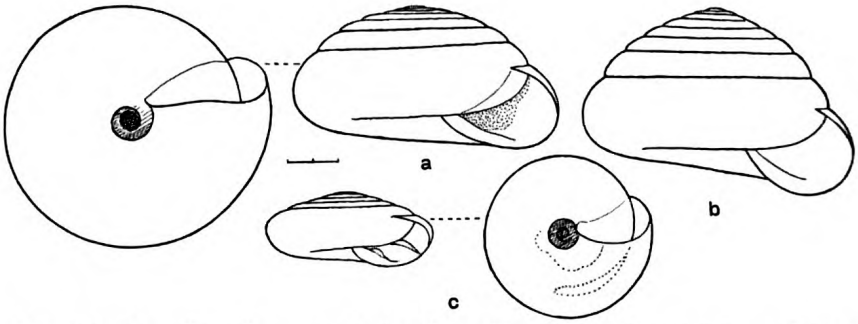

Fig. 245. *Ventridens lawae cumberlandicus.* Type (a) and paratypes. c, immature stage. Scale line = 2 mm.

In the neanic stage there is a small tubercle or short lamina on the columella and a deeply placed outer-basal lamina (Fig. 245 c).

Height 4.5 mm., diameter 8.8 mm.; 8 whorls.
Height 6.2 mm., diameter 9 mm.; $8\frac{1}{2}$ whorls.
Height 4.5 mm., diameter 8.5 mm.; $7\frac{3}{4}$ whorls.
Height 4.8 mm., diameter 9 mm.; 8 whorls. Type.

TENNESSEE: 7 miles east of Smithville, DeKalb Co. (Pilsbry, Sept., 1935).

This snail of the Cumberland plateau stands very close to *V. lawae* of the Blue Ridge province, but it differs in several details. The base is more flattened within the central concavity, being convex there in *lawae*. The neanic stage has a narrower umbilicus, that of *lawae* being about as wide as in the adult (cf. Fig. 244 c). 24 specimens taken.

Ventridens coelaxis (Pilsbry) Fig. 246.

Zonites . . . new, Sterki, 1893, Nautilus, 7:15, paragraph 6.
Gastrodonta coelaxis Pilsbry, 1899, Nautilus, 12:140.

"Shell rather widely umbilicate, the width of umbilicus contained 6 to $6\frac{1}{2}$ times in the greatest diameter of the shell; thin, somewhat fragile, yellow-corneous, sub-transparent, the last suture readily visible through the base; much depressed, the periphery subangular, upper surface convex; surface glossy, sculptured with irregular wrinkles in the direction of growth lines

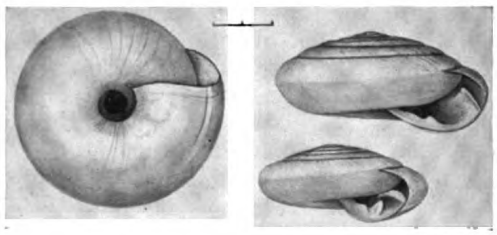

Fig. 246. *Ventridens coelaxis,* Cranberry, N. C. Scale line = 2 mm.

above, almost smooth beneath, and in favorable lights showing subobsolete spiral striae. Whorls 6½, slowly widening, a little convex, the last moderately convex below. Aperture oblique, irregularly lunar, deeply excised by the preceding whorl, not calloused inside, two-toothed a short distance within; one thin and rather short lamella projecting from the lower part of the outer wall, and another smaller one from the middle of the baso-columellar wall; both sometimes wanting; peristome thin and sharp, the outer margin well rounded, baso-columellar margin straightened. Umbilicus well-like, but widening at the opening and showing the penultimate whorl." (Pilsbry.)

Height 3 mm., diameter 6.6 mm., 6¾ whorls; umbilicus contained 6.13 times in diameter. Type.

North Carolina: Cranberry, Avery Co (Mrs. George Andrews), Type 75730 A.N.S.P.

This snail is rather fragile for its group, thinner, smaller and more depressed than *V. lawae,* and with a narrower umbilicus than *V. lasmodon.* The periphery is bluntly subangular.

In the neanic stage (lower figure) the two laminae are strongly developed, longer than in adult shells, and there is a nodule on the columellar callus, strongly developed in some shells, but quite weak in others. It is a rare snail, one of Mrs. Andrews' many prizes.

(Κοῖλος + *axis,* hollow axis.)

Ventridens lasmodon (Phillips) Fig. 247.

Helix lasmodon J. S. Phillips, 1841, Proc. Acad. Nat. Sci. Phila., 1:28; 1842, Jour. Acad. Nat. Sci. Phila., 8:182.—Binney, 1851, Terr. Moll; 2:254, pl. 37, fig. 2.

Zonites lasmodon Phillips, W. G. Binney, 1878, Terr. Moll., 5:131, pl. iii, fig. o (dentition. Suggests that the name should be *elasmodon*).

Zonites elasmodon W. G. Binney, 1885, Man. Amer. L. Sh., 227, in synonymy of *Z. lasmodon* (emendation).

Zonites macilentus Shuttleworth, 1852, Mittheil naturforsch. Ges. Bern, Nr. 248, p. 195 (Tennessee orientali).

"Shell moderately elevated, lenticular; rather thick; epidermis pale whitish horn color, smooth, shining; whorls eight, very faintly and obliquely striated; suture indistinct; aperture compressed; within a broad calcareous

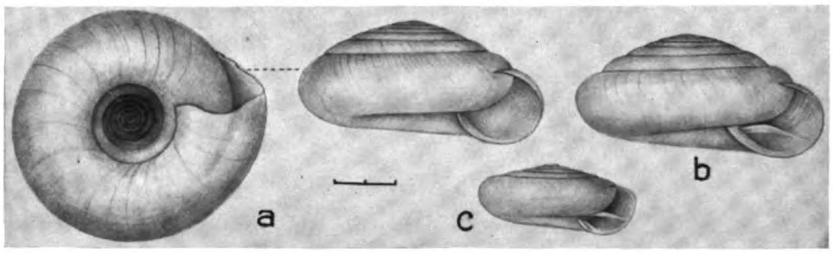

Fig. 247. *Ventridens lasmodon.* a, b, Knoxville. c, Knox Co., Tenn., young shell. Scale line = 2 mm.

deposit, and one or two lamellar teeth following the direction of the whorls; lip acute; umbilicus moderately large, rounded and deep; base regularly rounded into the umbilicus. Transverse diameter seven-twentieths, height three-twentieths of an inch. Brought from Alabama by Dr. W. Blanding." (Phillips.)

TENNESSEE: Head of Sequatchie Valley, Cumberland Co. (Clench & Archer). Knoxville (Mrs. Geo. Andrews), and north of Fountain City (H. B. Baker), Knox Co. Dove, Marion Co. (H. B. Baker). Monroe Co. (Mrs. Andrews). Oakdale, Morgan Co. (Ferriss). Harriman, Roane Co. (H. E. Sargent). Gatlinburg, Sevier Co. (Clench & Archer). Near Fall Branch, Sullivan Co (Clench & Archer). ALABAMA: (Dr. W. Blanding). St. Clair Co. (T. Bland, 1867).

The most conspicuous differential feature of this snail is the wide umbilicus, contained from 3 to 3½ times in the diameter of the shell. The closely wound whorls of the spire are finely but distinctly wrinkle-striate, the striae weaker on the base, which is well rounded with a perspective umbilicus, which is nearly as wide as the aperture. Phillips calls it " rather thick," but fresh shells are rather thin. The lunate aperture has a rather deeply placed entering outer-basal lamina and a rather heavy callus on the columella having a low, blunt prominence in its upper part.

In some of the largest examples seen the outer-basal lamina has disappeared, only the columellar callus remaining; and sometimes this condition is found individually in lots containing equally large laminiferous shells.

Height 3.8 mm., diameter 7.8 mm. 7¾ whorls. Knoxville.

Height 3.7 mm., diameter 7.5 mm. 7½ whorls. Knoxville.

In a mid-neanic stage, diameter 5 mm., 5⅓ whorls, the outer-basal lamina and the columellar callous prominence are relatively larger, and there is a well-developed though small inner-basal lamina (Fig. 247 c); this lamina diminishes and finally disappears a variable time before complete maturity.

In most lots seen, including a neotype from St. Clair Co., Alabama, the outer-basal lamina is present, though often small, in the largest specimens collected, so that it seems that disappearance of both laminae is not an invariable feature of the adult stage, but may sometimes supervene only in old age. The inner-basal lamina of youth is not upon the columellar callus as in most *Ventridens,* but at its foot.

" Alabama " was the original record, and no definite locality in that state is yet known. I am using a specimen from Bland, diameter 7.5 mm. from St. Clair Co., as a neotype (No. 57126 A.N.S.P.), as Phillips' original example seems to be lost.

(Ἔλασμα, ὀδούς, lamina tooth.)

V. LIGERA GROUP (*Ventricallus,* new section)

Often larger than typical *Ventridens,* the aperture toothless or with an outer-basal lamina, but having no columellar tooth or lamella at any stage of growth. Type *V. ligera* (Say).

This group occupies a larger area than *Ventridens* proper, from Ontario to Florida and west to eastern Oklahoma.

Ventridens demissus (Binney) Fig. 248.

Helix demissa Binney, 1843, Boston Jour. N. H., 4:361, pl. 16, fig. 1 (Western Pennsylvania); 1851, Terr. Moll., 2:232, pl. 42, fig. 1.

Zonites demissus Binney, W. G. Binney, 1878, Terr. Moll., 5:104; 1885, Man. Amer. L. Sh., pp. 212, 477, fig. 223; 1883, Bull. Mus. Comp. Zool., 11:138.

Gastrodonta demissa (Binn.) Pilsbry, 1900, Proc. Acad. Nat. Sci. Phila., p. 142.—Walker, 1906, Ill. Cat. Moll. Mich., 1:487; 1928, Terr. Moll., Alabama p. 102.

Ventridens demissus (Binney) F. C. Baker, 1939, Fieldbook Ill. Land Snails, p. 82. —Archer, Nautilus, 47:149 (Sinistral).

"Shell depressed-convex; epidermis yellowish horn-color, shining; whorls six, with minute lines of growth; spire obtuse; suture impressed; body-whorl expanding very little towards the aperture; aperture transverse, not large,

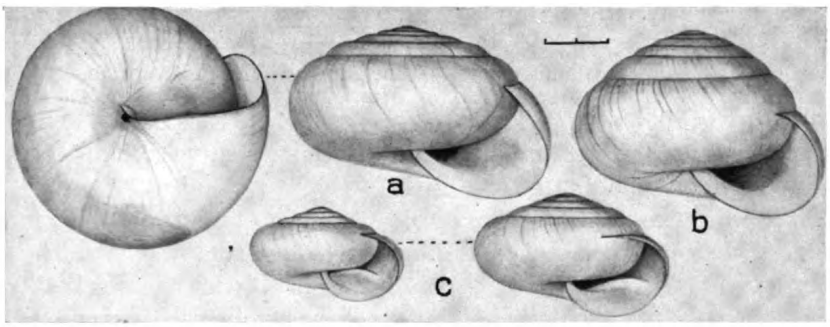

Fig. 248. *Ventridens demissus*. a, Flint Ridge, Licking Co., Ohio. b, Belmont Co., Ohio. c, two young shells, Tuscarawas Co., Ohio. Scale line = 2 mm.

a white, testaceous deposit within; lip thin, acute; base rather flat, smooth; umbilicus very small; umbilical region a little impressed. Greatest transverse diameter rather more than three-eighths of an inch." (Binney.)

Typical *V. demissus* from eastern Ohio and western Pennsylvania is rather small, 7.5 to 9 mm. diameter, usually quite depressed (Binney's type shaped about as in Fig. 248 a), but there are some convexly conic individuals also. It is minutely perforate. The adult stage has a thick white lining within, showing buff externally on the last fourth of the base. After the smooth initial $1\frac{1}{2}$ whorls it is distinctly and rather finely striate, the striae becoming somewhat more widely spaced on the last one or two whorls.

The young shells have a strong, entering outer-basal lamina, the columella being simply concave (Fig. 248 c). When about 5.5 mm. diameter the lamina is lower, like a prominent edge of the basal callus. This form of the lamina is often seen also in smaller shells.

Height 4.8 mm., diameter 7.8 mm.; 6 whorls. Licking Co., O.,
Height 5.8 mm., diameter 7.5 mm.; $6\frac{2}{3}$ whorls. Belmont Co., O.
Height 5.4 mm., diameter 9 mm.; $6\frac{3}{4}$ whorls. Wise Co., Va.
Height 6.8 mm., diameter 10 mm.; 7 whorls. Wayne Co., Ky.
Height 6.3 mm., diameter 10.4 mm.; $6\frac{3}{4}$ whorls. Davidson Co., Tenn.

PENNSYLVANIA: Western part (Binney, type loc. Type 38842 U.S.N.M.). Alleghany Co. (G. H. Clapp in Carnegie Mus.) Reported by Wurtz from Fayette Co. OHIO: Licking and Belmont counties (A. F. Archer.); near Port Washington; Tuscarawas Co. (Sterki.) MICHIGAN: Kent Co., according to Walker. INDIANA: Lake Co. according to Goodrich. ILLINOIS: Shelby and Effingham counties, according to F. C. Baker. VIRGINIA: Natural Bridge, Rockbridge Co. (Pilsbry); Newport News, Warwick Co. (S. N. Rhoads); 12 miles S. W. of Pulaski, Wythe Co., and Big Stone Gap, Wise Co. (Clench & Archer). WEST VIRGINIA: Wirt Co. (W. J. Fox). Slagle, Logan Co. (S. T. Brooks). KENTUCKY: Bowling Green, Warren Co. (L. E. Daniels); near Monticello, Wayne Co. (B. R. Bales). NORTH CAROLINA: Reported from Town Mountain near Asheville by Bryant Walker. Stratton Bald, Graham Co. (H. E. Sargent). TENNESSEE: Bledsoe, Blount, Davidson, DeKalb, Morgan and Roane counties. GEORGIA: Chatsworth, Murray Co. (C. C. Allen); near Presly, Towns Co. (Jesse White). FLORIDA: Baily's Ferry, Chipola R., Calhoun Co.; Marianna, Jackson Co. North of Havana and Jackson's Bluff, Ochlochnee River, Gadsden Co. (C. W. Johnson). Chatahoochee and Quincy, Gadsden Co. (Van Hyning). Cedar Keys, according to W. G. Binney. ALABAMA: Baldwin, Calhoun, Clarke, Cleburne, Elmore, Etowah, Jackson, Jefferson, Madison, Mobile, Montgomery, Perry, Shelby, Talladega and Tuscaloosa counties. (Walker records it also from the following counties: Bibb, Blount, Choctaw, Conecuh, Cullman, Dallas, Franklin, Greene, Lauderdale, Macon, Marengo, Monroe, Pickens, St. Clair, Sumter, Walker, Washington and Wilcox.) MISSISSIPPI: Jackson Co. near mouth Pascagoula River (C. B. Moore).

Specimens seen from Virginia, West Virginia, Kentucky and Tennessee are like those of Ohio, but often a little larger.

The young stages are not well represented in our lots from Tennessee, but there is a specimen of 7 mm. diameter from Cades' Cove which has a rather low outer-basal lamina; an adult shell of this lot measures 10.5 mm. Alabama lots seen, though abundant, are deficient in young shells. Those down to 5 or 6 mm. in several lots are toothless.

This snail is abundant in western (non-peninsular) Florida, where it is often over 10 mm. in diameter, a specimen from Marianna measuring 6.5 × 11.4 mm.; $6\frac{1}{2}$ whorls. In several hundred shells examined, some less than 2 mm. diameter, not one was found having a lamina in the mouth.

In Alabama, as in the north, some lots show wide variation in the elevation of the spire, but everywhere the more depressed shells predominate; two specimens from a Tuscaloosa lot measure:

Height 5.3 mm., diameter 8.7 mm.; $6\frac{3}{4}$ whorls.
Height 6.8 mm., diameter 8.7 mm.; $7\frac{1}{2}$ whorls.

A sinistral example was taken by Henry Van der Schalie near Duncanville, Tuscaloosa Co., Alabama.

(*Demissus,* depressed.)

Ventridens demissus brittsi (Pilsbry) Figs. 249, 250.

Zonites brittsii Pilsbry, 1892, Nautilus, 5:99 (Hot Springs, Ark.).

Gastrodonta demissa var. *lamellata* Pilsbry, 1900, Nautilus, 13:107 (Tuskahoma and Poteau, I. T.).

G. demissa and var. *brittsi* and *lamellata* Pilsbry, 1900, Proc. Acad. Nat. Sci. Phila., p. 456; 1903, ibid., p. 213.—Ferriss, 1900, Nautilus, 14:31.

Zonites demissa Binn., *brittsi* Pils. and *gularis* Say, Sampson, 1894, Ann. Rep. Geol. Surv. Ark. for 1891, 2:182, 183

Zonites acerra Lewis, Simpson, 1888, Proc. U. S. Nat. Mus., 11: 451 (Fort Gibson, I. T.).

Gastrodonta demissa brittsi Pilsbry & Ferriss, 1906, Proc. Acad. Nat. Sci. Phila., p. 558, figs. 2, 3.

"Shell *imperforate, depressed, obtusely angled at the circumference,* about equally convex above and below. Color yellowish-green, somewhat translucent, becoming light straw-yellow and opaque on the last fourth of the last whorl. Surface shining, having oblique striae under the sutures, the growth lines being quite light on the rest of the surface; base seen under a lens to be *very densely concentrically striated.* Whorls 6. Base slightly indented at the axis. Aperture slightly oblique, depressed-lunar, *the outer and basal walls lined with a heavy, opaque-white calcareous layer.*" (Pilsbry.)

Height 4.7 mm., diam. 8.8 mm. Type of *brittsi.*

Height 6 mm., diameter 10.8 mm.; 7 whorls. Adult, Hot Springs.

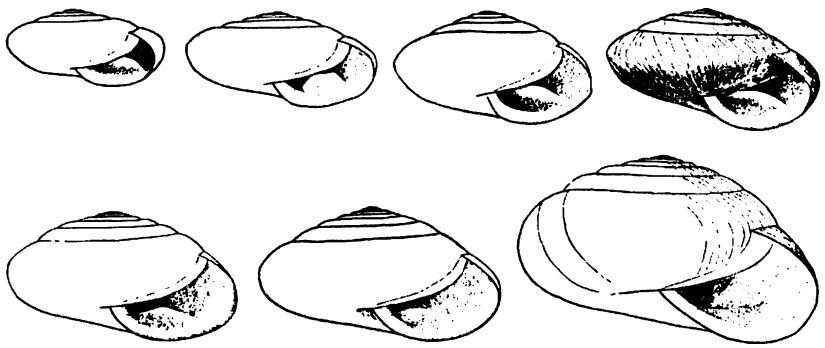

Fig. 249. *Ventridens demissus brittsi,* Hot Springs; series showing changes with growth, × 4.

MISSOURI: Chadwick, Christian Co. (Pilsbry). ARKANSAS: Many places in Garland, Hot Springs, Logan, Montgomery, Polk, Sebastian, Sevier and Washington counties (Britts, Ferriss, Pilsbry and Archer). OKLAHOMA: Wister and Sugarloaf Mt., Le Flore Co. (Pilsbry), Page, Le Flore Co. (Archer); Tuskahoma, and near Finlay, Pushmataha Co. (Ferriss & Pilsbry). LOUISIANA: Grand Cane, De Soto Parish (Geo. Williamson); Mt. Lebanon, Bienville Parish (R. Walton); Calcasieu Parish near Lake Charles (Pilsbry).[97] TEXAS: "A carinate variety [of *demissus*] was found 20 miles north of Beaumont (Wetherby)." (J. A. Singley.)

The above description is that of the original specimens of *brittsi,* now known to be immature. A laminate example of the same species, also immature, was described later as *demissa* var. *lamellata.* With further collections it became clear that both are varying states of a race which becomes higher than *V. demissus,* and about 10 or 11 mm. diameter in the type locality, Hot Springs, Arkansas.

The shell varies from imperforate to perforate as in *V. demissus;* the periphery is well rounded in adults, and the basal and outer walls of the aperture have a white callous lining, showing yellow outside on the last third of the base, the rest of the shell being olivaceous. Young shells usually have at some stage of growth an entering callous lamina within the basal lip, at

[97] Louisiana specimens may belong to the coastal plain *demissus* proper; those seen do not show the special characteristics of *brittsi,* but no large lots are at hand.

the position of the similar lamina in *V. gularis.* "In any good series from one place, it is found that some shells possess the basal lamina within the mouth, and that while these shells may be of various sizes, *they fall short of the maximum size of the toothless individuals found with them.* In the fully adult shells from any colony the lamina has always been absorbed, so far as our experience goes. But specimens of any size may also want the lamina; so that the laminate stage is a transitory feature appearing sooner or later, or it may not be developed at all in many individuals.

In one lot of 24 shells from Hot Springs, 1901, the largest one showing a lamina is 8.5 mm. in diam., and the lamina is very low, hardly noticeable. All of the 7 from this size down to the smallest (5.5 mm.) are laminate, most strongly so in the youngest. None of the larger shells (16 individuals, up to 10 mm. diam.) show a lamina. Fig. 249 represents a series of these shells, drawn to the same scale." (Pilsbry & Ferriss.)

In another lot of 22 specimens from Hot Springs, 1935, running from 5.8 to 10.3 mm. diameter, only 2, of 7.3 and 8.2 mm., have a small lamina. In some colonies the laminate stage persists in somewhat larger shells than above indicated.

Large forms of *V. d. brittsi.*—In Garland Co., Arkansas, the shells are a little larger, up to about 12.5 mm. diameter. Similar ones were taken in Christian Co., Missouri. Shells from Mena, Polk Co. measure up to 9 × 13.8 mm., slightly over 7 whorls; the young ones, 5 to 7 mm., being laminate (Fig. 250).

Fig. 250. *Ventridens demissus brittsi.* Mena, Ark. The outline figures are actual size.

A series of 27 shells up to 10 × 14 mm., 7 whorls, was taken by A. F. Archer on Rich Mountain, Polk Co., Ark. None of several young, down to 6 mm. diameter is lamellate, but some have a heavy basal callus about half filling the aperture. These large Arkansas shells resemble *V. acerra* very closely in size and color, almost the only difference being that the umbilical perforation is very narrow or closed. *V. acerra* is a little more openly perforate, and in the young the basal lip is not laminate or heavily calloused. Simpson's record of *Z. acerra* from Fort Gibson, Muskogee Co., Oklahoma, was doubtless this large form of *brittsi,* though he gave no details.

The status of this subspecies is dubious, resting upon the usual occurrence of specimens laminate or very heavily calloused within up to eight-tenths the adult size, while in the further evolved *demissus* laminate shells are small and rather rare, or in some regions apparently absent. In the range of variation it differs from eastern *demissus;* but it is true that many western individuals can be selected which seem quite indistinguishable from eastern *demissus*. However, we are allowing the race from west of the Mississippi living room at this time, with the warning that its standing may be thought insecure, as no invariable difference has been demonstrated.

(Named for John H. Britts a shell collector of Clinton, Missouri in the Nineties.)

Ventridens acerra (Lewis) Fig. 251.

Helix ligera Say, var., *Helix annae* and *Helix acerra* Lewis, 1870, Amer. Jour. Conch., 6:190, pl. 12, figs. 3, 4.

Zonites acerra Lewis, 1875, Proc. Acad. Nat. Sci. Phila., p. 335.

Z[onites] acerrus Lewis, W. G. Binney, 1885, Man. Amer. Land Sh., p. 213, fig. 224.

Gastrodonta acerra (Lewis), Pilsbry, 1900, Proc. Acad. Nat. Sci. Phila., p. 142.—Walker, ibid., 1902, p. 433; 1928, Terr. Moll., Alabama p. 102.

"*Unusually* large specimens of *H. ligera* Say, only very slightly elevated . . . My shell has 7 whorls and a fraction. Greater diameter 0.81 inch = 18 mill." (Lewis, 1870.)

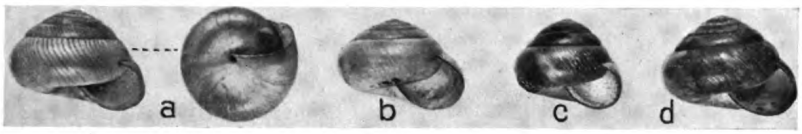

Fig. 251. *Ventridens acerra.* a, Cades Cove. b, Monroe Co., Tenn. c, near Gneiss, Macon Co., Tenn. d, Roan Mt., Carter Co., Tenn.

The shell is narrowly perforate, convexly conic with rather flattened base, of about 7 whorls, the last rounded at periphery and base. The surface is very glossy, the first 1½ whorls smooth, following whorls finely and rather regularly striate, the last whorl or two having low, wide, rounded striae above the periphery, the base smoother, radially rippled. Color a somewhat translucent light yellowish olive, becoming opaque naples yellow on the last fourth of a whorl. The lunate aperture has a white callous lining; lip thin, shortly dilated at the axial insertion.

Height 12 mm., diameter 17.3 mm.; 7⅔ whorls. Blount Co.
Height 11 mm., diameter 16.3 mm., 7⅓ whorls. Blount Co.
Height 11.5 mm., diameter 14.8 mm.; 7⅓ whorls. Blount Co.
Height 11.1 mm., diameter 18.3 mm.; 7⅓ whorls. White Sulphur Springs, Ga.
Height (broken), diameter 18.4 mm. Blowing Springs, Nantahala Mts., N. C.

VIRGINIA: At Natural Bridge and on hills around Rockbridge Co. (H. B. Baker). KENTUCKY: Pine Mt., Harlan Co., (Witmer Stone). NORTH CAROLINA: Cranberry, Avery Co. (H. B. Baker and others). Roan Mt. and Magnetic City (A. G. Wetherby). Mt. Mitchell, Yancey Co. (Clench & Rehder). Nantahala Mts., Swain Co. (Clench). Mts. northwest of Waynesville, Haywood Co. (J. B. Clark). Highlands and elsewhere, Macon Co. (Archer). Cherokee and Clay counties (Archer). TENNESSEE: Valley Forge and on the flanks of Roan Mt., Carter Co. (H. B. Baker). Dove, Marion Co. (Baker). Mt. LeConte and elsewhere in Sevier Co. (Clench, Archer, McClure). Blount Co. from Cade Cove to the summits of Thunderhead, Clingman Dome, etc. Great Smoky Mountains (Pilsbry, Ferriss); Chilhowee Mt. (Miss Law). Monroe Co. (A. G. Wetherby). GEORGIA: White Sulphur Springs (H. H. Smith). Near Presly, Towns Co. (Jesse White). ALABAMA: DeKalb, Elmore, Jackson and Montgomery counties; recorded by Walker from Blount, Cherokee, Cleburne, Madison and Randolph counties also.

V. acerra appears to be most nearly related to *V. demissus*, but it is larger. I have seen no intergradation in size of adults anywhere east of the Mississippi.[98] It also resembles *V. ligera*, but *acerra* is more glossy, usually lower, more widely excavated around the perforation, and it has the striae wider on the last whorl. Young specimens down to 3.3 mm. diameter have no teeth, and except at the columella, no internal callus.

The usual diameter is about 14 to 15 mm. Lewis' 18 mm. specimen was exceptional, though I have seen larger ones. The largest of several Monroe Co. shells from the Lewis collection measures 16.7 mm. The smallest seen are from Pine Mt., Harlan Co., Kentucky, diameter 11.7 mm.; but possibly these may be *demissus*.

While the spire is typically rather a depressed cone, it is quite high in some lots, particularly those from considerable elevations, such as Thunderhead Mountain, the tops of Clingman Dome and Mt. LeConte, Gneiss, Macon Co., N. C. and others. Most shells of such high lots have rather small diameter. Some of the shells from northern outliers of Roan Mt. in Carter Co., Tenn., are rather high.

Height 13.2 mm., diameter 15.7 mm.; 7½ whorls. Thunderhead.
Height 11.4 mm., diameter 12.6 mm.; 7 whorls. Thunderhead.
Height 10.8 mm., diameter 13.4 mm.; 7¼ whorls. Clingman Dome.
Height 11.3 mm., diameter 14.2 mm.; 7⅓ whorls. Gneiss, N. C.
Height 13.2 mm., diameter 17.2 mm.; 7½ whorls. Carter Co., Tenn.

The form of *acerra* prevalent in the Great Smoky Mountains is generally a little smaller and more elevated than Dr. James Lewis' specimens from Monroe County, Tenn., and the last whorl seen from above is not so wide. Occasional specimens, however, may be found almost exactly like the Monroe County shells, though the average or norm of the mountain shells is perceptibly different. Bryant Walker got a sinistral specimen in Cade's Cove.

(*Acerra*, casket for holding incense.)

[98] W. G. Binney (1883) stated that, "From the mountains of North Carolina and Tennessee I have received a gradual series of size from the typical *demissus* to *acerrus*." But were all adult?

Ventridens percallosus (Pilsbry) Fig. 252.

Gastrodonta collisella percallosa Pilsbry, 1898, Nautilus 11:134.

The minutely perforate subglobose-conic shell has a more convex base and less extensive axial impression than *V. gularis*. The upper surface is smoother than in *V. collisella*, the striation not so sharp, being about like the more strongly sculptured examples of *gularis*. Superficial spiral striation is more or less developed on the base. The aperture is more ample than in

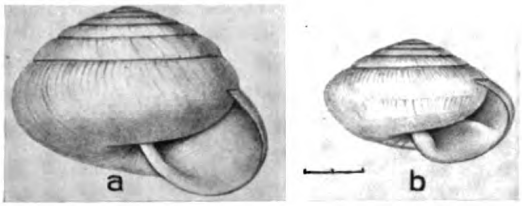

Fig. 252. *Ventridens percallosus*. a, Chattanooga. b, Nashville. Scale line = 2 mm.

gularis or *collisella*, being higher relative to the width, as in *V. ligera*. The columellar margin is more curved than in *gularis* or *collisella*. The interior has an extensive, thick, white, callous lining upon which the weak trace of an outer-basal lamina may be seen in the Chattanooga specimens, and in some of those from Nashville.

Height 7 mm., diameter 9 mm.; 7¼ whorls. Type.
Height 7.9 mm., diameter 9.9 mm.; 7½ whorls. Nashville.
Height 7.2 mm., diameter 8.4 mm.; 7½ whorls. Nashville.

TENNESSEE: Tennessee River 3 mi. above Chattanooga, Hamilton Co. (A. G. Wetherby), Type 65454 A.N.S.P. Nashville (G. A. Lathrop, J. B. Clark).

Immature shells up to 6 whorls and nearly 7 mm. diameter have a strong outer-basal lamina and a blunt prominence, or it might be described as a short, subtruncate callus, on the columella (Fig. 252 b, Nashville); this subtruncate callus being, perhaps, the main feature distinguishing it from *demissus*.

This is a perplexing form, which was at one time thought to be a small, heavily calloused form of *V. ligera*, and afterwards described as a subspecies of *V. collisella*. It differs from the latter by the shape of the aperture and the sculpture. Though but few specimens have been examined, from only two places, it seems well detached from both species; yet the probability that it is a form of the more depressed *V. demissus* must be considered when further immature material is available.

Ventridens ligera (Say) Fig. 253.

Helix ligera Say, 1821, Jour. Acad. Nat. Sci. Phila., 2:157 (Missouri).

Zonites ligerus Say, Binney, 1878, Terr. Moll., 5:105, pl. 35; pl. ii, fig. M (teeth).—Sampson, 1885, Bull. Sedalia Nat. Hist. Soc., 1:17.

Helix wardiana Lea, 1836, Trans Amer. Philos. Soc., 6:67, pl. 23, fig. 82; Obs. Gen. Unio, 2:67 (Cincinnati and Chilicothe, Ohio).

Helix rafinesquia Férussac, 1821, Tableau Syst., no. 311, p. 46, corrected to *Helix rafinesquea* on p. 68 (72), (nude name); 1832, Hist. Nat. Moll. Terr., pl. 51A, fig. 5 (Kentucky).[99]

Zonites ligerus var. *stonei* Pilsbry, 1889, Nautilus, 3:46 (Newcastle Co., Delaware).

Zonites (*Gastrodonta*) *ligerus* var. *sagdinoides* Gratacap, 1901, Bull. Amer. Mus. Nat. Hist., 14:344 (Indiana).

Gastrodonta ligera Say, Walker, 1906. Ill Cat. Moll. Mich., 1:488; 1928, Terr. Moll. Alabama, p. 103.—Sampson, 1913, Trans. Acad. Sci. St. Louis, 22:104.

Ventridens ligerus (Say), Brooks, 1935, Ann. Carnegie Mus., 24:67 (W. Va.).—F. C. Baker, 1939, Fieldbook Ill. Land Sh., p. 81.

" Shell subglobose, pale yellow horn color, polished; body whorl pellucid, yellowish-white, opaque beneath near the aperture; volutions rather more than six, all, excepting the apical one, wrinkled across; spire convex, a little elevated; umbilicus very small, suture not deeply impressed; labrum not reflected. Greatest length 3/10; oblique length less than 9/20; transverse diameter less than 11/20." (Say.)

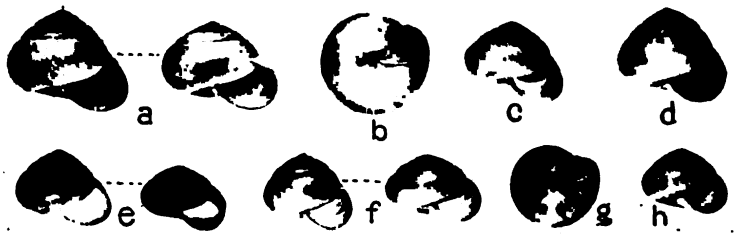

Fig. 253. *Ventridens ligera*. a, Chattanooga. b, Washington, D. C. c, Vinita, Okla. d, Lawrenceburg, Ind. e, opp. Wilmington, N. C. f, Montgomery Co., Pa. g, form *stonei*, type. h, Bellevue, New Castle Co., Del.

The spire is convexly-conic, though the convexity of the sides is often very slight. Whorls irregularly but strongly wrinkle-striate and somewhat glossy above; the base is much more glossy, with weaker striation and under a lens, fine shallow spiral striae may usually be seen. It is deeply impressed around the umbilical perforation, which is quite small, about one-twelfth the diameter of the shell. There is generally an opaque buff or naples yellow patch behind the basal lip, due to the white callous lining of the aperture, but this is often very thin or almost wanting.

Height 9.6 mm.,	diameter 13 mm.;	$6\frac{2}{3}$ whorls.	Vinita, Okla.
Height 9.3 mm.,	diameter 11 mm.;	$6\frac{2}{3}$ whorls.	Vinita, Okla.
Height 11.5 mm.,	diameter 14 mm.;	$6\frac{3}{4}$ whorls.	Mt. Carmel, Ill.
Height 8 mm.,	diameter 11 mm.;	$6\frac{3}{4}$ whorls.	Buffalo, N. Y.
Height 12.2 mm.,	diameter 15.5 mm.;	7 whorls.	Illinois.
Height 9.7 mm.,	diameter 12.2 mm.;	7 whorls.	Lawrenceburg, Ind.
Height 12 mm.,	diameter 14 mm.;	$6\frac{2}{3}$ whorls.	Lawrenceburg, Ind.

[99] In the *explication* of Pl. 51A, Férussac says of figure 5, *Helix rafinesquea*: " cette figure est inexacte; " and he added " (*Helix ligera* Say) " after the reference.

Height 8.3 mm., diameter 11.7 mm.; 6¾ whorls. Ann Arbor, Mich.
Height 12 mm., diameter 14 mm. Washington, D. C.
Height 10 mm., diameter 12.3 mm. Wissahickon, Phila., Pa.
Height 12 mm., diameter 15.6 mm.; 6⅔ whorls. Chattanooga, Tenn.
Height 12.7 mm., diameter 15 mm. Chattanooga, Tenn.
Height 11 mm., diameter 11.2 mm.; 6½ whorls. Montgomery Co., Pa.

ONTARIO: Brantford (R. Walton). NEW YORK: Erie, Greene, Herkimer, Madison and Ulster counties (and recorded also from Allegheny, Cayuga, Onondaga, Ontario, Otsego, Tompkins, Wyoming counties and Staten Island). NEW JERSEY: Burlington, Camden, Cape May and Gloucester counties. PENNSYLVANIA: Adams, Allegheny, Beaver, Berks, Bucks, Chester, Clinton, Delaware, Fayette, Fulton, Greene, Juniata, Lancaster, McKean, Montgomery, Philadelphia, Somerset, Sullivan, Westmoreland and York counties. DELAWARE: New Castle Co. MARYLAND: Allegany, Baltimore, Cecil, Garrett, Harford, Kent, Montgomery and Washington counties. DISTRICT OF COLUMBIA: Zoological Park, etc. VIRGINIA: Augusta, Albermarle, Fairfax, and Roanoke counties. WEST VIRGINIA: Greenbrier Co. Cited by Brooks from Mineral, Monongalia, Ohio, Pendleton, Preston, Randolph and Wayne counties. NORTH CAROLINA: Balsam, Brunswick, Haywood and Jackson counties. KENTUCKY: Quicksand, Breathitt Co. (Funkhouser). Opp. Frankfort, Franklin Co. and Mammoth Cave, Edmonson Co. (S. N. Rhoads). TENNESSEE: Chattanooga, Hamilton Co. ALABAMA: Baldwin, Jackson and Tuskaloosa counties. According to Walker, also Choctaw, Conecuh, Lauderdale, Madison, Mobile and Shelby counties; "of local distribution through the northern and western part of the state." FLORIDA: Gainesville, Alachua Co. (Van Hyning). Probably introduced. OHIO: Brown, Clark, Franklin, Greene, Guernsey, Hamilton, Huron, Jefferson, Licking, Montgomery, Tuscarawas and Warren counties. "Over the state, common." (Sterki.) MICHIGAN: Clinton, Kent, Lenawee, Monroe, Washtenaw and Wayne counties. "Generally distributed in the southern part of the state." (Walker.) INDIANA: Dearborn, Posey and Tippecanoe counties. "Common all over the southern portions of the state." (Call.) ILLINOIS: Wabash and Will counties. "Found over much of the state, more common in the southern than in the northern half." (F. C. Baker.) MISSOURI: (Say), Type loc. Recorded by Sampson from Boone, Butler, Cooper, Marion, Moniteau, New Madrid, Pettis, Saline and St. Louis counties. ARKANSAS: Crittenden Co., opposite Memphis, Tenn. (Rhoads.) OKLAHOMA: Fort Gibson, Muskogee Co. (C. T. Simpson). Vinita, Craig Co. (Pilsbry.)

The foot is coarsely, not very distinctly granulated, foot-margin wide. Caudal pore appears to be a slit from the pedal groove to the end of the tail. The sole is very long and narrow when the animal is moving, not tripartite, grayish-buff, anteriorly bluish-gray in the middle, and peppered with white. The back, face and tentacles are slate-black. Collar pale gray peppered with white. The mantle is subcentral, the shell carried over the posterior half of the foot, the end of the tail sometimes projecting beyond it; though not when it ascends vertically.

While *V. ligera* resembles *V. intertextus* somewhat in shape, it is lighter colored, less sharply striate, and such spiral striae as it possesses are much more superficial and restricted to the base.

It varies widely in degree of elevation in almost every large lot. Thus the h/d index in three lots is: from 70.4 to 84.5 (Wissahickon Creek, Philadelphia), 76.2 to 85 (Chattanooga, Tenn.) and 68.9 to 77.1 (Lawrenceburg, Ind.). The species attains greater size in parts of the Middle West and the Potomac valley than in the Delaware and St. Lawrence drainages, and no very large shells have been seen from west of the Mississippi. A sinistral shell from Philadelphia is in coll. A.N.S.P.

In Form *stonei* Pilsbry (Fig. 253 g) the shell is thin and rather small, with slightly wider perforation, about 1 mm. wide in shells of 10 or 11 mm. diameter. Except upon the columella there is no lining of white callus. Type measures: 7.6 × 11.4 mm., 6⅓ whorls, the usual diameter 10-11 mm. It was described from Hollyoak, New Castle Co., Delaware, Type 60054 A.N.S.P., and occurs elsewhere in the drainage of Delaware Bay.

A very similar thin form was found on the Roanoke River, Salem, Roanoke Co., Va., and in abundance in Brunswick Co., N. C., across the river from Wilmington. The perforation is smaller than in the Delaware form. It appears quite possible that these very thin shells are ecologic forms rather than true races.

The names *wardiana, rafinesquea* and *sagdinoides* were all based upon specimens from the central portion of the *ligera* area, and in my opinion are strictly synonymous with *ligera*.

Dr. Gratacap suggested a varietal name for a specimen in the Binney & Bland collection, thus: " A very high, as Dr. Pilsbry might express it ' bee hive ' form from Indiana is conspicuous, and is marked by Binney as ' abnormal.' Following the prevalent hunt for varieties, ' *sagdinoides* ' might be suggested as a sobriquet." It was inconsiderate to use my name in connection with a shell I never saw, and which so competent a judge as Binney thought abnormal. As the degree of elevation varies widely in many lots, this " variety " is clearly superfluous.

(Etymology of name uncertain.)

Ventridens intertextus (Binney) Fig. 254.

Helix intertexta Binney, 1841, Boston Jour. N. H., 3:414; 1851, Terr. Moll., 2:206, pl. 36.—Leidy, Terr. Moll., 1:257, pl. 12, figs. 1-3 (anatomy).—W. G. Binney, 1858, Proc. Acad. Nat. Sci. Phila., p. 202, with var. *carinata*, nude name.

Zonites intertextus Binney, W. G. Binney, 1878, Terr. Moll., 5:106, pl. ii, fig. 1 (teeth).

Gastrodonta intertexta Binney, Walker, 1906, Ill. Cat. Moll. Mich., 1:487; 1928, Terr. Moll. Alabama, p. 101.

" Shell sub-pyramidal; epidermis yellowish horn-color; whorls six to seven, with numerous fine, oblique striae, and very minute spiral striae, intersecting each other; outer whorl with a narrow, light-colored band, and an ill-defined brownish band below it; aperture rounded, a little transverse; lip thin, somewhat thickened within by a deposition of testaceous matter, slightly reflected at its junction with the base of the shell; umbilicus small, sometimes nearly obsolete; base whiter than the upper surface. Greatest transverse diameter about three fourths of an inch." (Binney.)

Height 12.3 mm., diameter 16.5 mm.; 6½ whorls. Paratype.
Height 13.3 mm., diameter 18.5 mm.; 6½ whorls. Paratype.
Height 11.7 mm., diameter 14 mm. Auburn, N. Y.
Height 12 mm., diameter 14.7 mm. Woodville, Ala.
Height 10 mm., diameter 13.4 mm.; 6½ whorls. Woodville, Ala.
Height 12 mm., diameter 15.6 mm. Cade's Cove, Tenn.[101]

[101] Periphery weakly angular.

Height 9 mm., diameter 13.6 mm.; 6¼ whorls. Valley Head, Ala.[102]
Height 11.3 mm., diameter 15 mm.; 6¾ whorls. St. Clair Co., Ala.[102]
Height 7.3 mm., diameter 12.3 mm.; 5¾ whorls. Walker Co., Ga.[102]
Height 8.3 mm., diameter 12 mm.; 6 whorls. Murray Co., Ga.[102]
Height 9.5 mm., diameter 12 mm. Tannersville, Catskills.

Fig. 254. *Ventridens intertextus*. a, type, after Binney, natural size; b, c, Cazenovia, N. Y., × 1½.

ONTARIO: St. Williams, Norfolk Co. (Oughton); Hamilton (Walton).
NEW YORK: Cayuga, Greene, Madison, Niagara, Oneida, Onondaga, Rensselaer and Tompkins counties; reported also from Albany, Chautauqua, Erie, Herkimer, Monroe, Ontario and Wayne counties. PENNSYLVANIA: Cambria, Clinton, Indiana, McKean, Monroe, Potter and Wyoming counties. MARYLAND: Allegany, Cecil and Garrett counties. OHIO: Adams, Jefferson and Licking counties. "Over the state" generally (Sterki). MICHIGAN: Recorded by Walker from Sanilac Co. only. INDIANA: Over the southern part of the state, according to R. E. Call. ILLINOIS: No valid record, those reported being erroneous (F. C. Baker, Fieldbook Ill. Land Sh., p. 150). VIRGINIA: North of Lynchburg, Amherst Co. WEST VIRGINIA: Recorded by S. T. Brooks from Monongalia, Ohio and Preston counties. NORTH CAROLINA: Cabarrus Co. (Binney), Type locality.[103] Cherokee, Clay, Gaston, Jackson, Macon, Transylvania and Warren counties.
KENTUCKY: Quicksand, Breathitt Co. TENNESSEE: Blount, DeKalb, Hamilton, Knox, Marion, Monroe and Polk counties. SOUTH CAROLINA: Abbeville, Abbeville Co. Dela Howe State School, McCormick Co. (Jacob). GEORGIA: Dade, Fulton, Murray and Muscogee counties. FLORIDA: Green Cove Springs, Clay Co., and Chattahoochee, Gadsden Co. (Van Hyning). Baily's Ferry, Calhoun Co. (C. W. Johnson). ALABAMA: Baldwin, Bibb. Blount, Calhoun, Clarke, Cleburne, Colbert, Elmore, Franklin, Hale, Jackson, Jefferson, Lee, Marion, Marshall, Randolph, St. Clair, Talladega and Tuscaloosa counties; additional counties cited by Walker are: Barbour, Chambers, Cherokee, Clay, Conecuh, Dale, DeKalb, Dallas, Etowah, Fayette, Lauderdale, Madison, Marengo, Mobile, Perry, Pike, St. Clair, Shelby, Sumter, Tallapoosa, Walker and Washington. MISSISSIPPI: Vicksburg (C. W. Johnson). LOUISIANA: Border of Lake Charles, Calcasieu Parish. Claiborne Parish. Mt. Lebanon, Bienville Parish. TEXAS: "20 mi. north of Beaumont." (A. G. Wetherby.)

The axial perforation varies from less than one mm. wide to almost closed. The surface is dull, with very little or no gloss, thus differing from *V. ligera* which is glossy, at least on the base. A further distinction is seen in the sculpture, the last whorl of *intertextus* being more or less distinctly striate spirally, while in *ligera* such striae as are present on the base are very superficial. The initial 1½ whorls are glossy, smooth at first half whorl or more, then showing weak spiral lines.

[102] Periphery strongly and sharply angular

[103] According to Binney: "It inhabits North Carolina; I have seen numerous specimens from Cabarrus County. It is also found in Ohio and Pennsylvania." Cabarrus Co., N. C., has therefore been chosen as the type locality.

There is more or less angulation of the periphery, strong in many lots, but varying to hardly noticeable in adults, in which it is sometimes replaced by a weak pale band. In immature stages this angulation or carination is stronger than in adults.

The size varies widely. Binney's type, about 20 mm. diameter, according to the figures, was larger than any I have seen. Many lots do not exceed 12 to 13 mm. diameter. Shells which are strongly angular in the adult stage do not usually reach the size of those which acquire a rounded last whorl. Although the angular and rounded forms are often very unlike, the extremes of form appear completely connected. It varies in color to russet.

It is not known from west of the Mississippi River anywhere north of Louisiana.

(*Intertextus,* interwoven.)

Ventridens intertextus eutropis new subspecies Fig. 255.

The shell is perforate, the umbilicus (measured to insertion of columellar lip) contained 10 times in diameter, though the actual perforation is very little more than 1 mm. wide; it is acutely carinate throughout, the keel filling the suture and, in places, projecting a little above it; the surface slightly concave above and below the keel. Embryonic 1½ whorls are smooth, the rest closely and rather sharply sculptured with retractive striae, on the last 1½ whorls cut by weak spirals, the base with similar radial striation and, near the periphery, well impressed spirals. The aperture is strongly angular outwardly, and is lined with a thin callus. Height 7.7 mm., diameter 14.7 mm.; 5⅔ whorls.

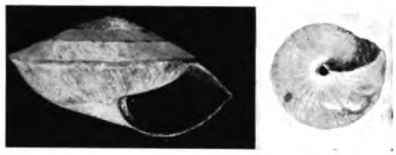

Fig. 255. *Ventridens intertextus eutropis,* type, the basal view actual size.

TENNESSEE: "Cherry Valley," east of Watertown, Wilson Co., on the north side of Route 26, under flat limestone slabs on a low hill with growth of brush and small trees (Pilsbry & Cyril Harvey, 1935).

This form is not merely sharply angular, as in many *V. intertextus,* but strongly carinate. While the sculpture is that of *intertextus,* the shape is quite unlike any of several hundred of that species seen. A single "dead" specimen was among shells gathered in a brief roadside stop in course of a rapid trip from Nogales east.

(The name, from εὖ and τρόπις, means well keeled.)

Ventridens intertextus volusiae (Pilsbry)

Gastrodonta intertexta volusiae Pilsbry, 1900, Nautilus, 14:40.

The shell is small, narrowly umbilicate, the umbilicus contained 10 times in the diameter; thin, rather fragile, cinnamon colored. Form rather depressed, bluntly subangular at the periphery, the angle becoming nearly obsolete as it approaches the aperture. Sculpture of fine and close striae, weaker at the base, decussated by impressed spiral lines. The broadly lunate aperture has no callous lining within. Peristome thin, briefly dilated at the axial end, partly covering the umbilicus.

Height 5.4 mm., diameter 8.5 mm.; 5⅛ whorls.
Height 5 mm., diameter 8 mm.; 5⅛ whorls.

FLORIDA: "Mt. Taylor," an aboriginal mound on the St. Johns River south of Volusia, Volusia Co.[104] (Pilsbry & Johnson), Type 75769 A.N.S.P. Blufton, Volusia Co. (P. & J.).

The locality of this race is south of any record for *V. intertextus*, and those *intertextus* known from northern Florida (Gadsden, Calhoun and Clay counties) though small, diameter slightly over 10 mm., are similar to Georgia and Alabama shells in having the characteristic heavy white callus within the mouth, which is lacking in *volusiae*. The characters of *volusiae* are uniform in over 50 specimens collected.

VENTRIDENS ELLIOTTI GROUP (New Section *Elliottius*)

Depressed, umbilicate shells, with the last whorl descending in front, the aperture without teeth or laminae in any known stage, the lip thickened within.

Ventridens elliotti (Redfield) Fig. 256.

Helix elliotti Redfield, 1856, Ann. Lyc. N. H. of N. Y., 6:170 (mountains of Georgia and North Carolina).—Bland, ibid., p. 301, pl. 9, figs. 8-10.

Zonites elliotti Redfield, W. G. Binney, 1878, Terr. Moll., 5:110, fig. 29, pl. iii, fig. c (dentition).

Zonitoides elliotti (Redfield) Pilsbry, 1900, Proc. Acad. Nat. Sci. Phila., p. 141.—Walker, 1902, Proc. Acad. Nat. Sci. Phila., p. 433; 1928, Terr. Moll. Alabama, p. 102.

Z. (*Ventridens*) *elliotti* (Redfield), H. B. Baker, 1929, Proc. Acad. Nat. Sci. Phila., 81:258, pl. 9, figs. 7-9 (anatomy).

"Shell, with a rather narrow umbilicus, depressed-orbiculate, with fine transverse striae, greenish horn-colored, scarcely translucent, shining beneath; spire convex, but not much raised; whorls five, rather convex, last one sometimes very slightly depressed at the aperture; suture deeply impressed; aperture very oblique, lunate-circular; peristome a little sinuate, acute but thickened within. Diam. maj. 9 millim., min. 8 millim., alt. 4 millim." (Redfield.)

[104] Volusia was a former settlement on the east shore of the St. Johns River opposite Astor. "Mt. Taylor" is a shell and sand mound about a mile south of Volusia, and perhaps 200 yards from the river. Notes on its archaeology were given in Amer. Nat., 27:12, 1893.

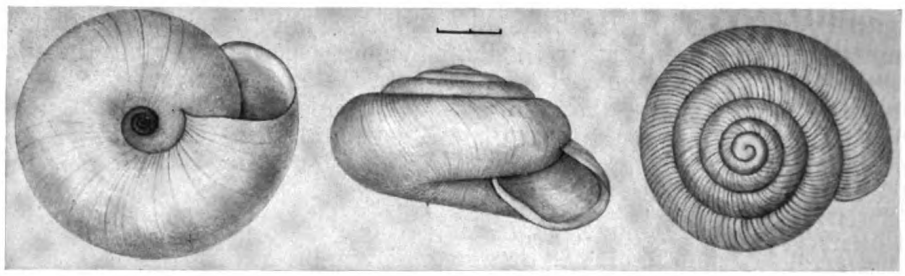

Fig. 256. *Ventridens elliotti,* Magnetic City, N. C. Scale line = 2 mm.

Height 4.2 mm., diameter 8 mm. Type.
Height 4.9 mm., diameter 8.4 mm.; $5\frac{2}{3}$ whorls. Magnetic City, N. C.
Height 4 mm., diameter 7.7 mm.; $5\frac{1}{2}$ whorls. Magnetic City, N. C.
Height 4 mm., diameter 7.5 mm. Macon Co., N. C.
Height 4.2 mm., diameter 8.4 mm. Clay Co., N. C.

West Virginia: Recorded by W. G. Binney from Wayne Co. Kentucky: Pine Mountain, Harlan Co. (Witmer Stone). Tennessee: W. Pikeville, Bledsoe Co.; Dove, Marion Co. (H. B. Baker). Cades Cove and to near the summit of Thunderhead, Blount Co. (Pilsbry). Knoxville, Knox Co. (Sargent). Cherokee Nat. Forest, Polk Co., and Gatlinburg, Elkmont and Mt. LeConte, Sevier Co. (A. F. Archer).

North Carolina: Andrews and Murphy, Cherokee Co. Hayesville and west of Marne, Clay Co. (Archer). Tuskegee Mt. and Stratton Bald, Graham Co. (Sargent). Waynesville, Haywood Co., and Mt. Balsam, Jackson Co. (J. B. Clark). Many places in Macon Co. (Archer). Magnetic City (A. G. Wetherby) and Spruce Pine, to 8 miles west of Rosman, Mitchell Co. (S. G. Gordon). Welch Bald, Swain Co. (Sargent). Transylvania Co. (Archer). Macon, Warren Co. (Archer).

Georgia: Decatur, De Kalb Co. (Katharine Buckman); Chatsworth, Murray Co. (C. C. Allen). Clayton and Mountain City (J. Chester Bradley), and Walhalla Rd. (Archer), Rabun Co. Near Hiawassee and near Presly, Towns Co. Alabama: Around Woodville, Jackson Co. (H. B. Baker).

The surface is rather sharply, finely striate after the smooth initial $1\frac{1}{2}$ whorls, the sculpture nearly effaced at the base. In front the suture descends shortly to the aperture, a character unique in the genus. The oblique height of the aperture is about equal to its width. The lip is distinctly thickened within in the adult stage, but it is thin, with no internal callus in immature stages, thus differing from most *Ventridens.* Among many hundreds seen, none in an early neanic stage could be found. It is an isolated species, often occurring in abundance under the loose bark of logs.

Redfield's type specimen (76988 A.N.S.P.) with his original label, " Mts. of Georgia & N. C." does not agree with his measurements, copied by Binney, owing to the fact that these older authors did not use a caliper, and they measured the axis for altitude, not the whole height of the shell.

Specimens dissected by Dr. H. B. Baker (A.N.S.P. 128892) were collected by J. B. Clark on July 18th, 1921, from a mountain (4,500 ft) near Eaglesnest, northwest of Waynesville, Haywood County, North Carolina.

" Foot: almost white; head lightly pigmented; peripodial angle and mucous pore as in *Z. nitidus.* Sole: relatively short; uniform. Mantle collar

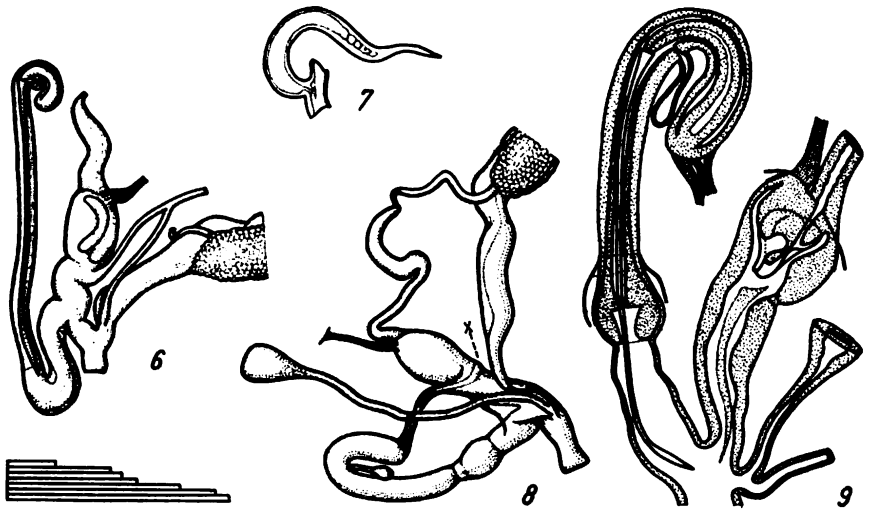

Fig. 257. 6, *Zonitoides lateumbilicatus*, terminal genitalia, with dart at left, penis and epiphallus in center, free oviduct at right. 7-9, *Ventridens elliotti*, Waynesville, N. C., 7, spermatophore; 8, terminal genitalia; 9, diagrammatic optical section (after H. B. Baker).

and pallial complex as in *Z. nitidus*, but kidney relatively shorter and thicker. Lung: almost 3 times as long as its base or length of kidney. Kidney: about 1½ times as long as its base or length of pericardium; proximal end almost as thick as wide.

" Uterus: sacculate. Free oviduct (Fig. 257:8): long, acuminate basally. Spermatheca: sac relatively small, ovoid, imbedded near middle of uterus; duct of short type, bifurcate and with penial branch expanded into capsule (as in genus). Prostate: long type. Vas deferens: relatively short; epiphallus long and quite slender, slightly swollen in apical half; penial papilla (Fig. 257:9) quite short and conical with orifice on one side about halfway to apex, armed with heavy and complicated collar. Spermatophore (Fig. 257:7): fusiform, often with expanded base. Vergic sac: about 3 times as long as penial papilla; wall with heavy internal pilasters; capsular orifice opposite apex of penial papilla. Penial retractor: short and slender; origin from diaphragm; insertion near apex of vergic sac. Dart sac: almost twice as long as vergic sac and relatively slender; swollen to form a distinct annulus just above thin-walled basal ¼ of its length; dart papilla almost ⅓ as long as sac; coronal gland elongate and simple; dart gently curved throughout most of its length but quite sharply bent just before its expansion into a short, lanceolate blade; dart retractor bipartite, with origins investing spermathecal fork. Cloaca: quite short; external opening some distance above dorsal pedal groove and slightly behind anterior edge of visceral stalk.

" Columellar muscles: much as in *Z. nitidus*, but with less complete union between left lateral and tail muscles. [In my account of *Z. nitidus* (1928: 39), the 4th division should read left instead of right lateral.]

" Salivary glands: left (anterior) one flattened ovoid in shape and about as large as buccal mass; right one slightly smaller; ducts about 3 times as

long as glands. Jaw: heavy, with median projection (as usual in *Ventridens*). Radular formula: 21-7-1-28 (W.G.B. gives 32-1-32); 81 transverse rows, shaped as in *Z. lateumbilicatus*. Forms of teeth: much as in *Z. lateumbilicatus*, but all teeth slightly more elongate (as shown in W. G. Binney's figures); inner 1 or (rarely) 2 marginals (8th & 9th teeth) bicuspid.

"Although the shell of *Z. elliotti* is more like that of *Zonitellus* in form, it agrees better with that of *Ventridens* in size and thickness as well as in the development of a basal callus on its peristome. The genitalia of *Z. elliotti* are remarkably like those of *Z. ligerus*, as figured by Leidy (l.c.). While evidently a transitional species, *Z. elliotti* appears to be closer to the other members of *Ventridens* than to *Zonitellus*." (H. B. Baker.)

ZONITOIDES Lehmann

Zonitoides Lehmann, 1862, Malak. Blätter, 9:111, monotype *Helix nitida* Müll.—H. B. Baker, 1928, Proc. Acad. Nat. Sci. Phila., 80:33, 37; 1929, same Proc., 81:254.—Hugh Watson, 1934, Jour. of Conch., 20:33 (genital dimorphism).

Zonitellus H. B. Baker, 1928, Proc. Acad. Nat. Sci. Phila., 80:37, type *Helix arboreus* Say.

The shell is small (diameter 4 to 8 mm.), thin, depressed, umbilicate, lightly or distinctly striate above, rarely ribbed, composed of 3½ to 4½ convex, regularly increasing whorls, the last rounded; aperture rounded, lunate, lip thin; no internal callus or teeth.

The foot is long and narrow with distinct pedal grooves and a narrow, slit-like caudal pore. Sole not tripartite, without muscular waves, movement being arythmic.

The jaw is smooth, arched, with a median projection (Fig. 258 D, *Z. nitidus*). The teeth (Fig. 258 B, C, *Z. nitidus*). Centrals tricuspid, not longer than the laterals; laterals bicuspid; marginals of the usual thorn-shaped form.

Genitalia (Fig. 258 A, F). Atrium rather long, the free oviduct, spermathecal duct and penis branching from it at about the same level, there being no vagina. The penis terminates in a short epiphallus and terminal retractor muscle, and bears a long dart sac with one or two coronal glands, or sometimes none, and from the apex of the sac a short connective runs to the spermathecal duct close above its fork. The free oviduct is long. Spermatheca oval, on a long duct, which near the anterior insertion gives off a branch which terminates in a capsule sheathing the basal part of the penis.[105]

Distribution, practically holarctic, occurring over most temperate parts of the northern continents.

Zonitoides has no conspicuous distinctive shell characters. The whorls increase in width regularly and are more tubular than in *Retinella* or *Oxychilus*, and they are without the differentiation of sculpture into major and minor series of grooves or wrinkles, as is often seen in *Retinella*.

[105] According to Dr. H. B. Baker, the branch from the spermathecal duct to the sheath around the base of the penis actually communicates with the cavity of the penis by an opening in the penial wall in *Z. arboreus*. Hugh Watson denied the presence of such an opening in *Z. nitidus*, and none was seen in two specimens I opened.

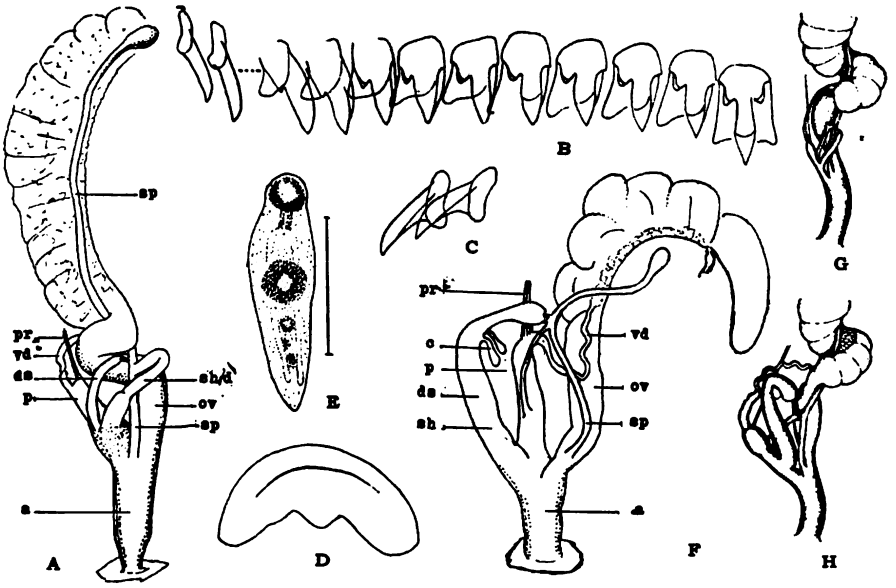

Fig. 258. *Zonitoides nitidus,* A, genitalia; B, C, teeth; D, jaw; E, fluke. Scale line = 1 mm. F, *Zonitoides arboreus,* genitalia. G, H, *Z. nitidus,* anterior genitalia of hemiphallic (G) and euphallic (H) individuals, after Watson. a, atrium; ds, dart sac; ov, free oviduct; p, penis; pr, penial retractor; shd, duct to penial sheath; sp, spermathecal duct; vd, vas deferens.

The paleontologic history of the genus is uncertain, and part of the European Tertiary species placed here by Wenz (Fossilium Catalogus) may be Retinellae. Information on the advent of *Zonitoides* in America is vague. *Z. arboreus* would seem to be an old resident, present throughout the Pleistocene, which has become adapted, within its great area, to both subarctic and tropical climates. *Z. nitidus* seems more recent, a palearctic immigrant, as it has made little progress southward in America, and its presence in the loess rests upon a single record.[106] The strongly striate *Z. limatulus* group, *Pseudohyalus,* is a specially American group, and may be as old an Appalachian stock as *Ventridens.* In American *Zonitoides,* therefore, we see a reunion of several herds, long separated, but diverging only slightly in structure from their common ancestors.

Subdivisions of Zonitoides

Shell glossy, with only weak sculpture, ...Subgenus *Zonitoides*
Genitalia dimorphic, the copulatory organs either normal or only weakly developed .....Section *Zonitoides* s.s.
Genitalia only normally developed .....Section *Zonitellus*
Shell dull, with conspicuous rib-striation, ...Subgenus *Pseudohyalus*

[106] L. E. Daniels, 1905, Nautilus, 19:63, Posey Co., Indiana. Considered by F. C. Baker to be loess of the Sangemon interval.

Subgenus ZONITOIDES Lehmann

GROUP OF Z. NITIDUS (Section *Zonitoides* s. str.)

This group comprises, so far as known, only the holarctic *Z. nitidus* and the European *Z. excavatus* Bean.

The singular dimorphism of the copulatory organs of *Z. nitidus* has been described by H. B. Baker, 1928 (Proc. Acad. Nat. Sci. Phila., 80:38, 39) and by Hugh Watson, 1934 (Jour. of Conch., 20:33-40). Watson writes:

" My researches accord with those of earlier observers in showing that two strikingly different types of genital ducts occur among apparently mature specimens of *Zonitoides nitidus*. In one type (Fig. 258 H) the dart-sac is long and recurved posteriorly; it usually contains a long and slender dart, and when fully mature often bears a rounded coronal gland. The penis and epiphallus are also both well developed; the vas deferens pursues a more or less serpentine or zigzag course; and the prostate gland is usually rather conspicuous. In the other type (Fig. 258 G) the dart-sac and penis are very much smaller and simpler. The slender, degenerate dart-sac is not usually reflexed posteriorly; it never contains a dart and never bears a coronal gland. The epiphallus is but little developed, being sometimes scarcely broader than the narrow vas deferens, which is straighter than in the other type. A prostate gland is not distinguishable; and probably owing to the small size of the penis the anterior end of the latter organ does not extend as far forward as in the other type, so that the genital atrium is somewhat longer." (Hugh Watson.)

H. B. Baker (1928) has termed these types the male and the female phases, but as Hugh Watson (1934) found spermatozoa equally in the ovotestes of both phases, he thought these terms inappropriate and refers to them as the *euphallic* condition, that in which copulatory organs are fully developed (Fig. 258 H), and the *hemiphallic*, in which they are small and degenerate (Fig. 258 G). The evidence indicates that these conditions are permanent in each individual. As Watson writes: " It seems almost certain that one type does not change into another during the individual's life but that some snails are permanently of one type and some of another. It is remarkable, however, that the relative abundance of the two forms varies at different times of the year." In the summer hemiphallic specimens are in a great majority, with very few euphallic, and in the autumn euphallic specimens become more numerous and are found of all sizes, while hemiphallic specimens become less common than in mid-summer.

For a full discussion of this subject the papers of Baker and of Watson should be consulted.

Zonitoides nitidus (Müller) Fig. 259.

Helix nitida Müller, 1774, Hist. Verm., 2:32 (Fridrichsberg, Denmark).

Zonites nitidus Müller, W. G. Binney, 1878, Terr. Moll., 5:113, pl. iii, fig. A (teeth).

Zonitoides nitidus (Müll.) Dall, 1905, Harriman Alaska Exped., 13:42.—F. C. Baker, 1920, Life of the Pleistocene, pp. 307, 339, 389.—J. Henderson, Univ. Colo. Studies, 13:147; 17:102; 23:109.—H. B. Baker, 1928, Proc. Acad. Nat. Sci. Phila., 80:38 (anatomy).—Hugh Watson, 1934, Jour. of Conch., 20:33 (anatomy).

Helix hydrophyla Ing., Miles, 1861, Ist. bienn. Rept. Prog. Geol. Surv. Mich., p. 235, 238.

Helix hydrophila Ingalls in coll., Binney & Bland, 1869, Land and F. W. Sh. N. A., 1:32 (as synonym of *Hyalina nitida* Müll.; Greenwich, Washington Co., N. Y.).

The shell is umbilicate, umbilicus contained five times in the diameter; olivaceous yellow, very glossy, somewhat transparent, composed of about $4\frac{1}{2}$ convex, gradually widening whorls joined by a well impressed suture. Em-

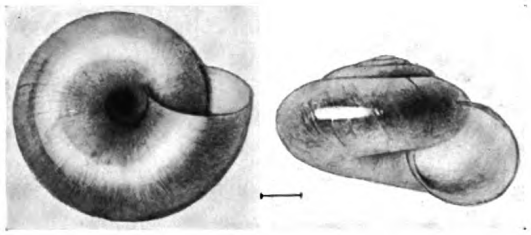

Fig. 259. *Zonitoides nitidus,* Mohawk, New York.

bryonic $1\frac{1}{2}$ whorls smooth, the rest finely, weakly marked by growth-lines, the base smoother and more transparent. Aperture lunate, the peristome thin. The columellar margin narrowly dilated.

Height 3.6 mm., diameter 6.1 mm.; $4\frac{1}{2}$ whorls. Dutchess Co., N. Y.
Height 4 mm., diameter 7 mm.; $4\frac{3}{4}$ whorls. Germantown, Pa.

The animal is black throughout except for some pale flecks along the foot-edges. Mantle black.

Distribution: all of Europe; Algeria; nearer Asia and Siberia; North America south to Maryland, northern Illinois and Utah.

ALASKA: Klukman, reported by Krause.

BRITISH AMERICA: Red River drift, Manitoba; Peace River, Athabasca and Great Slave Lake, according to Dall. Ontario, near Moose Factory Hudson Bay, Ottawa, Hamilton etc. Quebec, Anticosti Island.

UNITED STATES: Maine and Rhode Island west in the northern tier of states to Minnesota; South Dakota. Throughout Pennsylvania, south to Baltimore, Maryland; Ohio; Henry and Fayette counties, Indiana; Will Co., northern Illinois; Knoxville, Tennessee. Crawford, Conway and Franklin counties, Arkansas, according to Sampson; south of Missoula, White's Spring west of Ward, and at Darby, Montana. Idaho Falls and Homedale, Idaho (Henderson). Ogden and Logan, Utah (Chamberlin & Jones). On the west coast reported from a greenhouse in Seattle, Washington (Randolph), and at Astoria, Oregon (Hemphill, according to W. G. Binney.) Orcutt stated that it is not rare about San Diego, and plentiful in grounds of the University at Berkeley. I have seen a specimen from a canyon in Los Angeles Co. (M. J. Becker). Fossil, according to F. C. Baker, it is known from the Pleistocene of Illinois and Indiana (Sangemon Interval), but there are only a few records.

Z. nitidus is larger, less depressed, and a little more narrowly umbilicate than *Z. arboreus*, and it has not the spiral lines which are usually sketched faintly on that shell; the base is more convex, and the aperture rounder. It sometimes reaches a larger size than given above, up to 8 mm. diameter in western Pennsylvania, according to Dr. Clapp.

This species is common and generally distributed in the Canadian Zone, more local, though abundant when found, in the northern part of the Alleghanian fauna, Transition Zone. It is confined to cooler latitudes in America than in Europe. *Z 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.

Unlike many northern species, it is not generally spread southward in the Rocky Mountain states, and it has not been taken in Newfoundland. The records from West Coast states are few and scattered, and partly lack expert verification. Accidental importation in that area appears possible. The distribution suggests that it is a relatively recent Pleistocene immigrant in America.

Dr. Baker has dissected specimens from Cheboygan County, Michigan and Philadelphia, Pennsylvania. His account follows:

"Foot: very dark; peripodial angle acuminate, but not protuberant; mucous pore in a groove just behind. Sole: very long and narrow; uniform. Mantle collar (Fig. 260:1): deep and thick in front of lung; right necklappet large and complex; left one small. Lung: aerating surface deeply pigmented; about 2½ times as long as its base or 2¼ times length of kidney; area between principal pulmonary vein and ureter with evident cross-veins. Kidney: long-triangular; a little over twice as long as its base and about 1⅔ times length of pericardium; secondary ureter considerably swollen.

"Ovotestis (Fig. 260:5): four, widely-separated clusters of subspherical acini; duct of medium length, gradually swollen in male phase (Fig. 260:3); talon clavate, with knob-like caecum; carrefour small and ellipsoid. Uterus: long; sacculately swollen in female phase. Free oviduct: apical ⅓ a large, ovoid sac with a heavy pilaster on left side of wall (markedly differentiated in female phase only). Spermatheca: sac subspherical, imbedded on columellar side of uterus, just below loop of aorta; stalk slender, divided opposite middle of oviducal sac into three branches: 1) short, stout duct, which pierces pilaster of oviducal sac; (2) long vaginal branch, which is basally swollen; (3) penial branch to base of vergic sac. Vagina: practically absent. Prostate: practically undifferentiated in female phase; slender and of long type in male phase. Vas deferens; short, passing directly to apex of epiphallus. Epiphallus (Fig. 260:2): slightly shorter than

Fig. 260. *Zonitoides nitidus*. 1, pallial complex; 2, penis and accessories of "male phase"; 3, genitalia of same; 4, dart from male phase; 5, genitalia of "female phase". *Zonitoides arboreus*, 6, dart; 7 (above) optical section of penis and accessories, diagrammatic; 7 (below) genitalia; 8, coronal gland from another specimen. A, anus; B, ovotestis; C, carrefour; D, dart-sac; DC, coronal gland; DM, dart retractor; E, epiphallus; F, free oviduct; G, prostate gland; H, heart and pericardium; HV, principal pulmonary vein; I, intimate sheath; K, kidney; L, left neck lappet; LU, umbilical lobe; M, mantle collar; N, pneumostome; O, cloaca and genital orifice; PM, penial retractor; R, right neck lappet; S, spermatheca; T, talon; U, uterus; V, vagina; X, (fig. 7, above), opening between vergic sac and capsule of penio-spermathecal duct; Y, albumen gland; Z, vas deferens. (After H. B. Baker.)

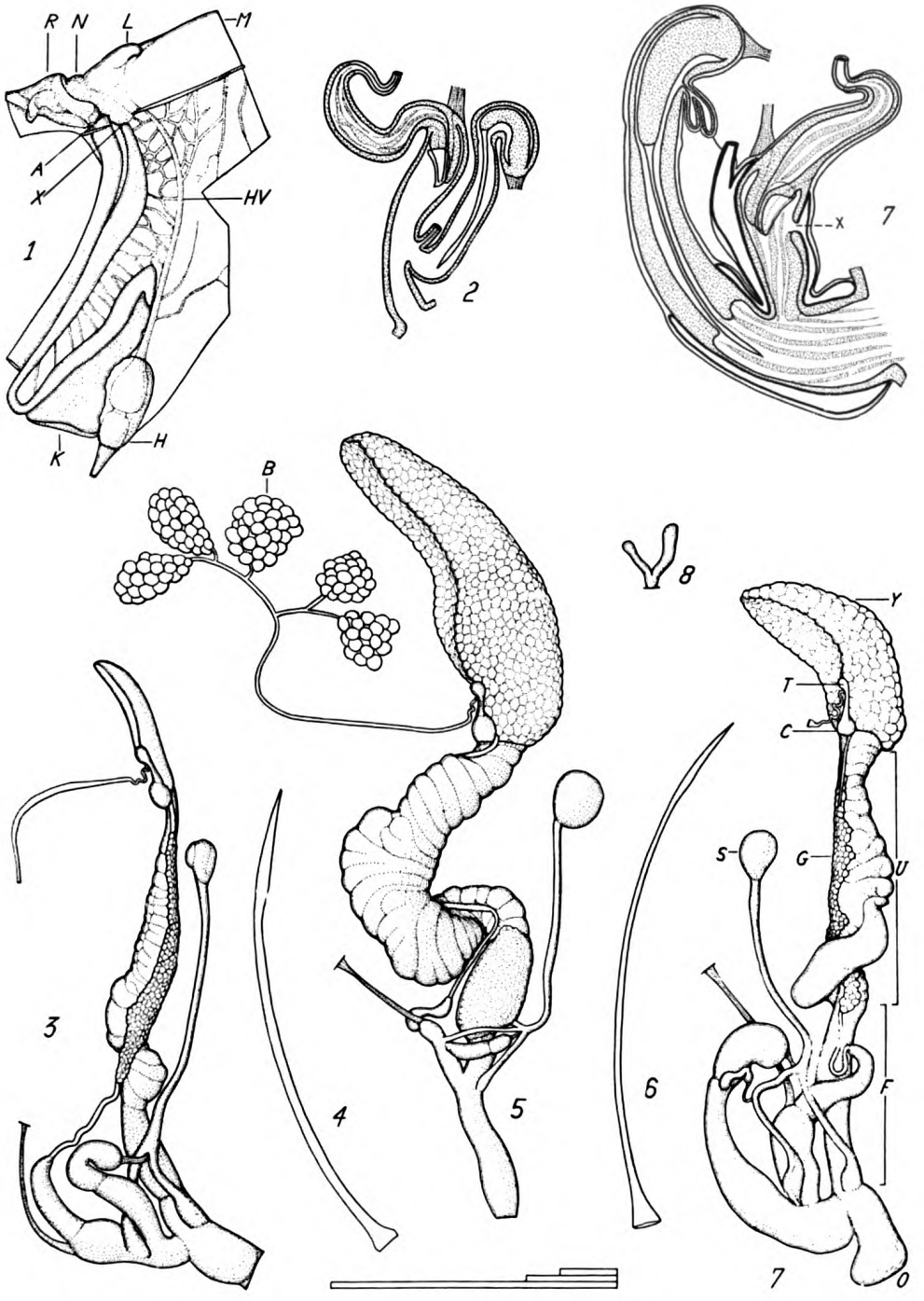

Fig. 260. See bottom of page 478 for legend.

penis with heavy pilasters; penial papilla large, partially invested by a curved, calcareous plate (Cf. Taylor, fig. 185). Penis: differentiated into a vergic compartment, a dart-sac and a short preputial portion. Vergic sac: swollen; penial papilla apical. Penial retractor: long and slender; insertion on side near apex of vergic sac. Dart-sac: twice as long as vergic sac; apical $\frac{2}{5}$ marked off by a slight constriction as a papillary sac, which is usually recurved and is slightly longer than its dart-papilla; coronary gland absent (although Taylor claims it is present in European individuals); basal $\frac{3}{5}$ containing long and slender, curved dart (Fig. 260:4). Dart retractor: short and stout; origin from spermathecal fork; insertion at apex of papillary sac. (The above description of the penis is based on the male phase; all of the parts, except the dart itself, are represented in the female phase, but are of much smaller proportions.) Cloaca: long in female and short in male phase; opening just above dorsal pedal groove, slightly behind anterior edge of visceral stalk.

"Columellar muscle gives off: 1) buccal retractor, which is practically separate at origin; 2) heavy right free muscle near origin; 3) left tentacular slightly below; 4) left lateral, which remains almost entirely fused to 5) tail muscle, that is above half as wide as either lateral. Right free retractor: promptly gives off tentacular retractor and somewhat heavier lateral muscle.

"Salivary glands: each flattened, irregularly lanceolate in shape, and about as long as buccal mass; mainly above, but somewhat investing oesophagus; right one about as long as its duct. Stomach: large. Intestine: S-loops imbedded in tongue of liver tissue and quite free from albumen gland.

"The connection between the spermathecal stalk and the free oviduct appears to be a unique feature of this species. Although it would require transverse sections for absolute proof, I feel fairly certain that it has a lumen. The more or less complete fusion of the left lateral muscle with the small tail retractor appears to be a common feature in the Gastrodontae."

(*Nitidus*, glittering.)

Group of Z. arboreus (Section *Zonitellus* H. B. Baker)

Zonitoides arboreus (Say) Figs. 261, 262.

Helix arboreus Say, 1816, [Nicholson's] Amer. Edit. British Encycl., vol. 2, art. Conchology, species no. 2, pl. 4, fig. 4.

Zonites arboreus Say. W. G. Binney, 1878, Terr. Moll., 5:114, pl. 29, fig. 3; pl. iii, fig. F (teeth).

Hyalina arborea var. *viridula* Cockerell, 1888. Science-Gossip. 24:257, Custer Co., Colo.

Hyalina arborea Say, Von Martens, 1892, Biol. Centrali-Amer., Moll., p. 116, pl. 6, figs. 13-13c.

Zonitoides arboreus (Say), J. Henderson, 1924, Univ. Colo. Studies, 13:147; 1929, 17:102; 1936, 23:109, 258.—Sterki, 1893, Proc. Acad. Nat. Sci. Phila., p. 394, development of teeth.—Chamberlin & Jones, 1929, Descr. Cat. Moll. Utah, p. 101 (generally spread in Utah).—Bartsch & Quick, 1926, Jour. Agric. Research, 32:783-791, pls. 1-4 (anatomy, etc.).—Bishop, Nautilus, 37:70 (in Mammoth Cave).—Lindholm, 1922, Ann. Mus. Zool. Acad. Sci. Russie, 23:307 (dist. in U.S.S.R., etc.).—H. B. Baker, 1928, Proc. Acad. Nat. Sci. Phila., 80:39, pl. 8, figs. 6-9; 1929, 81:255, pl. 8, fig. 7 (anatomy); 1930, Occas. Pap. Mus. Zool. Univ. Mich., 220:39 (Córdoba. V. C. 2650 ft.; Necaxa, Puebla, 3000-4925 ft.).—Connolly, Ann. S. Afr. Mus., 33:173.

Helix ottonis Pfeiffer, 1840, Arch. Naturg., 6:251 (Cuba).—Gould, 1851, Terr. Moll., 2:238.

Helix breweri Newcomb, 1864, Proc. Cal. Acad. Sci., 3:118 (Lake Tahoe, Cal.) Cf. H. B. Baker, Occas. Pap. Mus. Zool. Univ. Mich., 269:13.

Hyalina breweri Newc., W. G. Binney, 1869, Land and Fr. W. Sh. N. A., 1:43, fig. 66.

Helix whitneyi Newcomb, 1864, Proc. Cal. Acad. Sci., 3:118 (Lake Tahoe).

Hyalina whitneyi Newc., W. G. Binney, 1869, L. and Fr. W. Sh. N. A., 1:32, fig. 37.—H. B. Baker, 1931, Nautilus, 44:98 (identical with *Z. arborea*).

Hyalinia (*Polita*) *roseni* Lindholm, 1911, Nachrbl. d. d. mal. Ges., 43:98 (park near Moscow); cf. Lindholm 1922.

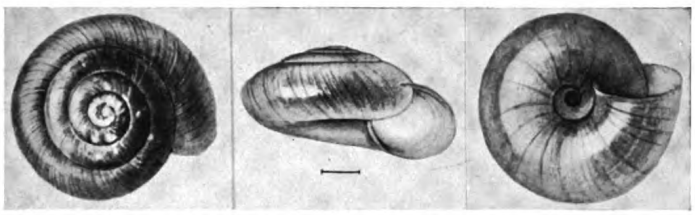

Fig. 261. *Zonitoides arboreus,* Philadelphia.

The shell is umbilicate, umbilicus contained about 4½ to 5 times in the diameter; translucent olive buff, glossy; composed of about 4½ moderately convex and regularly increasing whorls. Embryonic 1½ whorls smooth, following whorls irregularly, weakly sculptured with growth-wrinkles, and having extremely faint, minute spiral striae; the base smoother. Aperture rather deeply lunate, wider than high. Peristome thin.

Height 2.8 mm., diameter 5.4 mm. (Philadelphia).
Height 2.4 mm., diameter 5 mm. (Philadelphia).
Height 2.5 mm., diameter 5.3 mm., umb. in diam. 4.4 times. (York Co., Pa.)
Height 2.8 mm., diameter 6 mm., umb. in diam. 4 times; 4¾ whorls. (Williams Co., Colo.).
Height 3 mm., diameter 5.5 mm., umb. in diam. 5 times; 4¾ whorls. (Idaho Co., Ida.).

BRITISH AMERICA: Great Slave Lake; Peace River District; Field and Cameron Lake, B. C.; Victoria and near Union, Vancouver I. Edmonton, Alberta. Butler Island and Moose Factory, Ont. Newfoundland, generally distributed; Prince Edward I.; Nova Scotia; Magdalen Is.; Anticosti I.; Eardley and Montreal, Quebec; generally distributed in Ontario.

UNITED STATES: All of the states except Nevada. WASHINGTON: King, Spokane, Stevens, Walla Walla and Yakima counties. OREGON: Clackamas, Douglas, Jackson, Klamath and Umatilla counties. CALIFORNIA: Calaveras, Los Angeles, Madera, Mariposa, Modoc, Placer, San Bernardino, San Diego and Siskiyou counties. Throughout the Pleistocene from Aftonian to Recent.

MEXICO: States of Chihuahua, Nuevo Leon, Vera Cruz, Puebla and Morelos.

CENTRAL AMERICA: Banana River, Costa Rica. Peten, Guatemala.

WEST INDIES: Cuba, Santo Domingo, Jamaica, Guadeloupe.

Introduced in Hawaii; Japan; South Africa, widely spread in cultivated localities, Maritzburg, Natal; Vancluse, N. S. W., Australia; Prague; Lojo and Malm, Finland; Moscow.

The shell is smaller and more depressed than *Z. nitidus* and the living animal is lighter colored.

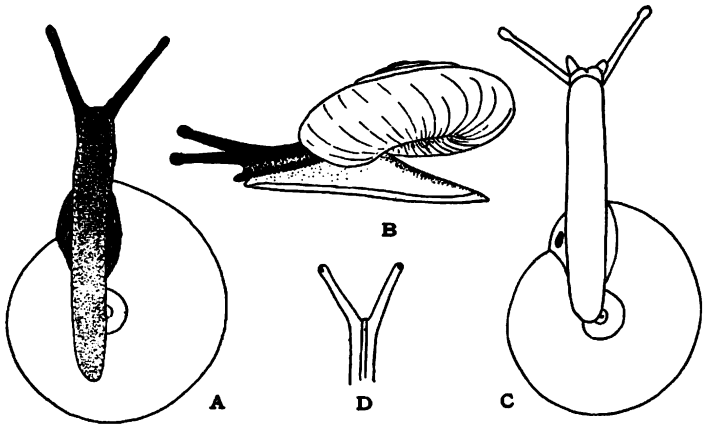

FIG. 262. *Zonitoides arboreus*, Philadelphia. A, B, moving on a horizontal plane; C, ascending a vertical tube; D, head, from above.

Its movements are rather quick. The eye tentacles are usually carried widely diverging. Their tips, bearing the distinct black eyes, are but slightly bulbous. Anteriorly the animal is bluish-gray above and on the tentacles, paler towards the foot edges, the sides and tail not pigmented. The sole is white or gray with paler flecks in a narrow border around the edge but without division otherwise. It shows no waves in progression. Mantle collar slate, closely flecked with white. The surface is copiously lubricated, not distinctly granulose in life, though alcoholic specimens are rather strongly so. Two dorsal grooves run along the back. Pedal furrows are distinct (Fig. 262 B). There is considerable variation in the shade of gray in different examples. The anterior parts are sometimes slate or, especially the tentacles and eye pedicels, nearly black, almost as dark as *Z. nitidus*, with darker stripes to the eye stalks, the sole remaining nearly colorless. A specimen with the shell 4.7 mm. in diameter had the sole 5.7 mm. long, 1.3 mm. wide. Another in rapid progression had a sole 0.8×4.5 to 5 mm.

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. In the southern Alleghanies I have found it up to about 5800 feet, and in the Colorado Rockies it has been taken at 10,000 feet.

There are areas of considerable extent whence *Z. arboreus* has not been reported. It is common in Florida south to the Miami region and middle Cape Sable, but has not been found on the Keys. There are but few records from Idaho, and in California many coastal counties are without records.

There is some variation in size and in the width of the umbilicus but the only considerable variation noted is in specimens from Magazine Mountain, Logan Co., Arkansas, where the shells taken are weakly striate, very glossy, with crowded but shallow microscopic spirals, and the umbilicus is very small; height 2 mm., diameter 3.9 mm., umbilicus contained 6.6 times in diameter; 4 whorls.

In Louisiana *Z. arborea* attacks the roots of cane, reached through earthworm burrows, eating out minute cavities through which deleterious microorganisms from the soil enter, often killing the plant (Nautilus, 39:70.)

Dr. Baker has given the following account of specimens from Cheboygan County, Michigan.

"Foot: long and slender; lighter in color than that of *Z. nitidus;* tail similar in structure. Lung: about 2¾ times as long as its base or 2¼ times length of kidney; minor venation indistinct. Kidney: 2¼ times as long as its base or twice length of pericardium.

Ovotestis: consisting of three groups of relatively larger, less numerous and more clavate acini; duct gradually but strongly swollen and weakly convoluted in basal half of length; talon (Fig. 260:7) more slender than in *Z. nitidus.* Uterus: shorter than in female phase of *Z. nitidus.* Free oviduct: quite long, without very definite enlargement. Spermatheca: stalk slightly shorter, without connection to free oviduct. Prostate: long type, but alveoli absent at apical end. Penis and accessories (Fig. 260:9): relatively larger than in *Z. nitidus*: dart (Fig. 260:6) and dart-sac proper longer; papillary sac shorter than dart-papilla, with bifurcate coronary gland (Fig. 260:8) near base. Cloaca: short and stout; opening as in *Z. nitidus.*

Radular formula: 19-6-1-25; 77 transverse rows counted. Central: tricuspid, noticeably larger than first lateral. Laterals: bicuspid: outermost bidentate tooth (6th) of marginal form.

The dart-papilla of immature specimens is continued by a stout, cellular outgrowth, in which the dart is secreted. Besides the characters mentioned in the key, this species lacks the connection between the spermathecal stalk and the free oviduct, which is present in *Z. nitidus,* and apparently does not develop a distinct oviducal sac. These differences seem to warrant the sectional separation of *Zonitellus. Zonitoides excavatus* ("Bean" Alder) is another member of the group." (H. B. Baker.)

(*Arboreus,* of a tree.)

Subgenus PSEUDOHYALUS H. B. Baker

Pseudohyalus H. B. Baker, 1929, Proc. Acad. Nat. Sci. Phila., 81:256, type *Zonitoides lateumbilicatus* (Pilsbry).

The openly umbilicate shell of about 5 mm. diameter, is strongly depressed, opaque, lusterless, with sculpture of fine, rather sharp striae along lines of growth, weaker on the base.

Zonitoides limatulus (Binney) Fig. 263.

Helix limatula "Ward, ined.", Binney, 1840, Boston Jour. Nat. Hist., 3:434, pl. 21, fig. 2 (Ohio); 1851, Terr. Moll., 2:220, pl. 30, fig. 3.

Zonites limatulus Ward, W. G. Binney, 1878, Terr. Moll., 5:117, pl. ii, fig. x (teeth).

Zonitoides limatula Ward, Walker, 1906, Ill. Cat. Moll. Mich., p. 484, fig. 59.

Zonitoides limatulus ("Ward" Binney), F. C. Baker, 1939, Fieldbook Ill. Land Sh., p. 80.

"Shell small, convex-depressed; epidermis white, immaculate; suture distinctly impressed; whorls more than four, convex, with very fine, oblique, parallel striae, which become obsolete on the base; aperture sub-circular, slightly modified by the penultimate whorl; lip thin, acute; umbilicus large and deep, not exhibiting all the volutions. Greatest transverse diameter about one-fifth of an inch." (Binney.)

Fig. 263. *Zonitoides limatulus,* Ohio. Scale lines = 1 mm.

The shell is much depressed, openly umbilicate, the umbilicus contained 3-4 times in the diameter of shell; thin, whitish-corneous or corneous with white striae, not transparent. Spire convex, whorls 4½, slowly widening, convex, joined by a deep suture; embryonic 1½ whorls smooth; following whorls finely, rather sharply striate along growth-lines, the striae almost effaced on the base; minutely and weakly striate spirally. Aperture oblique, rotund-lunate.

Height 2 mm., diameter 4.3 mm. (Ohio, from Binney).
Height 2.7 mm., diameter 5 mm. (St. Louis Co., Mo.).

New York: Cayuga Lake, Tompkins Co. (Banks). Onondaga Co. (Beauchamp). Greenwich, Washington Co. (Binney). Ohio: (C. J. Ward, M. D.[107]) Columbus, Cincinnati (Sterki) ?Michigan: Grand Rapids (Streng).[108] Indiana: Henry Co. (R.

[107] Dr. Ward lived at Chilicothe and later at Roscoe, Coshocton Co., and that may be the type locality if the species occurs there; but Sterki stated that *limatulus* does not occur in the adjoining Tuscarawas Co. The known Ohio localities are considerably farther southwest.

[108] Walker appears to doubt the old records of *limatulus* in Michigan; that from Grand Rapids needs confirmation

Walton); Wabash, Terre Haute, Indianapolis, Dearborn, La Porte, Parke and Jackson counties (Goodrich & Van der Schalie). ILLINOIS: Clark, Washington and Hamilton counties (F. C. Baker). MISSOURI: 4 miles east of Eureka, St. Louis Co. (Hubricht).[109]

Z. limatulus differs from all other *Zonitidae* of similar dimensions, in the northern states, by its lusterless, striate surface. *Z. lateumbilicatus* of the southern Appalachians is very similar, but it is somewhat flatter with slightly wider umbilicus and smaller aperture. *Z. limatulus* is rather rare and local except perhaps in southern Ohio and Indiana. Binney has confirmed the generic position by finding a dart in specimens he dissected. The radula, he states, has 23.1.23 teeth with 5 laterals.

Mr. F. A. Sampson (Ann. Rep. Geol. Surv. Arkansas for 1891, p. 183) states that, "on the Boston Mountains in Crawford County I found a shell bearing considerable resemblance to *Z. limatulus* Ward, but of only 3 mm. diameter, more depressed, sutures less impressed, and outer whorl more rounded."

(*Limatulus,* neat, or somewhat smoothed.)

Zonitoides patuloides (Pilsbry) Fig. 264.

Gastrodonta (*Pseudohyalina*) *patuloides* Pilsbry, 1895, Nautilus, 9:15.
Zonitoides patuloides Pilsbry, 1900, Proc. Acad. Nat. Sci. Phila., p. 141.

"Shell about the size and form of *Pyramidula striatella* Anth.; light green, hardly transparent; irregularly but closely rib-striate above, below

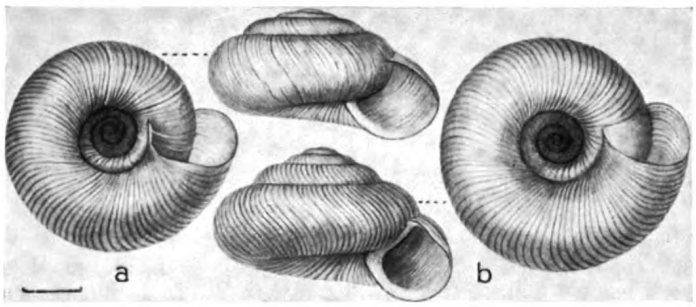

Fig. 264. *Zonitoides patuloides.* a, Thunderhead, Great Smoky Mts., Tennessee. b, Highlands, Macon Co., North Carolina. Scale line = 1 mm.

and in the umbilicus, the first 1½ whorls smooth. Whorls 4½, slowly increasing, convex, with impressed sutures; last whorl rather tubular, rounded at periphery and below; aperture about the size of umbilicus, round-lunate, flattened above, lip simple, the *upper margin flattened down and arched forward,* as in *Selenites* or *Gastrodonta elliotti;* retracted at insertion. Umbilicus large, showing all the whorls very plainly." (Pilsbry.)

The umbilicus is contained 3.2 times in the diameter.

[109] *Zonites limatulus* Ward was recorded from San Mateo, California, by W. G. Binney, 1878; but Hanna, 1939, believes it was "introduced accidentally, no subsequent collection has been made."

Height 2.5 mm., diameter 5 mm.; 4½ whorls. Type.
Height 3.6 mm., diameter 5.8 mm.; 5 whorls. Highlands, N. C.

TENNESSEE: Thunderhead, Great Smoky Mountains, Blount Co., under bark of a rotten log (Mrs. George Andrews), Type 12122 A.N.S.P. Cade's Cove at the foot of Thunderhead (Pilsbry, A. F. Archer). NORTH CAROLINA: several places around Highlands, Macon Co. (A. F. Archer).

A light grape-green shell, with the last whorl less depressed than *Z. limatulus,* and the riblets less effaced on the base, though weaker than on the upper surface. The degree of deflection of the last whorl at aperture varies. It is a rare species, the anatomy unknown.

Zonitoides lateumbilicatus (Pilsbry) Fig. 265.

Gastrodonta (*Pseudohyalina*) *lateumbilicata* Pilsbry, 1895, Nautilus, 8:102.—Sargent, ibid., p. 105.

Zonitoides lateumbilicata Pilsbry, 1898, Nautilus, 11:131.—Walker, 1928, Terr. Moll. Alabama, p. 98, fig. 137.

Zonitoides (*Pseudohyalus*) *lateumbilicatus* (Pilsbry), H. B. Baker, 1929, Proc. Acad. Nat. Sci. Phila., 81:256, pl. 9, figs. 1, 6, anatomy.

"Shell resembling *Ps. limatula* in color, texture and sculpture, but much depressed, the upper surface almost flat, last whorl of much smaller caliber, the umbilicus very much wider, shallow, its cavity widely open and saucer-shaped, much as in *Helicodiscus lineatus.*" (Pilsbry.)

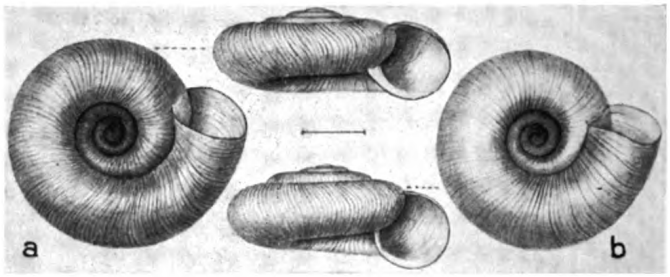

Fig. 265. *Zonitoides lateumbilicatus,* Marion Co., Tennessee. a, Sweden Cove; b, Dove. Scale line = 1 mm.

The striae continue over the base, becoming somewhat weaker there. The umbilicus is contained about 2.8 times in the diameter.

Height 1.7 mm., diameter 4.3 mm. Type.
Height 2.3 mm., diameter 5 mm.; 4½ whorls (Burnside, Ky.).

ALABAMA: some distance below Green Falls, near Nat, Jackson Co., abundant in leaf mold (H. E. Sargent), type and paratypes 65316 A.N.S.P. Florence, Lauderdale Co.; cove joining valley of Little Crow Creek, near Tennessee state line (H. H. Smith). TENNESSEE: Sherwood, Franklin Co., and Sweden Cove, Marion Co. (H. H. Smith). Dove, Marion Co. (H. B. Baker). KENTUCKY: Burnside, Pulaski Co. (H. E. Sargent).

It is more depressed than *Z. limatulus,* with a noticeably wider umbilicus, and the striae are somewhat stronger on the base.

Dr. Baker has given the following data:

"The following details of the anatomy were obtained from one of the cotypes of this species (A.N.S.P. 65316), after it had been soaked in dilute hydroxide. Despite its 34 years of dessication, a fairly good, although exceedingly brittle mount of the penis was procured.

"Foot: similar to *Z. arboreus*. Free oviduct (Fig. 257:6) quite long and cylindrical. Spermatheca: divisions of duct apparently as in *Zonitellus*, but details obscured by poor material. Vas deferens: epiphallus conical; penial papilla armed, arising from one side of the vergic sac. Penis: vergic sac longer than in *Z. arboreus*, orifice in wall triangular, but located as in that species; dart sac very long and slender, thickening (around apex of dart) inconspicuous: dart papilla short; coronal gland small and bifurcate; dart long, slender and almost straight; dart retractor not observed (probably broken); preputial sac very short. Cloaca: short; external opening as in *Z. arboreus*. Jaw: quite heavy, with median tubercle as in *Zonitellus*. Radular formula (Fig. 266): 17-5-1-22; 85 transverse rows, which are almost horizontal in lateral but slope anteriad in marginal fields. Central: large, tricuspid. Laterals: smaller and bicuspid. Marginals: innermost (6th tooth) bicuspid; remainder relatively short with steep cusp."

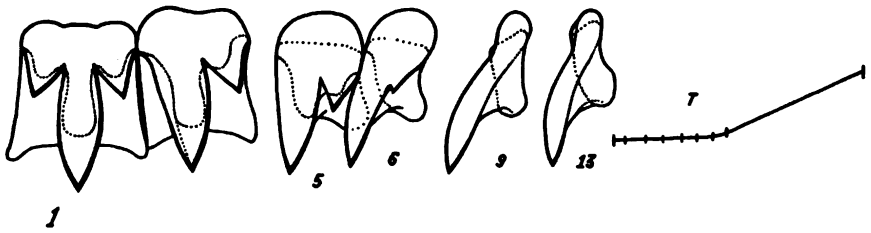

Fig. 266. *Zonitoides lateumbilicatus*, teeth; at T, outline of half of a transverse row (after H. B. Baker).

"As far as known, the anatomy of this species is very close to that of *Z. arboreus*. However, *Z. lateumbilicatus* appears to have a relatively longer and straighter dart and dart sac. The section *Pseudohyalus* is distinguished by its conchological characters." (H. B. Baker.)

STRIATURA Morse

Striatura Morse, 1864, Syn. Fluv. Terr. Moll. Me., p. 1; [110] Jour. Portl. Soc. N. H. 1:17, for *S. ferrea* and *S. milium*.—Tryon, 1865, Amer. Jour. Conch., 1:72, type *S. ferrea*.—H. B. Baker, 1928, Proc. Acad. Nat. Sci. Phila., 80:33, type *S. milium;* 1941, B. P. Bishop Mus. Bull., 166:324, 350 (Hawaiian species and their distribution).

Pseudohyalina Morse, 1864, Syn. Fluv. Terr Moll. Me., p. 1; Jour. Portl. Soc. N. H., 1:15.—Kobelt, 1880, Ill. Conchylienbuch p. 223, *Helix exigua* Stimps. designated type.

Striaturops H. B. Baker, 1928, Proc Acad. Nat. Sci. Phila., 80:33, "type *Striatura ferrea* Morse, but from Big Springs, near Univ. Mich. Biol. Sta., Cheboygan Co., Mich., my material."

[110] Morse's Synopsis was an undated list of Maine shells. As it was mentioned in the bibliography of his Portland Journal work, Dr. Baker considered it to be prior to that.

The shell is minute, depressed, umbilicate, thin, of few (3 to 3½) whorls, with sculpture of fine spiral striae and more or less obliquely axial riblets, which may be high and well spaced or fine and close, or in *S. ferrea*, subobsolete.

Genitalia, either having a well-developed penis and epiphallus, or with both much reduced. Penial dart, when present, short and conical, developed in apex of penis, and without connection with spermathecal duct. The spermathecal duct is long, anteriorly with branches to the base of the penis and to the vagina.

Jaw smooth with a low median projection when not worn away by the central tooth. Radula with tricuspid centrals, about as large as the first lateral or much larger, the basal-plate short and wide, the mesocone projecting well beyond it. Laterals few, 1 to 5, bicuspid, with short, wide basal-plates. The inner marginals are bicuspid, outer ones unicuspid.

Distribution.—Nearctic; one subgenus, *Pseudohyalina*, also in Hawaii.

These minute snails, with elaborately sculptured shells, have the branched spermathecal duct of *Zonitoides*, but the dart apparatus is either lost, or in *Striatura milium* remains reduced in size and moved to an apical position on the penis. The presence of three species in the Hawaiian Islands is an anomaly in distribution which appears explicable only on the supposition that the snails or their eggs were carried by migratory birds.

Key to subgenera of Striatura[111]

A. Penis with circlets or rows of spines near apex; epiphallus well developed; central of radula not much larger than first lateral; embryonic whorls of shell with distinct spiral ridgelets which begin at the very apex; later whorls gradually expanding, with oblique riblets superimposed on the growth-wrinkles
Subgenus *Pseudohyalina* Morse

AA. Penis without circlets of spines; central much the largest tooth in radula; embryonic whorls of shell with weak spirals which begin some distance below apex.
B. Epiphallus well developed; penis with apical dart-sac, papilla, and dart; radula with more than one bicuspid marginal (as in *Pseudohyalina*); shell small, diameter 1.5 mm., with less rapidly expanding whorls; one northeastern species ..... Subgenus *Striatura*, s. s.
BB. Epiphallus and penis almost vestigial; radula with only one bicuspid marginal; shell larger, maj. diam. 2.5 mm. or more, with more rapidly expanding whorls; one northeastern species ..... Subgenus *Striaturops*. H. B. B.

Key to species of Striatura

A. Umbilicus rather large, contained 2.5 to 3.3 times in diameter.
B. Shell 2 to 2.5 mm. diameter, with high, thin, widely spaced cuticular riblets, 30 to 40 on the last whorl; umbilicus about 2.6 times in diameter. Northeastern ..... *S. exigua*
BB. Shell diameter 2 mm. or less, with more numerous low riblets; umbilicus contained about 3 (2.8 to 3.3) times in diameter.
C. Riblets oblique, not beaded, parted by wider intervals; minute spiral striae extending to apex
D. Western, Vancouver I. to Lower California ..... *S. pugetensis*
DD. Middle States to Mexico ..... *S. meridionalis*
CC. Growth riblets crenulated by the spiral lines, very close, about equal to their intervals; spirals weak or wanting on first whorl; diameter about 1.5 mm. Northeastern ..... *S. milium*

AA. Umbilicus rather small, contained about 5½ times in diameter; shell 2.5 mm. or more diameter, of about 3½ rapidly increasing whorls; without distinct riblets, having irregular cuticular growth striae and minute spirals. Northeastern
S. ferrea

[111] Adapted from H. B. Baker.

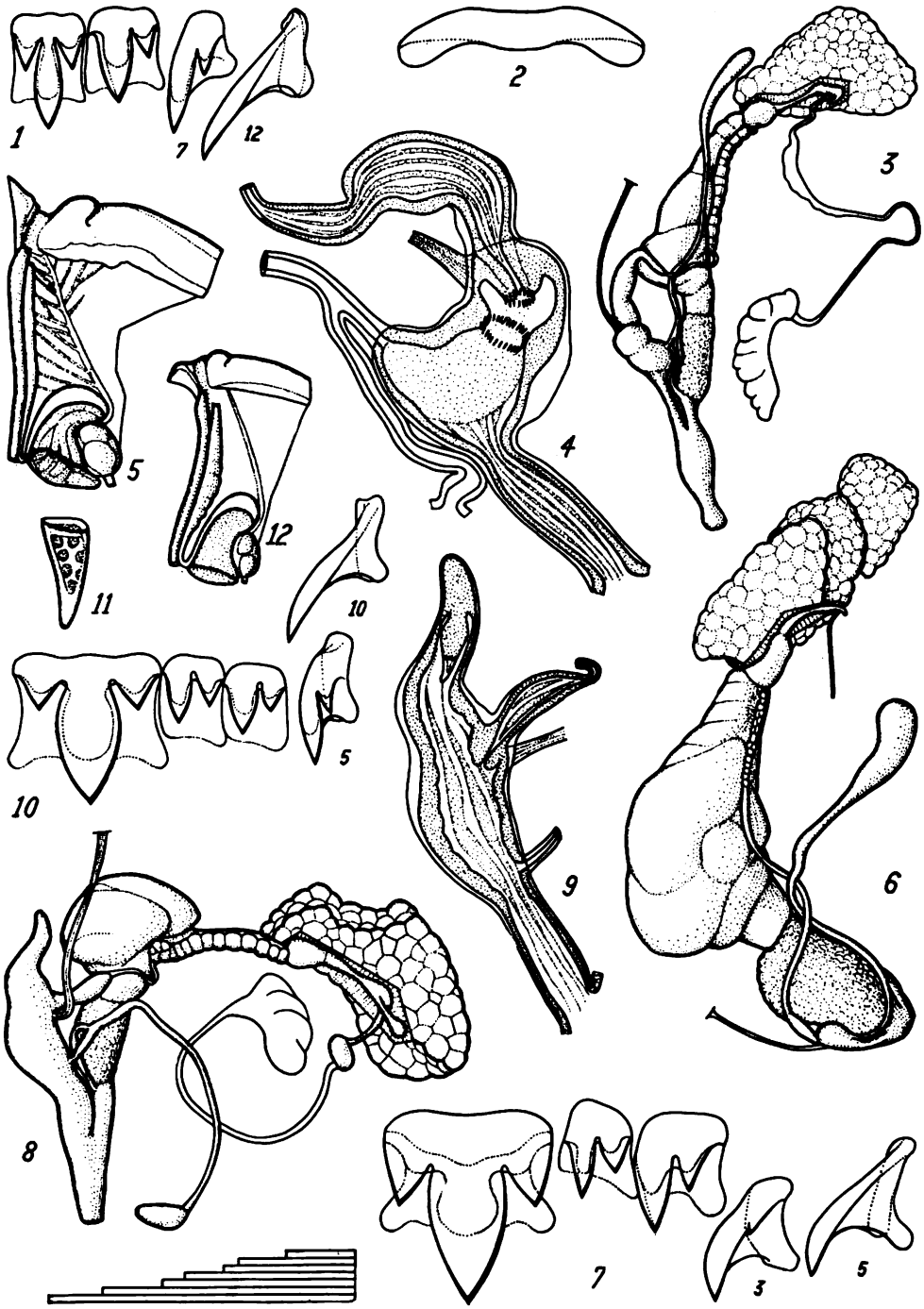

Fig. 267. 1-4, *Striatura exigua*. 5-7, *S. ferrea*. 8-12, *S. milium*. (After H. B. Baker.)

Subgenus PSEUDOHYALINA Morse

Striatura exigua (Stimpson) Fig. 268.

Helix annulata Case, 1847, Amer Jour. Sci. & Arts (2), 3:101, figs. 1-3 (near Lake Superior, apparently in northern Michigan). Not *Helix annulata* Gmelin, 1790, Syst. Nat. (13) 1:3622.

Helix exigua Stimpson, 1850, Proc. Boston Soc. N. H., 3:175 (vicinity of Boston, Mass.).—Morse, 1867, Amer. Nat., 1:543, fig. 34.

Pseudohyalina exigua Stimpson, Morse, Jour. Portland Soc. N. H., 1:16, pl. 2 fig. 3; pl. 7, fig. 33.

Zonites exiguus Stimpson, W. G. Binney, 1878, Terr. Moll., 5:122, pl. iii, fig. D teeth.

Striatura exigua (Stimpson) H. B. Baker, 1928, Proc. Acad. Nat. Sci. Phila., 80:33, pl. 7, figs. 1-5 (anatomy).

"Shell minute, discoidal, pellucid, corneous-greenish, a little convex above, concave below; whorls 3½, convex, spirally striate and (except at apex) having distant longitudinal ribs which are obliquely crossed by growth striae. Last whorl rounded; suture impressed; umbilicus wide. Aperture rounded, the lip simple. Diameter .078 inch." (Stimpson.)

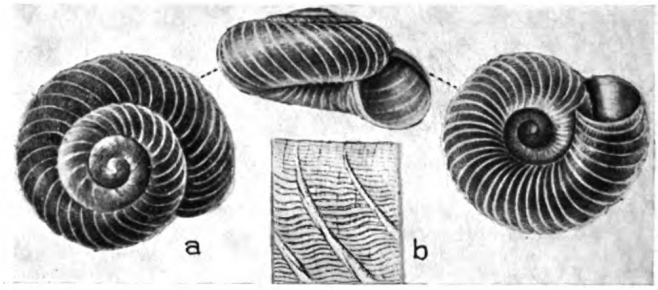

Fig. 268. *Striatura exigua,* Greenwich, N. Y.

The shell is depressed, broadly, openly umbilicate, the umbilicus more than one-third the diameter of the shell, and larger than the aperture; thin, yellow or greenish-yellow, composed of 3½ whorls. First whorl smooth, the rest closely striate spirally. After about 1½ whorls, narrow retractive riblets appear, more oblique than the growth-lines and rather widely spaced, about 36 to 40 on the last whorl, the intervals densely covered with spiral striae, which become tangential on the last whorl. Aperture small, rotund. Height 1.25 mm., diameter 2.3 mm.

Nova Scotia: Hectanooga, Digby Co. Maritime Provinces: Grindstone and Basin Islands, Magdalen Is. Prince Edwards Is. (B. Long). Ontario: Lake Temagami and Nipissing (J. Oughton); Hamilton (Hanham), 1½ miles east of Malachi and near Cygnet Rapids (Mosley). Maine: Aroostook, Cumberland, Hancock, Oxford, Penobscot and Piscataquis counties. Vermont: Fairlee, Orange Co. Massachusetts: Plymouth and Middlesex counties. Vicinity of Boston, type loc. (Stimpson). New York: Franklin, Greene, Herkimer, Monroe, Onondaga, Tompkins, Washington and Ulster counties. New Jersey: Cape May Courthouse. Pennsylvania: Allegheny, Monroe, Northampton and Pike counties. Ohio: Portage Co. Michigan: Cheboygan and Kent counties. Minnesota: Duluth (W. Stone).

This charming little snail, like most of the Canadian zone species, extends into the Alleghanian fauna, though not extensively. It may be recognized by the beautiful, wavy spiral striation and the radial ribs, which are more oblique than growth-lines and are more widely separated than in any other *Striatura*. In *Planogyra asteriscus* the ribs run less obliquely and are not so numerous. *S. exigua* generally prefers low, wet ground, acording to Morse.

Dr. Baker dissected specimens from Cheboygan Co., Michigan.

"Living animal: body light-colored, slightly greenish; sole relatively broad and without pedal waves in locomotion, but with entire foot showing some serpentine undulation; movement relatively slow. Tail: rounded posteriad; peripodial angle acute and hiding inconspicuous mucous depression. Mantle collar: wide and glandular; right and left neck-lappets quite large. Lung: about 3 times as long as its base or about $2\frac{1}{3}$ times length of kidney; minor venation not observed. Kidney: a little over twice as long as its base or about $1\frac{2}{3}$ length of pericardium; secondary ureter swollen and sacculate, especially just anterior to level of apex of kidney.

"Ovotestis (Fig. 267:3): roughly lanceolate in shape, weakly lobate on its sutural side; imbedded with long axis parallel to that of liver; duct long, strongly swollen for about $\frac{1}{3}$ of its length near base; talon long-stalked, caecoid tip swollen and recurved; carrefour ellipsoid. Uterus: relatively short, broadly swollen at base. Free oviduct: quite long and stout; basal $\frac{3}{4}$ with yellow, glandular development. Spermatheca: sac clavate, imbedded along side of albumen gland; duct bifurcate, with short, stout, penial branch and longer, more slender, vaginal one. Vagina: short. Prostate: almost as long as uterus. Vas deferens: short and transverse. Epiphallus (Fig. 267:4): large, acuminate apically and swollen near middle; with heavy wall and coarse, longitudinal plicae; penial papilla low and rounded, crowned by a circlet of small, apparently horny spines. Penis: apical $\frac{2}{5}$ swollen and heavy-walled, with a second, larger circlet of spines near apex and a heavy, transverse, glandular thickening which extends from entrance of epiphallus to that of spermathecal duct; basal $\frac{3}{5}$ more slender and thin-walled. Penial retractor: very long and slender; insertion at apex of penis; intimate sheath complete. Cloaca: long, opening on side of foot, slightly anterior to middle of visceral stalk.

Columellar muscle gives off: 1) buccal retractor which is practically separate, and almost as heavy as remainder; 2, 3) right and left free retractors near origin; and continues as 4) main band to tail fan. Right free retractor: divides, some distance above root of tail into right tentacular and slender right lateral, which gives off band to base of cloaca; right ocular free from genitalia. Left free retractor: left tentacular given off almost immediately; left lateral closely associated with tail muscles.

Jaw (Fig. 267:2) much like that of *Z. arboreus*, but with less prominent median projection. Radular formula (Fig. 267:1): 9-7-5-1-21; 60 transverse rows counted. Central: tricuspid; base slightly longer than broad; cusps of medium length, ectocones almost as broad as mesocone. Laterals: first slightly smaller than central with considerably shorter mesocone; entoconal shelf entire. (The centrals and laterals are all very small in relation

to the size of the animal, and no sharp line can be drawn between the laterals and the bicuspid teeth of elongate form.) Marginals: inner seven bicuspid; outer nine unicuspid; ectoposterior projection stout and short; backs of aculeate teeth fairly broad. Salivary glands: mass triangular, about ⅓ as long as buccal mass; ducts short. Intestine: S-loops quite deeply imbedded in albumen gland, although accompanied by considerable liver tissue." (H. B. Baker.)

Subgenus STRIATURA s. str.

Striatura pugetensis (Dall) Fig. 269.

Patulastra? (*Punctum?*) *pugetensis* Dall, 1895, Nautilus, 8:130 (Seattle).—Cf. Pilsbry, Nautilus, 9:18.

Striatura milium pugetensis (Dall), Berry, 1919, Proc. Acad. Nat. Sci. Phila., p. 203.

Striatura pugetensis (Dall), H. B. Baker, 1930, Occas. Pap. Mus. Zool. Univ. Mich., 220:38, pl. 11, fig. 3; 1941, B. P. Bishop Mus. Bull., 166:325, pl. 60, figs. 1-3.

"Shell minute, pale greenish yellow, nearly smooth, the first whorl and a half smooth, the others with fine, silky, close-set, hardly elevated lines or minute regular riblets, somewhat flexuous and in harmony with the incremental lines; form moderately elevated, the whorls inflated with a deep suture, and, in the adult, rapidly enlarging near the aperture in the latter part of the last whorl; aperture large, quite oblique, almost circular, the segment of the body between the two lips about one-sixth of the whole; umbilicus ample, scalar, exhibiting part of all the whorls which make, in adults, from three to three and a quarter volutions. Alt. 0·5; max. diam. 1·5, min. diam. 1·2 mm." (Dall.)

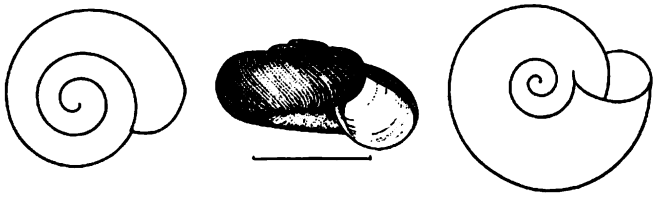

Fig. 269. *Striatura pugetensis*, near Lake Crescent, Washington. Scale line = 1 mm.

BRITISH COLUMBIA: Vancouver Island, 4 miles south of Union and at Cameron Lake (C. M. Cooke, Jr.); near Duncan (A. W. Hanham).

WASHINGTON: many places in Clallam, King, Pacific, Pierce and Snohomish counties; Type 107541 U.S.N.M. from near Seattle. OREGON: Clackamas Co. (J. A. Allen), Clatsop, Klamath and Multnomah counties (H. B. Baker). MONTANA: McDonald Canyon, Glacier Nat. Park (S. S. Berry). CALIFORNIA: Alameda, Calaveras, Los Angeles (W. O. Gregg), and Mariposa counties. San Juan Capistrano Creek, Orange Co. (M. E. Caruthers). Mountain Home, San Bernardino Mts. (S. S. Berry). Palomar Mts., San Diego Co. (J. L. Baily, Jr.).

LOWER CALIFORNIA: Guadalupe Island (G. D. Hanna).

HAWAIIAN Is.: Kauai in several places (C. M. Cooke Jr.).

Dr. Berry writes: "As compared with specimens of typical *pugetensis* from Seattle, the [Glacier National Park] Montana shells are notably larger (major diameter 1.67-1.85 mm.), flatter, and coarser in appearance, slightly

approaching in some respects the giant southern *meridionalis* Pilsbry and Ferriss. It may be that one day this mountain race will require a name of its own. Meanwhile the record is a new one for the state."

The following notes by Dr. H. B. Baker " are based on animals from near Piedmont (Lake Crescent), Clallam Co., Washington. Their genitalia are very similar to those in *S. meridionalis*, but the spermathecal sac is fusiform and lies imbedded near the base of the stomach and on the side opposite the albumen gland. Also, the penis (fig. 271 d) is armed with two elliptical circlets of small spines, one on either side of epiphallar opening, and with a single, large, stouter spine near the basal edge of each ring. In several individuals, the cloaca is exserted with the everted penis on its tip and certainly appears to substantiate the hypothesis advanced for the condition in *S. meridionalis*. This peculiar relationship between the penis and cloaca seems to present additional evidence in favor of my earlier suggestion that *Pycnogyra* may represent an approach to the Gastrodontinae and throws new light on a possible method of origin for the bifurcate spermathecal stalk in that subfamily." (H. B. Baker.)

" The two small examples from Kauai show no tangible characters to distinguish them from examples from the Pacific coast of the United States" (H. B. Baker).

Striatura meridionalis (Pilsbry & Ferriss) Fig. 270.

Vitrea milium meridionalis Pilsbry & Ferriss, 1906, Proc. Acad. Nat. Sci. Phila., p. 152.

Zonitoides milium meridionalis P. & F., Pilsbry & Ferriss, ibid., 1910, p. 130.

Striatura (*Pseudohyalina*) *meridionalis* (P. & F.), H. B. Baker, 1930, Occ. Pap. Mus. Zool. Univ. Mich., 220:36, pl. 11, fig. 2, 4, 5.

R(*adiodiscus*) *orizabensis* Pilsbry, 1921, Nautilus, 35:49, no description; cf. Nautilus, 39:28.

" Similar to *V. milium* but larger, diam. about 1.75 mm., with nearly $3\frac{1}{2}$ whorls, the first one finely, *distinctly lirate spirally*, the last whorl with oblique wrinkles much coarser than in *milium*, more or less anastomosing, and fine spiral striae, the latter distinct on the base.

" *V. milium* with the same number of whorls is smaller and more finely wrinkled, and in Maine and Ohio shells spirals on the first whorl are excessively weak or wanting, not deeply engraved to the tip, as in Texas shells." (P. & F.)

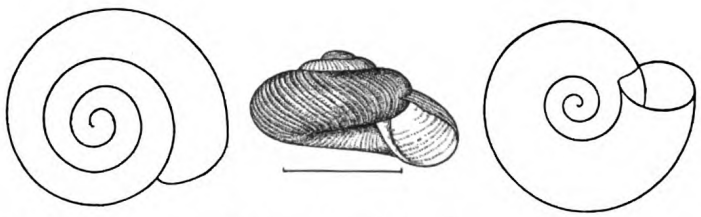

Fig. 270. *Striatura meridionalis*, Comal Co., Texas. Scale line = 1 mm.

PENNSYLVANIA: Beaver, Bucks, Chester, Montgomery, Northampton and Philadelphia counties. NEW JERSEY: Atlantic, Burlington, Camden and Cape May counties. DELAWARE: Kent and Sussex counties. MARYLAND: Garrett and Queen Anne counties. VIRGINIA: Amherst, Rockbridge and Page counties. WEST VIRGINIA: Marlinton, Pocohontas Co. NORTH CAROLINA: Alexander, Cherokee, Macon, Stokes and Watauga counties. SOUTH CAROLINA: Manning, Clarendon Co. TENNESSEE: Bledsoe, Carter, Franklin, Knox, Marion, Monroe and Unicoi counties. ALABAMA: Baldwin, Chambers, Clarke, Jackson, Madison and Randolph counties. FLORIDA: Alachua, Citrus, Clay, Hernando, Leon, Levy, Marion and St. Johns counties. MISSISSIPPI: near mouth Pascagoula River, Jackson Co. MISSOURI: near Eureka, St. Louis Co. ARKANSAS: Arkansas, Ashley, Calhoun and Ouachita counties. TEXAS: Bastrop, Comal, Hays, Medina and Val Verde counties. Type 90724 A.N.S.P., from along the Guadalupe River above New Braunfels. NEW MEXICO: Sacramento Mts., Otero Co. Santa Fe. Black Range, Grant and Sierra counties. Mogollon Mts. ARIZONA: Blue Mts., Graham Co.; Reservation Creek, Apache Co. Dragoon Mts., Chiricahua Mts. and Dos Cabezas. Huachuca Mts. Rincon Mts. Santa Catalina Mts. Bill Williams Mt., Coconino Co. Near Jerome, Yavapai Co.

MEXICO: near Orizaba (Heilprin); Necaxa, state of Puebla (H. B. Baker); near Pablillo, state of Nuevo Leon (Pilsbry).

BERMUDA: Whitby Cove, Bailey's Bay (Arthur Haycock).

According to Dr. Baker, " In the United States, *S. meridionalis* does not appear to endure the winter in the adult state. Specimens from Tennessee, collected during the last week in March and the first of April, are not fully mature; one out of five topotypes, obtained the last week in June, approaches maturity. On the other hand, several animals from Tennessee, collected in July and August, are sexually ripe. The following anatomical notes are mainly based on animals from Necaxa; only salient differences from the structure in *S. exigua* are given."

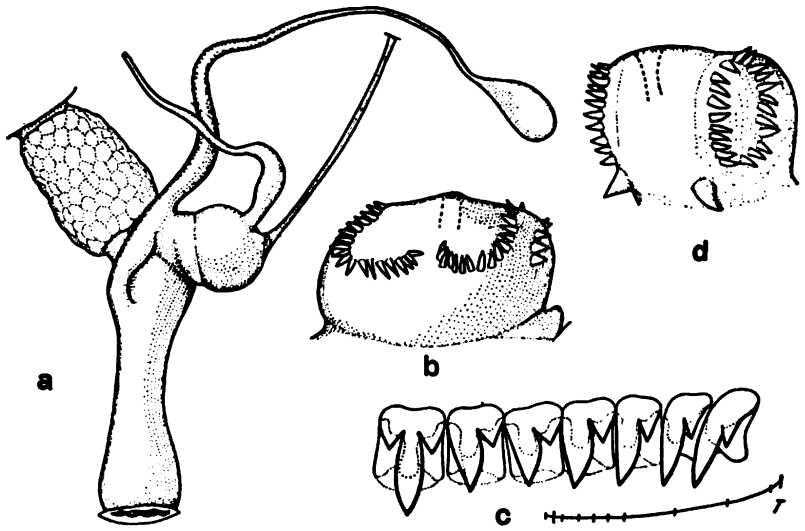

Fig. 271. a, *Striatura meridionalis,* terminations of genitalia; b, everted penis, outlines of epiphallic opening shown at apex; c, radula, diagram of right half of transverse row at T. d, *Striatura pugetensis,* Clallam Co., Washington, everted penis.

" Uterus: more markedly sacculate basally. Free oviduct (Fig. 271 a): more swollen and relatively shorter. Spermatheca: sac clavate, imbedded near base of albumen gland; stalk expanded at fork to form a small capsule which stretches across base of penis and is attached to cloaca; opening into cloaca slightly below penis (*i.e.*, vagina is a minus quantity). Prostate: about half length of uterus. Vas deferens: relatively long. Epiphallus: proportionately smaller; no distinct penial papilla. Penis: very small and short, little more than a subspherical, very thick-walled excrescence on side of oviduct; internally with two dome-shaped bosses, one on either side of epiphallar opening, each of which bears an S-shaped row of spines; those in outer arm of S stouter and more distant than remainder (fig. 271 b). Cloaca: long and thick-walled. Radular formula (Fig. 271 c) 11-5-5-1-21; 61 rows counted. Marginals: innermost 5 bicuspid, intergrading with laterals.

" One of the Mexican animals has the cloaca, penis, and part of the free oviduct exserted. The everted penis looks like a dome-shaped boss (Fig. 271 b). I suspect that the cloaca acts as the major portion of the copulatory organ and that the penis proper serves only as its glans." (H. B. Baker.)

Striatura milium (Morse) Fig. 272.

Helix milium Morse, 1859, Proc. Boston Soc. N. H., 7:28; 1867, Amer. Nat., 1:543, fig. 36.

Striatura milium Morse, 1864, Jour. Portland Soc. Nat. Hist., 1:18, figs. 41, 42; pl. 7, fig. 43.—H. B. Baker, 1928, Proc. Acad. Nat. Sci. Phila., 80:35, pl. 7, figs. 8-12.—F. C. Baker, 1939, Canad. Jour. Res., 17: 100.

Zonites milium Binney, 1878, Terr. Moll., 5:119, figs. 34, 35.

The shell is very minute, broadly umbilicate (umbilicus nearly one-third the diameter of shell), with low, conic-convex spire; yellowish-corneous or gray; composed of slightly over 3 convex whorls. Embryonic shell of 1½

Fig. 272. *Striatura milium*. Central figure × 25.

whorls, the first one smooth, the next half whorl usually more or less distinctly striate spirally. Post-embryonic whorls regularly, finely costulate, the riblets retractive, more oblique than growth-lines, and decussated by closer spirals. On the base this sculpture is almost effaced, and the surface more glossy. Last whorl tubular. Aperture subcircular. Height 0.8 mm., diameter 1.5 mm.

CANADA: Prince Edward I. (Bayard Long) Lake Nipissing (J. Oughton). Lake Kahnipiminanikok, Rainy River district (F. C. Baker).

MAINE: Cumberland, Hancock, Kennebec, Knox, Penobscot, Piscataquis and York counties; type loc., Portland. MASSACHUSETTS: Barnstable, Middlesex and Plymouth counties. NEW YORK: Erie, Niagara, Schuyler and Tompkins counties; Huntington, L. I. NEW JERSEY: Lake Hopatcong, Morris Co., Foul Rift, Warren Co. PENNSYLVANIA: Adams, Berks, Delaware, McKean, Monroe, Montgomery and Northampton counties. WEST VIRGINIA: Braxton Co. OHIO: Kent, Portage Co. MICHIGAN: Cheboygan and Livingston counties. ILLINOIS: Joliet, Williamson Co., subfossil (Ferriss), McHenry Co. (F. C. Baker). INDIANA: Gibson and La Porte counties (Daniels). KENTUCKY: Mammoth Cave, Edmonson Co.

This tiny snail is readily recognized by its beautiful sculpture. It 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 of pine, spruce and hemlock.

"The animal is white, the head and tentacles faintly marked with dark spots." (Morse.)

H. B. Baker writes: "My material comes from Cheboygan County, Michigan; three animals were dissected. The anatomy has many points in common with that of *S. exigua* and will be compared to the latter.

"Tail: narrowly rounded posteriad; peripodial angle abruptly pointed. Mantle collar (Fig. 267:12): narrow but heavy; right and left neck-lappets medium in size. Lung: about 3 times as long as its base and about 2⅓ times length of kidney; venation very weak. Kidney: about 1½ times as long as its base or length of pericardium; secondary ureter much as in *S. exigua*.

Ovotestis (Fig. 267:8): short, ellipsoid and weakly lobed; duct of medium length, swollen near base into short knot and enlarged again at confluence with stalk of talon; free talon clavate in shape; carrefour ellipsoid; both talon and carrefour deeply imbedded in albumen gland and relatively very large. Uterus: short, apical ⅜ very slender; basal ⅜ expanded into a sacculate bulb. Free oviduct: relatively large, major portion with yellow, glandular development. Spermatheca: sac obovoid, imbedded just below middle of albumen gland; vaginal and penial branches of duct short but stout. Vagina: short and narrower than free oviduct. Prostate: narrow, about ⅜ length of uterus. Vas deferens: quite short and transverse. Epiphallus (Fig. 267:9): shorter than that of *S. exigua;* penial papilla large but low, on side of penis between dart-sac and penis proper. Penis: apex developed, beyond epiphallar orifice, into a sac which contains a large dart papilla and a conical dart (Fig. 267:11): apical ⅜ of penis proper with very heavy walls; basal ⅝ more slender, with thinner walls; spermathecal opening between these two regions. Penial retractor: long and strong; insertion near entrance of epiphallus. Cloaca: rather long; opening on side of foot, just in front of middle of visceral stalk.

"Columellar muscle gives off: 1) big buccal retractor, which is practically separate; 2) right free retractor a short distance below; 3) left tentacular at same level; and continues as 4) broad band to tail fan. Right free retractor gives off: 1) right lateral immediately (this accompanies tail muscle and is about ¼ as wide as latter); 2) a very slender band, a short distance below (this rejoins lateral and takes part in vague band to cloaca); and continues as 3) right tentacular retractor; right ocular free from genitalia. Left lateral: apparently fused to tail fan.

" Radular formula (Fig. 267:10): 9-5-3-1-17; transverse rows counted with shape as shown by Morse (l.c.). Central: base slightly longer but very much broader than first lateral; sides slightly emarginate; mesocone very heavy; ectocones small in comparison. Laterals: similar in shape to those of *S. exigua*, but only three in number. Marginals: inner five bicuspid; outer nine unicuspid; also similar to preceding species. Salivary glands and intestinal loops: as in *S. exigua*.

" This species is perhaps closest to *S. exigua*, but is more or less intermediate between that species and *S. ferrea*, and also approaches the Gastrodontae. The shape of the ovotestis, the swelling of its duct, the development of the prostate, epiphallus and penis, the length of the cloaca, the elongate bicuspid teeth of the radula and the form of the shell agree most closely with the conditions in *S. exigua*. The very large central of the radula and the sculpture of the shell are most like these characters in *S. ferrea*. The presence of a dart, with a well-developed papilla, approaches the arrangement in the Gastrodontae.

" This development of the dart, in a species which is the smallest member of the Gastrodontinae (and one of the smallest in the Zonitidae), directly contraverts the usual idea that small species have simplified genitalia. Apparently, *S. milium* can manufacture these structures with some rapidity, as one or two loose ones may lie in the main cavity of the penis." (H. B. Baker.)

Subgenus STRIATUROPS H. B. Baker

Striatura ferrea Morse Fig. 273.

Striatura ferrea Morse, 1864, Jour Portl. Soc. N H., 1:17, figs. 36-39, pl. 2, fig. 10, pl. 7, fig. 40.

Zonites ferreus Morse, W. G. Binney, 1878, Terr. Moll., 5:121, figs. 37, 38.

Striatura (Striaturops) ferrea (Morse) H. B. Baker, 1930, Proc. Acad. Nat. Sci. Phila., 80:36, pl. 7, figs. 5-7.

" Animal dark blue, foot rapidly narrowing to an acute point behind. Shell very small, translucent, with a steel grey tint, not shining: having three volutions, the outer whorl rapidly enlarging, aperture well rounded, very large, spire slightly elevated. Suture distinct, and deeply channeled near the apex. Umbilicus small, though abrupt, and exhibiting all the volutions. Diameter .10 inch, axis .05 inch. Periostraca minutely marked with fine revolving lines, and lines of increase, which reticulate the whole surface.

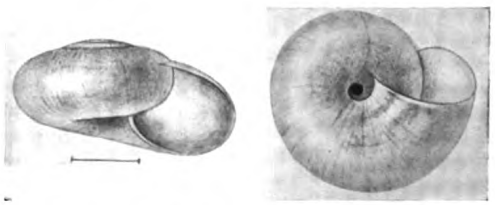

Fig. 273. *Striatura ferrea*. Scale line = 1 mm.

H. ferrea lacks also the impressed radiating lines so characteristic of *H. indentata*. The apex is marked with distinct revolving lines, the open umbilicus is constant, and it is not half as large as an adult *indentata;* finally the dead color alone is sufficient to distinguish it from the latter shell. Found in damp localities." (Morse.)

Diameter 2.5 to over 3 mm.

NOVA SCOTIA: Digby, Hants and Queens counties (Bayard Long). QUEBEC: 19 mi. south of St. Fabien (Mrs. Titus).

MAINE: Aroostook, Cumberland, Hancock, Kennebec, Knox, Oxford and York counties. VERMONT: Fairlee, Orange Co. NEW HAMPSHIRE: Exeter, Rockingham Co. NEW YORK: Onondaga, Tompkins and Warren counties. PENNSYLVANIA: McKean, Monroe, Northampton and Pike counties. MARYLAND: Jennings and near Bittinger, Garrett Co. NORTH CAROLINA: Cranberry, Watauga Co.; Chalk Mountain, Mitchell Co. WEST VIRGINIA: Franklin, Pendleton Co. OHIO: Garrettsville, Portage Co. MICHIGAN: Douglas Lake, Cheboygan Co. KENTUCKY: Pine Mt., Harlan Co. TENNESSEE: top of Roan Mt., Carter Co.

The shell has the appearance of a *Retinella,* as the whorl increase is more rapid than in other striaturas.

Dr. Baker writes: " The three animals dissected come from Cheboygan County, Michigan. The anatomy will be compared with that of *S. milium.*

" Living animal: ommatophores short and stout (those of *S. milium* are long); eyes large; movement slow and awkward, usually with worm-like expansions and contractions of entire body; sole uniform and relatively broad; foot with considerable black pigment; ommatophores very dark; mantle with hindgut and veins outlined with black granules. Mantle collar (Fig. 267:5): slightly wider than in *S. milium;* heavy and glandular; right neck-lappet small, left one large. Lung: about twice as long as its base or $2\frac{3}{5}$ times length of kidney; principal pulmonary vein large, with a number of tributaries, especially between it and hindgut. Kidney: shortened and crowded posteriad outside of anterior loop of intestine (more so than in *S. milium*); anterior end curved to left beyond pericardium; slightly longer than its base and $1\frac{1}{2}$ times length of pericardium; secondary ureter not so strongly swollen as in *S. exigua* and *S. milium.* (Despite the shortening of lung and kidney, the proportions between length of lung, kidney and pericardium are quite similar to those in the other species of *Striatura.*)

" Ovotestis: irregular in shape, consisting of two weakly-lobed, longitudinal, ellipsoid masses connected by a broad isthmus; duct medium in length and slender; talon (Fig. 267:6) large and elongate, with short caecum; carrefour big and ellipsoid (relatively smaller than in *S. milium*). Uterus: relatively short and stout. Free oviduct: large and swollen, almost all of its wall with yellow glandular development. Spermatheca: sac clavate, with only apical half above loop of aorta; vaginal branch of duct short; penial branch curved across dorsal side of free oviduct near body wall to enter terminal sac of penis. Prostate: scarcely differentiated, consisting of a few alveoli along upper portion of seminal groove (seen in sections). Vas deferens: long, passing directly to epiphallus, which is simply a slight, poorly differentiated, terminal enlargement; no penial papilla. Penis: a small ovoid sac with slender stalk, imbedded in side of free oviduct. Penial retractor: difficult to distinguish from fibers which bind free oviduct to body wall: apparently arises from side of diaphragm and inserts on apex

of penis.[112] Cloaca: exceedingly short; opening on side of foot, anterior to middle of visceral stalk.

"Columellar muscle gives off: 1) practically separate, relatively narrow, buccal retractors; 2, 3) large right and small left free retractors near origin; and spreads out into broad tail fan. Free retractors: tentacular muscles given off immediately; lateral retractors closely associated with tail fan.

"Radular formula (Fig. 267:7): 19-1-2-1-22; 46 transverse rows counted. Central: relatively larger than in *S. milium*, with more deeply constricted base and larger ectocones. Laterals: first reduced in size; second much as in *S. milium*. Marginals: one bicuspid; remainder unicuspid; ectoposterior processes long and slender.

"The penis in this species appears to be little more than a link between the male system and the spermathecal duct. However, the very short cloaca may conceivably permit its use as a copulatory organ." (H. B. Baker.)

Subfamily VITRININAE

The shell is very thin, of few rapidly enlarging whorls, and with imperforate axis; the aperture very large with simple, thin lip. The foot is narrow, tripartite, with pedal grooves but no caudal pit. Mantle with ample body and shell lobes. Kidney short. Marginal teeth with two or more points.

VITRINA Draparnaud

Vitrina Drap., Tableau Moll. Terr. France, 1801, pp. 33, 98, for *Helix pellucida* Müller.

The shell is imperforate or very narrowly perforate, heliciform, composed of few (usually 2½ to 3) rapidly increasing whorls; very thin, fragile, glassy and transparent; spire low, convex, the first whorl microscopically pitted spirally (Fig. 4 H). Aperture very ample, excised by the preceding whorl, the peristome thin and simple.

The foot of *V. limpida* 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 peripodial 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 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. (Fig. 274 d, e, f.).

The lung is very short. Kidney is very short and wide, its width about one and one-half times the length of the pericardium (Fig. 274 G).

The genital orifice is close behind and below base of right eye peduncle. Atrium is very long. The vas deferens and retractor muscle are terminal on the penis. The prostate gland is as long as the sacculate uterus. Free oviduct is short and wide. Spermatheca oval, on a short duct inserted at apex of atrium, as a vagina can hardly be said to exist (Fig. 274 c).

[112] Hugh Watson remarked upon the "hemiphallic" appearance of the male organs of *S. ferrea*.

The jaw is smooth, with a strong median projection. Teeth (Fig. 274 B, *V. limpida*) 27,10,1,10,27. Centrals and laterals with long mesocones and

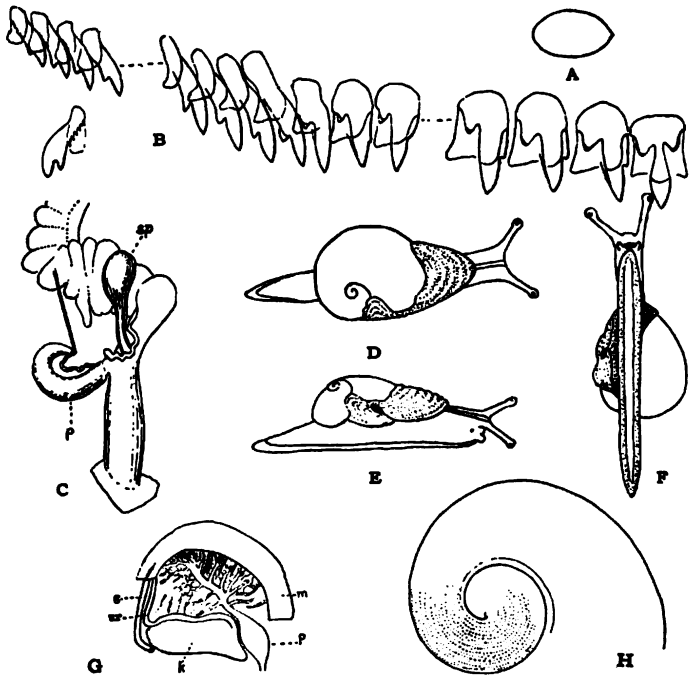

Fig. 274. *Vitrina limpida*, near Pittsburgh, Pa. A, egg × 6.5. B, teeth. C, anterior part of genitalia. D, E, F, living animal × 2. G, pallial organs. H, early whorls of shell. g, hindgut; k, kidney; m, mantle edge; p, pericardium and penis; sp, spermatheca; ur, secondary ureter.

short ectocones with extremely small overhanging cutting points. The marginals have the ectocones well developed and elevated on the mesocones. Some of the outer marginals of *V. limpida* are serrate below the ectocone, outwardly; this is not easily seen except in isolated teeth.[113]

The eggs of *V. limpida* are oval, usually acute at one end, translucent, closely peppered with buff dots, and plump but flexible. Length 1.6, diam. 1.2 mm. (fig. 274 a).

No living animal of *V. limpida* or any American *Vitrina* has been figured hitherto. *V. limpida* resembles *V. pellucida* of Europe, the type of the genus, externally. The Rocky Mountain species, *V. alaskana* Dall, is a less ample animal.

[113] Paul Hesse's paper: "Beiträge zur näheren Kenntnis der Familie Vitrinidae," in Archiv für Molluskenkunde, LV, 1923, may be consulted for data on the anatomy and classification of Vitrinae. He did not deal with American species. The nomenclature and the generic and subgeneric synonymy of the group have been considered by H. B. Baker, 1929, Nautilus, 42:137-139, and the classification by Luther Forcart, 1914, Revue Suisse de Zoologie, 51:629. As all American species belong to the typical section of *Vitrina*, the many subgeneric names applied to palearctic forms need not concern us here.

Vitrina is a holarctic genus, in America chiefly developed in the Canadian fauna, but also extending into the Transition zone. In the East *V. limpida* has not occurred south of the vicinity of Pittsburgh, Pa., but in the West *V. alaskana* reaches practically to the Mexican boundary, at considerable elevations in southeastern Arizona. These two species are all that we have in continental America, where the genus is apparently an immigrant from the Old World, of no long residence, probably Pleistocene.[114]

A remarkable shell character of *Vitrina* is the microscopic pitting of the latter half of the initial whorl and first part of the next (fig. 274 H). This has not been figured before, so far as I know, though noticed briefly in the author's Land Mollusks of the Belgian Congo, p. 281 (1919). It is seen best in young shells mounted in balsam.

(Generic name from *vitrum*, glass.)

Vitrina limpida Gould Figs. 274, 275.

Vitrina pellucida DeKay, Zoology of New York, Mollusca, 1844, p. 25, pl. 3, fig. 42.—Binney, 1851, Terr. Moll., 2:55. Not of Müller, 1774.

Vitrina limpida Gould, 1850, in Agassiz, Lake Superior, p. 243 (Cape Gourganne, Nipigon Bay, Ontario); 1851, Terr. Moll., 2:58, pl. 67a, fig. 1.—Morse, 1864, Terrestrial Pulmonifera of Maine, 1864, p. 11, pl. 5, f. 17.—Lewis, 1872, Proc. Acad. Nat. Sci. Phila., p. 107.—W. G. Binney, 1878, Terr. Moll., 5:136, pl. 67a, fig. 1, pl. vi, fig. c.—Dall, 1905, Harriman Alaska Exped., Moll., 13:37.—Clapp, Nautilus, 7:47, 94; 9:94; 17:91.—Walker, 1906, Ill. Cat. Moll. Mich., 1:476.—Goodrich, Occ. Pap. Mus. Zool. Univ. Mich., 233:4; 1912, Moll. of Mich., p. 28.—Mozley, 1928, Nautilus, 42:15.

Vitrina americana Pfeiffer, 1852, Proc. Zool. Soc. Lond., 20:156; Conchyl. Cab. p. 9, pl. 1, figs. 22-25 (United States of North America).

"Shell globose-discoid, thin, fragile, transparent, shining, whorls two and a half to three, scarcely convex, with very minute lines of increase, the last whorl large, and much expanded. Suture not much impressed, sometimes with an impressed line revolving near it; aperture large, sub-ovate, somewhat diminished by the intrusion of the penultimate whorl. Peristome thin and acute, the columellar margin a little reflected. Axis imperforate. Greatest transverse diameter nearly one-fourth of an inch." (Gould.)

The shell is colorless or of a pale green tint, glossy, with faint sculpture of low growth-wrinkles and, near the apex, microscopically pitted in irregular spirals (Fig. 274 H). The slender, slightly sinuous axis is visible through the shell. Whorls $2\frac{3}{4}$, rapidly increasing.

Height 4.5 mm., diameter 6 mm.

LABRADOR: Blanc Sablon (Bayard Long); Anticosti I. (Latchford). NEWFOUNDLAND: generally spread from Straits of Belle Isle south (Long). MARITIME PROVINCES: Magdalen Is.; New Brunswick. QUEBEC. ONTARIO: Ottawa, Moose Factory, James Bay (Whiteaves, Nautilus, 19:4). Lake of the Woods. Russel Lake, Rainy River district. "Scarce and sporadic in southern Ontario,[115] more common in central and northern

[114] "*Vitrina*" *obliqua* Meek & Hayden, 1857, of the Judith River Cretaceous, Montana, is a poorly preserved umbilicate land shell, certainly not a *Vitrina*.

[115] For limits of the divisions of Ontario used by naturalists see Canadian Field Nat., 53:22-24.

Fig. 275. *Vitrina limpida* × 2.

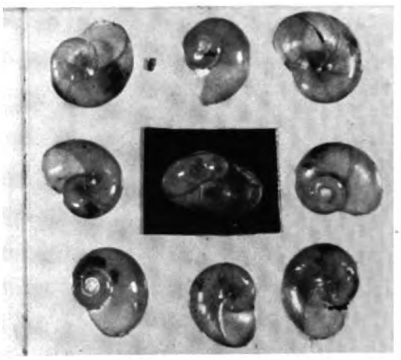

Fig. 276. *Vitrina alaskana* × 2.

Ontario, Cochrane district, north to James and Hudson Bays." (Oughton.) MANITOBA: Carberry, Morris, Winnipeg, Westbourne and Ninette. ALBERTA: Red Deer and Laggan. MAINE: generally spread, seen from Aroostook, Hancock, Knox, Penobscot and York counties. MASSACHUSETTS: Westport (Johnson). NEW YORK: Alleghany, Clinton, Erie, Herkimer, Madison, Monroe, Onondaga, Oneida, Otsego, Rensselaer, Tompkins and Wayne counties. PENNSYLVANIA: Leetsdale, Allegheny Co. MICHIGAN: (Only north of the Saginaw-Grand valley); Isle Royale, Ontonagon Co.; Lime Island in the St. Mary's River, Charlevoix, Traverse City and Crystal Lake, Benzie Co. (B. Walker). Copper Harbor, Keweenaw Co. (Goodrich).

Vitrina limpida was at first considered to be specifically identical with the European *V. pellucida,* and J. W. Taylor (1906) returned to that view, ranking the American form as a variety. While closely related, our species differs in the shell, which is a little more depressed and less extensively, more finely and irregularly, punctate at the apex (the punctation of *V. pellucida* being in beautifully regular spiral series); also in the genitalia, the duct of the spermatheca being slender, equal throughout, not swollen basally as figured for *V. pellucida*. *V. alaskana* is distinct by external characters of the animal.

The clear glass-snail occurs in the northern tier of states and Canada west to northern Minnesota and Alberta. 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.

"In November and December of 1864, by the side of a shaded ditch near the Mohawk River [near Mohawk, Herkimer Co., N.Y.], were found immense numbers of a species of *Vitrina*. The specimens were very fine, and attained an average size of nearly one-fourth of an inch in diameter, many of the larger ones exceeding somewhat this diameter. Since that time, no living specimens of *Vitrina* have been seen in this vicinity. It may also be remarked that previous to 1864 the station which produced the *Vitrina* had been visited yearly for small helices, but no specimens of *Vitrina* had until 1864 been detected, and at that time only in that one limited station" (Lewis, '68, 242).

Dr. George H. Clapp has recorded *Vitrina* from the drift debris of the Ohio River below Pittsburgh, in copious numbers, active in October and November, when the temperature was about 35° to 45° F. On November 8th and 15th they were depositing eggs, in bunches of six or eight, under rotting wood on the ground. "During ten years I have been watching this colony, I have never seen living ones in spring or summer although I have hunted for them carefully. In October they appear suddenly in large numbers. From October to January is their active season, and during these months they may be found active on any pleasant day. Have found them very active when the temperature was below 40° ".

According to Taylor,[116] in the related *V. pellucida* (Müll.) of Europe, the eggs have been observed to hatch on the 21st and 22nd. of March. "The young do not increase much in size during the summer months, but keep quite small and are difficult to find. They attain full growth during the colder months of the year, and die off in the early spring, after a life-period of twelve to fifteen months."

(*Limpidus*, transparent.)

Vitrina alaskana Dall Fig. 276.

Vitrina pfeifferi Newcomb, 1861, Proc. Cal. Acad. Sci., 2:92 (Carson Valley, Nevada).—Binney, 1878, Terr. Moll., 5:138, fig. 53, pl. 2, fig. A.—Raymond, 1890, Proc. Cal. Acad. Sci., (2), 3:62. Not *V. pfeifferi* Deshayes, 1851, cf. Nautilus, 19:107.

Vitrina alaskana Dall, 1905, Alaska: Land and Fresh Water Moll., Harriman Alaska Exped., 13:37, new name for *V. pfeifferi* Nc.—Pilsbry & Ferriss, 1906, Proc. Acad. Nat. Sci. Phila., p. 153; 1911, p. 191; 1917 p. 103; 1918 p. 327 (Arizona, New Mexico).—Henderson, 1924, Univ. Colo. Studies, 13:141 (Colorado, Utah, Wyoming); 1929, 17:98 (Oregon, Washington); 1936, 23:108 (Utah, Wyoming, Montana).—Chamberlin & Jones, 1929, Bull. Univ. Utah, 19:93.

"Shell moderately depressed, smooth, shining, greenish white; whorls 3, the last composing most of the shell; suture very finely margined; aperture large, obliquely and roundly ovate; lip thin; columella arched. Axis 2 mm. diameter 5 mm." (Newcomb.)

ALASKA: Muir Inlet; St. Paul, Kadiak Island; Popof and Unga Islands, of the Shumagin group; Akutan; Unalga; Rooluk; and Unalaska, of the Aleutian chain; St. Paul and St. George Islands, Bering Sea, in tall grass of bluff fifty feet above the sea (Dall). BRITISH COLUMBIA: Nanaimo and near Duncan, Vancouver Island.

WASHINGTON: Yakima and Walla Walla counties; Spokane Co. OREGON: Wallowa, Umatilla and Klamath counties. IDAHO: Adams, Bonner, Idaho, Nez Perce and Shoshone counties. MONTANA: Fergus, Gallatin, Glacier, Powell and Ravelli counties; Glacier National Park. SOUTH DAKOTA: generally spread in the Black Hills, Lawrence Co.; Reva Gap, Slim Buttes, Harding Co. WYOMING: Ft. Bridger, Uinta Co.; Fremont Co.; Yellowstone National Park. COLORADO: known from most counties west of the 105th meridian. UTAH: Salt Lake, San Juan, Tooele and Washington counties; Zion National Park. NEVADA: Charleston Mt., Lincoln Co., and White Pine, White Pine Co. Carson Valley, type locality. CALIFORNIA: Fresno, Inyo, Lassen, Madera, Mariposa, San Bernardino, Siskiyou, Tulare and Plumas counties, 4000-8000 ft. ARIZONA: around Navajo Mt., Navajo Co. Bill Williams Mt.; southern rim of Grand Canyon below cross-bed

[116] J. W. Taylor, Monograph of the land and freshwater Mollusca of the British Isles, III, p. 6.

sandstone; Kaibab Plateau and Mt. Trumbull, Coconino Co. Reservation Creek, 9000 ft., Apache Co. Blue Mts., 12000 feet, Graham Co. Santa Catalina Mts. at 8-9000 ft. Chiricahua Mts. in parks around head of Cave Creek at about 8000 ft. Huachuca Mts. on Miller Peak. NEW MEXICO: Near Raton, Colfax Co.; Ft. Wingate, McKinley Co.; Las Huastus Canyon, Sandia Mts., Bernalillo Co.; near Las Vegas, San Miguel Co. Mogollon Mts. Black Range in Grant and Sierra counties, generally spread at 8-9000 ft. White Oaks, Lincoln Co. Sierra Blanca and Cloudcroft, Sacramento Mts., Otero Co.

Dall says of the Alaskan glass-snail that: "when fully grown under favorable conditions the shell may reach 10 mm. in major diameter, though most of the specimens as collected are considerably smaller. The shell is translucent, with a marked greenish tinge, and not over three whorls. It is flatter than *limpida,* larger, and of a different tint, and the size of the whorls increases more rapidly. It is less flat and much larger than *V. exilis,* which is also of a different hue. It is the most common land shell on most of the islands of Bering Sea and on the continent near the sea, where it usually occurs."

Unlike *V. limpida,* of which adult animals are to be found only late in autumn, I have seen *V. alaskana* active and of full size in August to October, in Arizona and New Mexico. The usual diameter of the shell is about 6 mm., sometimes up to 7.4 mm. Living animals observed October 15, at Bill Williams Mountain, were far less voluminous than *V. limpida.* There is a small shell-lobe covering the termination of the suture. In progression the tail did not project behind the shell.

In the mountain states from the eastern Rockies to the western slopes of the Sierra Nevada of California, this is a common snail. From Colorado northward "it is found almost everywhere that other land snails occur, and is by no means confined to the higher elevations" according to Junius Henderson, who has very fully recorded the details of its occurrence in the region from Colorado and Utah to Montana and Washington. Chamberlin & Jones state that "*Vitrina alaskana* Dall shares with *Oreohelix strigosa depressa* (Cockerell) the distinction of being the most widely distributed and most abundant snail in Utah. Specimens of *Vitrina alaskana* from Dry Canyon are often so membranous that they collapse when touched. We have seen the shells so membranous that they could be dented without breaking."

Farther south *Vitrina* occurs only at considerable elevations, as on the San Bernardino Mountains in California, and in southern Arizona and New Mexico, where it lives at about 8000 feet and above.

Vitrina angelicae Beck **Fig. 277.**

Helix pellucida Müll., O. Fabricius, 1780, Fauna Groenlandica, p. 389 (Siuterursak, Greenland).

Vitrina angelicae Beck. 1837, Index Moll., p. 1, based upon preceding reference.—Mörch, 1868, Amer. Jour. Conch., 4:27, pl. 3, figs. 1, 4.—Binney, 1878, Terr. Moll., 5:137, fig. 52.—Dall, 1905, Harriman Alaska Exped., 13:36, fig. 25.

"Shell vitreous, somewhat convex, greenish-buff, polished; whorls 3½, about equally raised on both sides; aperture moderate, rounded, subtransverse; columella somewhat straightened at base; peristome thin, brownish. Near *V. beryllina,* but larger, more convex and darker colored." (Beck MS. in Mörch, 1868.)

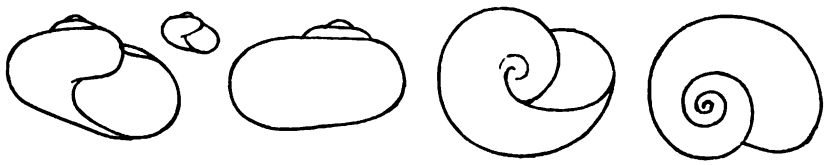

Fig. 277. *Vitrina angelicae,* enlarged and actual size (after Mörch).

"Animal bluish-gray, head black; the mantle edge bluish-gray, densely black-speckled; the hind part of the foot pale gray. The lobe of the mantle very small, by which latter character, and the smaller number of whorls, it is distinguished from *Vitrina pellucida* Müll." (Möller MS., in Mörch.)

GREENLAND: near the hot springs of Godhavn; Sukkertoppen.

Mörch's figures are copied. It seems a doubtful species, but Simroth, who dissected a single individual thought to be immature, found significant differences from *V. pellucida* in the genitalia. This needs further investigation. The single lot of Greenland vitrinas seen, from Sukkertoppen, seems to be indistinguishable in characters of the shell from *V. pellucida.*

G. Mandahl-Barth (1938) considers *V. angelicae* synonymous with *V. pellucida* (Müller). He remarks that "the Icelandic specimens of *Vitrina pellucida* belong to the larger race *angelicae* (Beck) Mörch, which, besides its larger size, is characterized by the sex-organs, especially penis, which is relatively more strongly developed than in *Vitrina pellucida.*" (The Zoology of Iceland, IV, part 65, p. 11.)

(Named for the umbelliferous plant *Angelica archangelica,* or *officinalis* L., among which Fabricius found it.)

SUPPLEMENT TO FAMILY CAMAENIDAE, SUBFAMILY AMMONITELLINAE (Vol. I, p. 554)

The genus *Megomphix* was omitted in its proper place, following *Glyptostoma,* in Vol. I, p. 573. As it has been considered a zonitid snail, and would naturally be looked for in that connection, it is thought best to include it here.

The subfamily Megomphicinae (Nautilus, 43:96, 100) may best be placed in the synonymy of Ammonitellinae; though prior in date, it was founded upon a misconception, and its definition would include only one of the five genera.

MEGOMPHIX H. B. Baker

Megomphix H. B. Baker, 1930, Nautilus, 43:96, for *M. hemphilli* (W.G.B.).

The shell is umbilicate, subdiscoidal, with nearly flat spire of rather closely coiled whorls, glossy, zonitoid in the light color and texture, with thin, sharp, unexpanded lip, but young shells have minute spiral lines on the parietal wall of aperture.

Foot aulacopod in appearance, the tail rounded behind, flattened, with a shallow diamond-shaped caudal foss; the sole tripartite.

Kidney about as long as pericardium, with closed secondary ureter.

Penis rather long, internally plicate longitudinally, with terminal retractor and reflexed epiphallus. No flagellum. Free oviduct joined near its base by a large ellipsoidal caecum with thick, internally plicate walls. Spermatheca with long duct. Talon long (Fig. 279:3).

Jaw strong, weakly and closely rib-striate.

Radula with broad, tricuspid central; 9 laterals in the type, broad, bicuspid; marginals narrower but scarcely longer, with short bases, mainly bicuspid, with lanceolate mesocone and small ectocone or ectocones (Fig. 279:1).

This snail of the Columbia river valley and the coastal region northward is wholly similar to *Glyptostoma* in genitalia and pallial organs, in the jaw, and in the general type of radula. It is like *Glyptostoma* also in the form of the shell, and the possession of minute spiral sculpture on the parietal wall in the young. It differs chiefly in external characters of the foot, which Dr. Baker described as aulacopod, with tripartite sole. But it must be remembered that holopod snails have furrows which may sometimes simulate the aulacopod structure. Thus in *Glyptostoma gabrielense* (Fig. 278) a weakly impressed pedal groove lies close above the foot angle, but it is the suprapedal groove which defines an aulacopod-like foot fringe, being unusually high above the pedal groove proper. I presume that this is substantially the structure of *Megomphix,* also, but I have not seen that snail in the flesh.

In *G. gabrielense* the sole shows very faintly impressed lines defining

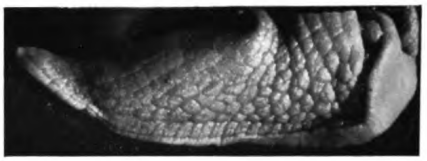

Fig. 278. Foot of *Glyptostoma gabrielense,* alcoholic specimen from Dominguez Hills, showing pedal and suprapedal grooves.

three areas in some alcoholic examples, not visible in others; but this is often noticeable in other holopod snails, in which the active central field of the sole may be visibly differentiated from the relatively inactive sides, the difference in muscular structure being variously expressed in contracted alcoholic examples, or sometimes hardly perceptible. I cannot make out any

tail fossa in *Glyptostoma*. I have not observed the locomotion of *Glyptostoma, Megomphix,* or any other Ammonitellinae, but I think waves will be found spread over the sole though weaker laterally, as in Helicidae, not limited to the central field as in the limaces and many Zonitidae. However, the difference is apparently not of fundamental importance since both arythmic and typically tritaxic types of locomotion are represented in snails we still refer to the family Zonitidae. It will be remembered that Binney & Bland at one time (1869) thought that *Glyptostoma* was a zonitid snail.

The question arises, should we consider *Megomphix* generically distinct from *Glyptostoma?* The stronger foot grooves of the former, the presence of a caudal foss and more distinctly tripartite sole, the somewhat different teeth, the small size, and the light color of the shell, may perhaps be held sufficient grounds for generic separation, though possibly subgeneric status may be better.

History.—M. hemphilli, the type species of *Megomphix,* was described by W. G. Binney in 1879 as a "*Macrocyclis,*" a name then used for *Haplotrema.* His statement, "The jaw and lingual dentition are as usual in the genus," led Dr. Baker to remark, "I cannot believe that W. G. Binney ever saw the radula of this species, as it has no resemblance to that in the *Haplotrematidae.*" C. F. Ancey, in 1882, did not accept Binney's generic reference, placing *M. hemphilli* in *Hyalinia,* a genus of the Zonitidae then understood in wide limits, including snails now placed in *Oxychilus, Retinella,* and other genera. *M. hemphilli* was collected by Dr. H. B. Baker in 1929, and an excellent account of the anatomy, reprinted below, was published in 1930. He made it type of the new genus *Megomphix,* in a new subfamily, Megomphicinae, of the family Zonitidae. This was retained in his Check List of 1933; but *Megomphix* was not mentioned in his later (1941) lists of zonitid and helicarionid genera—apparently indicating doubt as to its zonitid affinities. Thiele, 1931, placed *Megomphix* in the Endodontidae on account of the character of the radula.

(Μέγας, great, ὀμφαλός, umbilicus.)

Megomphix hemphilli (W. G. Binney) Fig. 280 a, b.

Macrocyclis hemphilli W. G. Binney, 1879, Ann. N. Y. Acad. Sci., 1:356, pl. 15, fig. 17, Olympia, Wash.; 1883; 1st Suppl., Bull. Mus. Comp. Zoöl., 11:137, pl. 2, fig. M; 1885, Man. Amer. L. Sh., pp 85. 475, fig. 48.

Hyalinia (Ammonoceras) hemphilliana Ancey, 1882, Le Naturaliste, 2:29, 110 (new name for *Macrocyelis hemphilli* W. G. B., from Olympia), with var. *tenuis,* p. 29, same locality.

Megomphix hemphilli (W. G. Binney), H. B. Baker 1930, Nautilus, 43: 96, pl. 5, figs. 1-4, anatomy.—Henderson, 1936, Univ. Colo. Studies, 23: 260.

"Shell allied to *M. vancouverensis,* but the umbilicus is narrower and not so much excavated, the termination of the last whorl not receding from the umbilicus, as in all forms of *vancouverensis* and *concava;* in all, the whorls are more or less strongly striated within the umbilicus, often almost

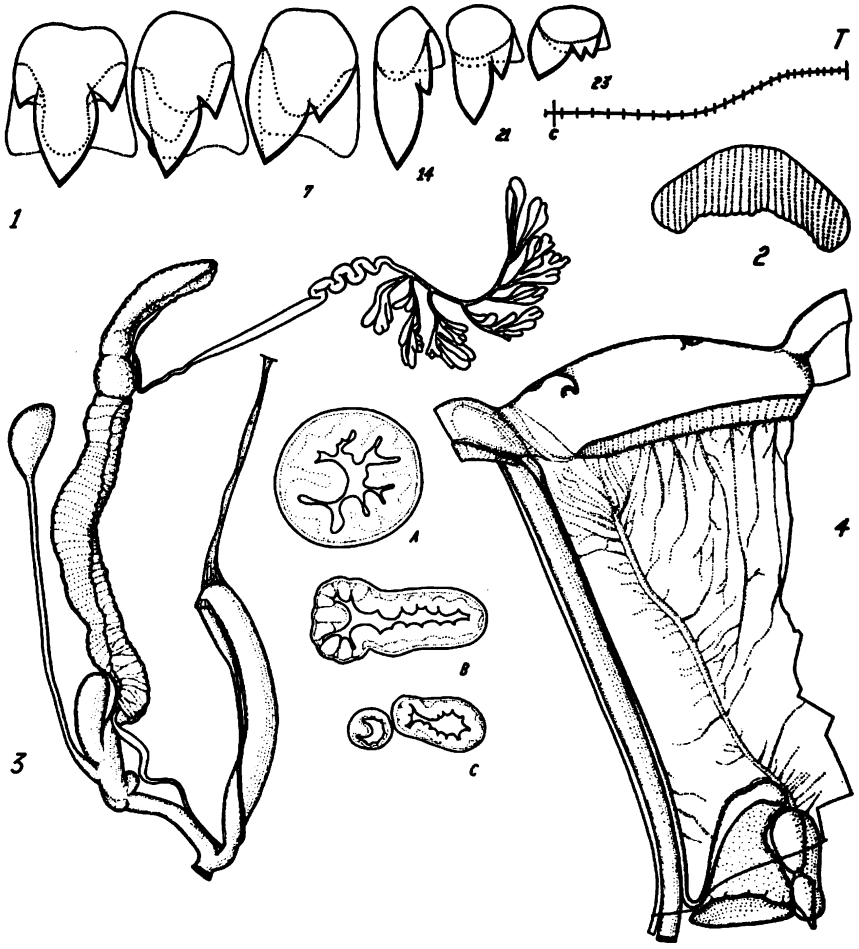

Fig. 279. *Megomphix hemphilli,* Riverdale, Oregon. 1, radula and line showing shape of right half of a transverse row of teeth, borders of each tooth indicated. 2, jaw. 3, genitalia, with sections through: A, oviducal caecum, B, vas deferens (left), and penis, at their confluence, and C, same a short distance below their junction, less enlarged. 4, internal view of pallial complex; curved line crossing pericardium and kidney indicates posterior wall of lung. (After H. B. Baker.)

ribbed in *concava;* not so in this shell; the texture of the shell is glassy like *Hyalina,* and there is no trace of microscopic revolving spiral lines found in all the other forms; beneath, the last whorl is proportionally wider. Greater diameter 14, lesser 10 mm.; height 5 mm." (Binney.)

The thin, somewhat translucent shell is of a pale dull green yellow tint. It is almost discoidal, the spire very little raised, the whorls slowly increasing to the last, which is much more than double the width of the penult, well rounded peripherally and beneath, openly umbilicate. The surface is highly polished, lightly marked with weak growth wrinkles. The rotund-lunate aperture is but slightly oblique, the lip thin and sharp, its terminations widely separated.

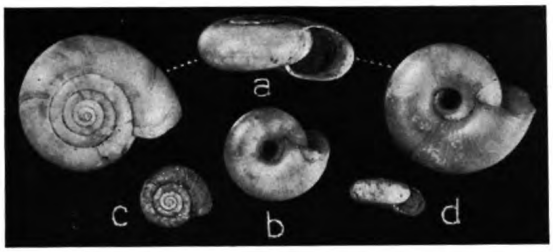

Fig. 280. a, *Megomphix hemphilli,* Riverdale; b, Olympia. c, d, *Megomphix lutarius,* Pine Creek, above Weston.

Height 6.8 mm., diameter 13.5 mm.; 5½ whorls. Olympia.
Height 8.2 mm., diameter 20 mm.; 6 whorls. Riverdale.
Height 8.3 mm., diameter 18 mm.; 6 whorls. Riverdale.
Height 7.4 mm.; diameter 16 mm.; 5⅔ whorls. Douglas Co.

WASHINGTON: Olympia (H. Hemphill), Type 38783 U.S.N.M. Freeport [117] (Hemphill). Toledo, Lewis Co. (F. L. Button). OREGON: Riverdale, Multnomah Co. (H. B. Baker). Douglas Co. (Button).[118]

The rather closely coiled whorls of the nearly flat spire are irregularly wrinkled radially and without spiral lines. The upper curve of the thin lip arches forward a little, but is not bent down as in *Haplotrema*. The parietal wall in young shells shows a very minute pattern of irregularly interrupted spiral lines or rugosities, comparable to the smoother and more regular spirals of *Glyptostoma;* but these disappear with advancing age.

Dr. Baker collected large specimens at Riverdale, a suburb of Portland, on the left bank of the Willamette River near the southern boundary of Multnomah County. He states that: "The estivating individuals of *M. hemphilli* burrow a few inches into the loose loam under fallen logs on quite steep hillsides, which are dominated by *Pseudotsuga-Tsuga* forest. They usually live under those trunks which are supported off the ground by other debris, which insures the snails plenty of air and comparative freedom from excessive accumulations of decaying humus."

Ancey described a "var *tenuis,* more pellucid and smaller (7½ mill.); shell thinner." This is apparently only an immature shell of *M. hemphilli.*

Dr. Baker's description of the soft anatomy follows.

"Animal: practically without pigmentation. Foot: aulacopod, medium in size and rather elongate; broadest near posterior end; pedal grooves double, prominent and with broad interstitial gyrus; sole tripartite to near posterior end, with middle zone about half as wide as either lateral one;

[117] There is no Freeport in Washington at present. Fifty years ago there were places so named in King and Cowlitz counties.

[118] F. L. Button recorded "*Circinaria*" *hemphilli* from localities in Alameda and Placer counties, middle California (Nautilus, 14:72), possibly a mistake for *Haplotrema alameda,* not recognized at that time.

locomotion not observed because animals were very sluggish. Tail: wide and dorsoventrally flattened; tip broadly rounded and very slightly emarginate; gland orifice quite large and diamond-shaped; peripodial angle broad, low and emarginate. Mantle collar (Fig. 279:4).: complete, relatively broad and swollen in palatal region but narrow in columellar; right pneumostomatic neck-lappet large; left one small and claw-shaped; accessory left lappet widely separated and vestigial. Lung (Fig. 279:4): about 3 times as long as its base or about 4 times length of kidney; principal pulmonary vein large but abruptly divided into a fan of tributaries before it reaches pneumostome; other branches stronger on columellar than on hindgut side; minor venation indistinct. Pericardium: unusually large, with over half its length outside of lung. Kidney: slightly longer than its base and about length of pericardium: thick and with almost half its bulk posterior to lung wall; ureter complete; external ureteric opening under a flap alongside of anus, which empties into a groove to right of inner end of pneumostome.

" Ovotestis (Fig. 279:3): eight groups of irregularly clavate alveoli, imbedded in lower half of liver; duct long, swollen except at ends; convoluted region short; talon exceptionally long, slender fusiform; carrefour imbedded. Albumen gland: brownish cream-colored, firm and shining. Uterus: long and quite slender, closely sacculate. Free oviduct: light cream-colored, of medium length, with heavy walls; joined near its base by a large, cream-colored, ellipsoid caecum, which has a spacious lumen and thick walls (A), that are longitudinally plicate internally. Spermatheca: sac obovate, imbedded near base of albumen gland; duct of long type, columellar in position but passing to right of oviducal caecum; slightly expanded at base. Vagina: whitish, exceptionally long; almost completely encircled near its upper end by a heavy muscular collar (without lumen) that is white and shining; no distinct glandular development. Prostate: of long type. Vas deferens: swollen along free oviduct; slender where it is forced into penioviducal angle by right eye-retractor; juxtaposed along entire length of penis. Epiphallus (B, C): slightly enlarged, with quite thin wall, which develops into a pilaster along side opposite penis and into a vague corona of low, knobby thickenings near termination; opening by a simple pore on one side of penial apex. Penis: long but quite slender, thickest near apical end; lumen large; walls with numerous, beaded, longitudinal plicae, two of which form heavier pilasters in apical fifth and partially separate a narrow compartment that receives opening of vas deferens. Penial retractor: insertion on penial apex; origin high on diaphram. Cloaca: very short; external opening just behind and slightly below base of right ommatophore.

" Mantle retractor: exceptionally heavy. Columellar muscle gives off: (1) buccal retractor which is almost free, (2, 3) heavy, right and left free retractors almost at origin and continues as (4) broad but thin tail fan. Buccal: divided near posterior end of buccal mass into bipartite ventral fan and two, tripartite lateral ones. Left free: divides a short distance below origin into subequal lateral and tentacular retractors; tentacular subdivides near posterior end of buccal mass into small ocular and large inferior retractor, both of which lend darkly pigmented anastomoses to base of ommatophores. Right free: similar to left but with all subdivisions anterior to posterior end of buccal mass and with pedal fan much heavier, although not

closely associated with uterus; ocular retractor and basal anastomoses passing through penioviducal angle.

"Buccal mass: fairly small, ellipsoid. Salivary glands: about 2½ times as long as buccal mass and quite slender (smaller than in carnivorous pulmonates); almost bilaterally symmetric; anterior ends above buccal mass and oesophagus; posterior ends enveloping oesophagus; ducts arising laterally, near middle of each gland. Jaw (Fig. 279:2): irregularly crescentic; heavy and brownish but quite narrow; weakly and closely rib-striate (i. e., showing vestiges of primitive plaits); growth-lines sharp. Radular formula (Fig. 279:1): 6-12-9-1-27. Transverse rows: 113 counted; almost horizontal in lateral fields, anterolaterally oblique in marginal and again horizontal in outer marginal region. Central: slightly asymmetric, broad and heavy, a little larger than first lateral; tricuspid with broad mesocone. Laterals (1-9): heavy and broad; inner ones almost tricuspid (entoconal plate weakly notched); outer ones intergrading with marginals. Marginals (10-21): much narrower although scarcely longer than laterals; bases much shorter; bicuspid with lanceolate mesocone and small, raised ectocone. Outer marginals (22-27): much shorter than inner; bicuspid or sporadically with double ectocones; outermost vestigial."

Megomphix lutarius H. B. Baker Figs. 280c, 281.

Macrocyclis hemphilli W. G. Binney, 1886, 2d Suppl., Bull. Mus. Comp. Zoöl., 13:25 (Weston, Ore., A.N.S.P. 11793); not of W.G.B. 1879.

Circinaria hemphilli W.G.B., in part, Pilsbry, 1898, Nautilus, 11:128, Walla Walla, Wash. Cf. Henderson, Univ. Colo Studies, 17:97

Megomphix lutarius H. B. Baker, 1932, Nautilus, 45:86, pl. 5, figs. 7-9.

Megomphix hemphilli lutrarius Henderson, 1936, Univ. Colo. Studies, 23:260, fig. 1.

"Shell (Figs. 280c, 281) quite small, thin and much depressed; rather dull, light corneous with a slight greenish tinge. Whorls 5¼ (type), quite gradually increasing; suture well impressed. Embryonic whorls 2, almost

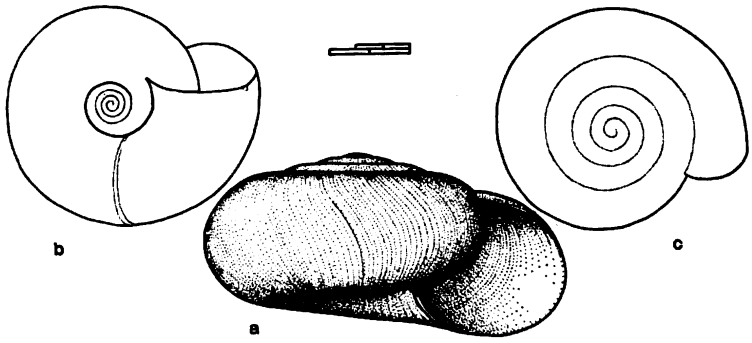

Fig. 281. *Megomphix lutarius* (after H. B. Baker). Scale lines = 2 mm., upper applying to figs. b, c, lower to fig. a.

smooth but with extremely weak traces of fine, closely spaced, spiral striae and with nepionic growth-lines gradually appearing on last ¼ whorl. Last whorl terete, slightly descending, with closely spaced, low but distinct

growth-wrinkles (more evident than in *M. hemphilli*), which are crossed by exceedingly fine, irregular, closely spaced, spiral striae (only visible under high magnification and in strong light). Umbilicus large, 3.35 times in maj. diam. Aperture well rounded except near sutural angle where outline is more convex. Peristome thin and sharp, easily broken (all shells show mended places); slightly arcuate above periphery and almost vertical (about 20° to axis of shell)." (H. B. Baker.)

Height 4.59 mm., diameters 9.01 and 7.88 mm., aperture alt. 3.45, diameter 3.73 mm.; 5¼ whorls. Type.

Height 5.14 mm., diameters 10.5 and 9.1 mm.; 5¼ whorls. Paratype.

OREGON: about 5 mi. above Weston, Umatilla Co., elevation over 2,000 feet; frequent on an almost vertical lava exposure, overgrown with dry moss, ferns and scattered bushes, below north-facing slope with Douglas fir (*Pseudotsuga*) and only a few feet from the practically dry bed of Pine Creek. Aestivating (Aug. 10), buried 2 to 5 inches under yellowish dust and dirt in hollows of the outcropping ledges, near *Polygyra, Microphysula, Haplotrema, Anguispira, Radiodiscus abietum, Gonyodiscus cronkhitei, Pristiloma idahoense, P. subrupicola,* etc. (H. B. Baker). Type 156443 A.N.S.P.

WASHINGTON: Walla Walla (Hemphill).

"*M. lutarius* is very closely related to *M. hemphilli* from western Oregon and Washington, but is a smaller shell and has relatively stronger growth-wrinkles, which give it a duller sheen. These differences, although apparently constant, are confessedly smaller than the range of variation displayed in some of the other, better known species of northwestern snails. The anatomy of paratypes of *M. lutarius* is also very similar to that of the genotype (H. B. B.; 1930, Naut. 43: 96, pl. 5, fig. 1-4), but the spermoviduct of the new species is much broader basally; its albumen gland is relatively larger; the apical half of its more elongate talon is recurved; and the 7 lobes of its ovotestis are not so completely subdivided. Also, its radular formula is 5 + 9 + 7 + 1 + 21, with 101 transverse rows, and the inner marginals are less elongate and more nearly intermediate between the laterals and the outer marginals. However, the differences in the spermoviduct and the albumen gland are perhaps due to the more complete maturity of the western animals (even of considerably smaller individuals than the type), while the peculiarities of the ovotestis and radula might be correlated with size." (H. B. Baker.)

INDEX TO SCIENTIFIC NAMES

Subspecies and forms are treated as species in this index.