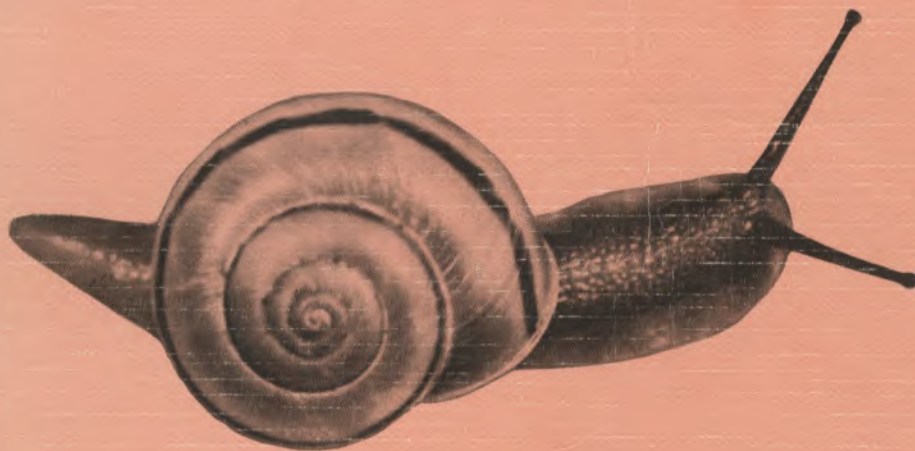


THE
MOLLUSKS
OF THE ARID SOUTHWEST

With an Arizona Check List



Sonorella orientis Pilsbry

JOSEPH C. BEQUAERT
and
WALTER B. MILLER

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About the Authors

JOSEPH C. BEQUAERT turned to malacology as his main interest following his retirement as Curator of Insects at the Museum of Comparative Zoology of Harvard, after serving as assistant professor at the Harvard Medical School. An honorary visiting scholar at the University of Arizona from 1959 on, he pursued this interest he had begun first at the University of Houston following his retirement in 1956. Some fifty of his many publications are based on land and fresh-water mollusks. A native of Belgium, he received his degree of Doctor of Natural Sciences at the University of Ghent in 1908, was entomologist and botanist for the Belgian Colonial Office in the Congo, then came to the United States in 1916 and subsequently acquired citizenship. Prior to his affiliation with Harvard, he was Research Associate at the American Museum of Natural History. He travelled extensively in Africa and the Americas, studying the evolution and ecology of the tropical fauna and flora.

WALTER B. MILLER, whose particular fields of interest lie in the taxonomy, zoogeography, speciation, and evolution of the land snails of Western North America—particularly the Southwestern United States and adjacent Mexican states—has described numerous new species from these areas. He began collecting and studying land snails as a boy in 1932, and accumulated a large, worldwide collection while serving in the U. S. Navy. He joined the Biological Sciences faculty at the University of Arizona in 1967, from which institution he received his doctoral degree, backgrounded by his master's degree from the California Institute of Technology and his B. S. from the U. S. Naval Academy.

In Memory of
HENRY AUGUSTUS PILSBRY
1862-1957
Pioneer of Southwestern Malacology

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yrs old). Recent in S Canada from Prince Edward I to British Columbia, and in most of E and central United States, W to Montana, E Colorado, and Arizona; also in Mexico (Puebla, Tamaulipas, San Luis Potosi, Nuevo Leon, Chihuahua) and Guatemala; not known from Sonora. Synonyms: *Pupa tappaniana* C. B. Adams, 1842, in Z. Thompson's *History of Vermont*:158 (described without locality; T.L. not in Vermont, as was assumed, but Roscoe, Coshoc-tion Co., Ohio, according to holotype at Mus. Comp. Zool., Cambridge, Mass.); stated by W. J. Clench (1965, *Nautilus* 78:106) not to be separable subspecifically from *G. pentodon*, with which it was synonymized before by A. A. Gould (1844) and W. G. Binney (1885: 323). *Pupa curvidens* A. A. Gould, 1841, *Report Invertebrata Mas-sachusetts*:189, fig. 120 (T.L.: Phillips Point at Lynn, Massachusetts).

104. ***Gastrocopta (V.) pilsbryana*** (V. Sterki, 1890, as *Pupa*). T.L.: "Colorado River," without more precise locality, but presumably in Arizona, since it is common in Grand Canyon of Colorado Riv. Widespread, living in Arizona highlands, mainly in Transition and Canadian Life-Zones at 3,000 to 10,000 ft; below 4,000 ft usually in riparian drift. Known Recent from Mohave Co. (Mt Trumbull; Hualapai Peak, at 8,000 ft), Coconino Co. (Bill Williams Mt; several Stations in Grand Canyon and on Kaibab Plateau; San Francisco Mtn at Lockett Meadow, W slope of Sugarloaf Mtn, 8,500 ft; Rio de Flag, 2 mi NW of Flagstaff, 7,000 ft; Mahan Mtn; Woody Mtn, 10 mi SW of Flagstaff, 8,000 ft; Walnut Creek near Winona, 13 mi E of Flagstaff, 6,450 ft; Padre Canyon, 25 mi E of Flagstaff; Mt Elden, 7,900 ft; drift of Oak Creek Canyon, 3,500 ft), Navajo Co. (drift of Carrizo Creek, on Hwy 60, 1 mi SW of Carrizo, 5,200 ft; dead but fresh shells in drift of Little Colorado Riv, 3 mi E of Winslow, 4,850 ft), Apache Co. (Alpine Divide, 3 mi NW of Alpine, 8,100 ft; drift of creek 12 mi N of Fort Defiance, 7,000 ft), Maricopa Co. (drift in Sycamore Canyon near Sunflower), Gila Co. (Pinal Peak at 7,300 to 7,500 ft; Sierra Ancha, widespread at 5,000 to 6,500 ft; litter on Pine Creek at Tonto Natural Bridge, 4,500 ft), Pinal Co. (Galiuro Mts at Whitlock Ranch; litter on S bank of Salt Riv, at Hwy 60, 4 mi N of Seneca, 3,000 ft), Pima Co. (Kitt Peak at 6,300 to 6,700 ft; Baboquivari Mts at 3,500 to 4,000 ft; Santa Catalina Mts, widespread at 6,000 to 8,500 ft, and in drift of lower Sabino Canyon at 2,800 to 3,000 ft; Rincon Mts at Spud Rock, 8,600 ft, and Manning Camp, 8,000 ft; drift of San Pedro Riv at Redington), Santa Cruz Co. (Santa Rita Mts, 5,200 to 6,200 ft; foot of Sanford Butte on Sonoita Creek, 3,800 ft; Pajaritos Mts, 1.5 mi S of Pena Blanca Lake, 4,000 ft), Cochise Co. (Dos Cabezas Mts, ca 8,000 ft; Whetstone Mts at 6,000 to 6,800 ft;

Dragoon Mts at 4,700 ft; Huachuca Mts, widespread at 5,200 to 9,200 ft; Chiricahua Mts, widespread at 5,600 to 7,600 ft; drift of San Pedro Riv at The Narrows, Fairbank, Hereford, and Palominas), Graham Co. (Pinaleno Mts: Mt Graham at 5,000 to 9,000 ft), and Greenlee Co. (Cospers Ranch on Blue Riv, 5,060 ft; Cospers Pasture in Blue Mts, ca 10,000 ft; Fish Creek; drift of Eagle Creek, 6 mi SW of Morenci, 3,550 ft). Not found fossil thus far in Pleistocene of San Pedro Valley; only fossil record from Arizona at Winona Site, 13 mi E of Flagstaff, R. D. Reger and G. L. Batchelder, 1971:191-193 [perhaps based on a dead Recent shell?]. Recent also in New Mexico, S Utah (1 record), trans-Pecos Texas (Guadalupe Mts in South McKittrick Canyon, 5,300 ft, Culberson Co., senior author, 1966), and Mexico (Sonora, Chihuahua, Tamaulipas). Synonym: *Gastrocopta pilsbryana amissidens* H. A. Pilsbry, 1934 (T. L.: Mahan Mtn, Coconino Co.).

105. ***Gastrocopta (Staurotrema) quadridens*** H. A. Pilsbry, 1916. T.L.: Capitan Mts, Lincoln Co., ca 35° 35' N, 105° 20' W, New Mexico, easternmost Station of species. Sporadic in Canadian and Hudsonian Life-Zones of Arizona at 8,000 to 10,000 ft. Known from Coconino Co. (Bill Williams Mtn, 9,200 ft, 35° 10' N, 105° 20' W, northwesternmost Station of species), Yavapai Co. (Mingus Mtn), Pima Co. (Santa Catalina Mts, 9,000 to 9,500 ft), Cochise Co. (Huachuca Mts, Wickersham Rock near Miller Peak, 8,500 ft, ca 31° 23' N, 110° 17' W, southernmost Station of species. Chiricahua Mts, Barfoot [or Bearfoot] Park, 8,500 ft [not 10,000 ft as given], ca 31° 55' N, 109° 10' W), and Graham Co. (Pinaleno Mts: Hospital Flat, at S foot of Mt Graham, 9,000 ft, senior author, 1960). Restricted to Arizona, New Mexico, and Utah (Fish Lake, Sevier Co., ca 38° 35' N, 111° 45' W, northernmost Station of species). Not known fossil. Synonym: *Bifidaria quadridentata* V. Sterki, 1899 (same T.L. as *quadridens*; not *Pupa quadridentata* von Klein, 1833, now placed also in *Gastrocopta*).

106. ***Gastrocopta (Immersidens) ashmuni*** (V. Sterki, 1898, as *Bifidaria*). Originally described from Arizona (Santa Rita Mts) and New Mexico (Cooks Peak, Luna Co., and Dripping Springs in Organ Mts, Dona Ana Co.); the Station in Santa Rita Mts, herewith selected as T.L., was defined by the collector, E. H. Ashmun (1899:14), as on E slope of Range, 20 mi W of Crittenden [Site of a former Army fort, 3 mi NE of Patagonia], Santa Cruz Co. The nominate, dextral form widespread in Arizona, mainly in Upper Sonoran and Transition Life-Zones, usually at 3,000 to 8,000 ft. Known alive in well-sheltered organic litter from Mohave Co. (Mt Trumbull, 8,000 ft, 36° 25' N, 113° 20' W, northwesternmost Station

of species), Coconino Co. (Oak Creek Canyon, at Owenby's Ranch and Page's Ranch, ca 4,500 ft; Rio de Flag, 2 mi N of Flagstaff, 7,000 ft; Grand Canyon of Colorado River, Bright Angel Trail, 100 ft below South Rim; Powell-Kaibab Saddle, N of Grand Canyon, ca 20 mi N of El Tovar; Walnut Creek, 13 mi E of Flagstaff, 6,450 ft), Yavapai Co. (Mingus Mtn: Hull Canyon, 6,000 ft; Walnut Canyon; Mescal Canyon, 6,000 ft; Kirwagen Ranch), Gila Co. (S bank of Salt Riv, 4 mi N of Seneca, 3,000 ft; Mogollon Rim at W side of Milk Ranch Point, 2.5 mi NE of Pine, 6,600 ft; Sierra Ancha, upper Parker Creek, 5,080 ft), Pinal Co. (Galiuro Mts: Copper Creek at Site of P.O., 3,800 ft; N slope at Whitlock Ranch), Pima Co. (Ajo Mts, Arch Canyon, 3,500 ft, 32° 2' N, 112° 42' W, southwesternmost Station of species. Baboquivari Mts, W slope at mouth of Baboquivari Canyon, 3,500 ft. Sierrita Mts, S slope on road to Harris Ranch. Santa Catalina Mts: Rattlesnake Canyon, off Sabino Canyon, 3,100 ft; SW slope above Molino Canyon, 4,800 ft; Marble Peak, 7,670 ft [not 8,000 as given]. Rincon Mts, SW slope in Madrona Canyon, 3,500 to 4,000 ft. Santa Rita Mts, S end at Rosemont and Helvetia, 5,500 to 5,600 ft), Santa Cruz Co. (Ephraim Canyon in Nogales, 3,800 ft. NE foot of Tumacacori Peak, 3,720 ft. Atascosa Mts, Sycamore Canyon, 4 mi SE of Ruby, 4,000 ft. Pajaritos Mts, Pena Blanca Canyon. Santa Rita Mts: Temporal Gulch, 4,000 ft; Madera Canyon, 4,800 to 6,000 ft; Adobe Canyon, 5,200 ft; Gardner Canyon, near Onyx Cave, 5,400 ft. Sanford Butte at Sonoita Creek, 3,800 ft. Patagonia Mts: mouth of cave on Bald Mtn; Harshaw Creek at Hermosa Hill, 4,850 ft. Canelo Hills: 4 mi S of Canelo, 5,500 ft; limestone hill W of Duquesne Rd; NW slope of Lookout Knob, 5,400 ft), Cochise Co. (Whetstone Mts: French Joe Canyon, 5,400 ft; N of Two-Peak mining camp. Mustang Mts, N slope of Eastern Dome, 5,200 to 5,400 ft. Huachuca Mts: Garden Canyon, 6,000 ft; Ash Canyon; Carr Canyon, 6,600 ft; Miller Canyon, 6,000 to 6,500 ft; Ramsey Canyon 5,800 to 6,000 ft; Manila Mine; Jack Wakefield Mining Camp, 5,600 ft; Copper Canyon, 6,000 to 6,200 ft; W slope at Sylvania Springs in Scotia Canyon, 6,150 ft. Dragoon Mts: Fourr Canyon, 5,500 to 5,700 ft; 9 Stations in Tweed [now Stronghold West] Canyon, 4,700 to 5,700 ft; Stronghold Canyon East, 4,700 to 4,800 ft; Bear Gulch branch of Stronghold Canyon East; mouth of Wood Canyon, 2 to 3 mi E of Dragoon, 4,800 ft. Chiricahua Mts: Whitetail Canyon, below mouth of Indian Creek, 5,500 ft; N slope on Paradise-Portal road, 5,600 to 5,800 ft; Big Emigrant Canyon, 4,800 to 5,400 ft; Limestone Mtn; Pinery Canyon, 5,000 to 7,000 ft; Crystal Cave, 0.5 mi SW of Southwestern Research Station; Cave Creek at Herb Martyr Dam, 5,600 ft; Tex

Canyon, 5,800 ft; Rucker Canyon, 5,900 to 6,000 ft; etc. Guadalupe Canyon, 18 mi E of San Bernardino Ranch, 4,200 ft), and Greenlee Co. (Cosper's Ranch on Blue Riv, 5,060 ft; Eagle Creek at Ole Hagen's Ranch). Common in riparian drift in Yuma Co. (Bill Williams Riv at Browns Crossing, 1,500 ft, 30 mi N of Wenden, 34° 25' N, 113° 25' W), Coconino Co. (Oak Creek, 7 mi N of Sedona, 3,500 ft), Navajo Co. (Little Colorado Riv at Winslow, 4,800 ft, and Holbrook, 5,075 ft; Carrizo Creek, 1 mi SW of Carrizo, 5,200 ft), Apache Co. (Puerco Riv at Adamana; Chinle Wash), Yavapai Co. (Big Chino Wash, 8 mi S of Seligman; Beaver Creek at Montezuma Castle National Monument; Verde Riv at Clarkdale, 3,500 ft), Gila Co. (East Verde Riv, 5 mi NW of Payson, 4,500 ft; creek 6 mi SE of Roosevelt), Maricopa Co. (Salt Riv at Tempe), Pima Co. (Santa Cruz Riv at Tucson and Continental; Pantano Wash near Vail; Rillito Creek at Tucson city limits; Agua Verde Creek, 5 mi E of Vail, 3,300 ft; Posta Quemada Canyon near Colossal Cave, 3,300 to 3,500 ft; San Pedro Riv at Redington; Cienega Creek, 6 mi NE of Empire Ranch, 4,200 ft), Santa Cruz Co. (drift of Santa Cruz Riv at Amado, Calabasas, and 5.5 mi NE of Nogales; Pena Blanca Lake, 3,900 ft; Oro Blanco Wash, 2.5 mi W of Ruby, 4,000 ft; wash 2.5 mi W of Pena Blanca Lake, 4,000 ft; Sonoita Creek at Patagonia, 4,044 ft), Cochise Co. (Walnut Gulch, 1 mi E of Tombstone, 4,500 ft. San Pedro Riv at Palominas, Hereford, Benson, and The Narrows 10 mi N of Benson. Dragoon Mts: creeks of W slope in Fourr Canyon, 5,500 to 5,600 ft. Stronghold Canyon East, 4,700 to 4,800 ft), Graham Co. (Turkey Creek, E slope of Galiuro Mts, 10 mi NW of Klondyke), and Greenlee Co. (Eagle Creek, 6 mi E of Morenci, 3,550 ft).

Dextral form also in New Mexico (in leaf litter: Grants and San Rafael, Valencia Co., ca 35° 10' N, 108° W, northeasternmost Stations of species; Oscura Mts, Socorro Co.; White Oaks, Lincoln Co.; Iron Creek in Black Mts, Grant Co.; Organ Mts, Dona Ana Co.; Little Palomas Creek, Sierra Co.; Florida Mts and Cooks Peak, Luna Co.; Big Hatchet Mts, Hidalgo Co.), trans-Pecos Texas (in soil rich in leaf debris at Hueco Tanks, ca 20 mi E of El Paso, El Paso Co., A. L. Metcalf and W. E. Johnson, 1971:89; South McKittrick Canyon of Guadalupe Mts, 5,500 ft, 31° 50' N, 104° 26' W, Culberson Co., A. R. Mead et al, 1969, easternmost Station of species; also in riparian drift of Rio Grande at Vinton, El Paso Co., and 11 mi SE of Redford, Presidio Co., and of Fresno Creek, 25 mi SE of Redford, Presidio Co., all 3 by senior author, 1961), Sonora (in leaf litter: Nogales, Pilsbry and Ferriss, 1906:144. Five Stations by junior author, 1964-1965: one in Sierra del Santo Niño,

N of Mina. El Milagro, on road to Sahuaripa, at 4,000 ft, ca 29° N, 109° 30' W; two near Magdalena, at 3,650 and 4,250 ft, ca 30° 55' N, 111° W; and two near Nacozari at 3,550 and 4,000 ft, ca 30° N, 110° W. Rancho Pinos Altos, Sierra Nacori, 5,800 ft, 29° 45' N, 108° 30' W, M. D. Robinson, 1969), and Chihuahua (in leaf litter, Rio Piedras Verdes, ca 9 km above Colonia Juárez, ca 30° 15' N, 108° W, Pilsbry, 1953:162). Not definitely known fossil thus far. H. G. Richards (1936:371) recorded a dead specimen from the Lindenmeier Site of Early Man, N of Fort Collins, Larimer Co., Colorado, some 300 mi N of northernmost known Recent Stations in Arizona and New Mexico; this may require verification, since there are no Recent or fossil records from Colorado or Utah. Synonyms: *Bifidaria ashmuni* form *minor* V. Sterki, 1898 (T.L.: Ephraim Canyon in Nogales, Santa Cruz Co.). *Gastrocopta perversa* form *sana* H. A. Pilsbry, 1918 (T.L.: drift of Salt Riv at Tempe, Maricopa Co.), *Gastrocopta ashmuni imperfecta* H. A. Pilsbry and J. H. Ferriss, 1923 (T.L.: Mustang Mts, at Site of former Dan Mathew's Ranch, ca 1.5 mi SE of Mustang Peak, 5,000 ft, Santa Cruz Co.); not figured, but probably based on juvenile snails with incomplete columellar lamella.

Many lots of nominate, dextral *ashmuni* contain also sinistral shells, described as a distinct species, *Gastrocopta perversa* (V. Sterki, 1898, as *Bifidaria*; T.L.: Ephraim Canyon in Nogales, Santa Cruz Co., 3,800 ft; found with dextral snails). Otherwise, *perversa* agrees with dextral *ashmuni*, sharing the diagnostic straight vertical extension of the columellar lamella alongside the parietal lamella (shown by Pilsbry and Ferriss, 1910c:137, fig. 29); it can therefore not rank as a valid subspecies, but is merely a recurrent mutation in many populations of the dextral form. In Arizona, it seems restricted to the southern half of the State, where it is usually less abundant than the dextral form, which may explain the more sporadic records. Known alive in leaf litter from Gila Co. (S bank of Salt Riv, 4 mi N of Seneca, 3,000 ft), Pinal Co. (Aravaipa Creek Canyon, 15 mi NE of Mammoth, 2,500 ft), Pima Co. (Baboquivari Mts: W slope at mouth of Baboquivari Canyon, 3,500 to 4,000 ft; SE slope, in Sycamore Canyon, 3,700 to 4,000 ft, and Brown Canyon, 4,000 ft. Sierrita Mts, at S side on road to Harris Ranch. Cerro Colorado, 3 mi NW of Santa Lucia Ranch, 4,100 ft. Santa Rita Mts: NE slope in Florida Canyon, 4,400 ft; E slope in Temporal Gulch, 4,000 ft, and Gardner Canyon, near Onyx Cave, 5,400 ft; W slope in mouth of Agua Caliente Canyon, 3,800 ft. Agua Verde Creek, 5 mi E of Vail, 3,300 ft. Empire Mts, 1.5 mi N of Total Wreck Mine, 4,800 ft. Coyote Mts, E slope in upper Mendoza

Canyon, 3,500 ft), Santa Cruz Co. (Nogales, 3,865 ft. Atascosa Mts, Sycamore Canyon, 4 mi E of Ruby, 4,000 ft. Pajaritos Mts, Pena Blanca Canyon, 1.5 mi S of Pena Blanca Lake, 4,000 ft. Foot of Sanford Butte on Sonoita Creek, 3,800 ft. Patagonia Mts: SW slope 10 mi NE of Nogales; mouth of cave on Bald Mtn), and Cochise Co. (Huachuca Mts: Ash Canyon; Carr Canyon, 6,600 ft; Manila Mine; Sylvania Springs in Scotia Canyon, 6,150 ft. Mustang Mts, N slope of Eastern Dome, 5,200 to 5,400 ft. Dragoon Mts: Tweed Canyon [now Stronghold Canyon West]; Stronghold Canyon East, 4,700 ft; N slope in mouth of Wood Canyon, 4,800 ft. Chiricahua Mts: Big Emigrant Canyon, 5,400 ft; Pinery Canyon, 5,000 ft; Rattlesnake Hill, 0.25 mi SW of Portal, 5,800 ft; Crystal Cave, 0.5 mi SW of Southwestern Research Station, 5,500 to 5,600 ft; East Turkey Creek, below Paradise; Whitetail Canyon, 5,500 to 5,600 ft; Tex Canyon, 5,800 ft). Also in riparian drift in Pinal Co. (Gila Riv, 1 mi N of Florence), Pima Co. (Cienega Creek, 6 mi NE of Empire Ranch; Posta Quemada Canyon, near Colossal Cave, 3,300 ft; Rillito Creek at Tucson city limits; Pantano Wash, 4.5 mi E of Vail; Santa Cruz Riv at Tucson and Continental; San Pedro Riv at Redington), Santa Cruz Co. (Santa Cruz Riv at Amado, Calabasas and 4.5 mi E of Nogales; Sonoita Creek at Patagonia; wash 2.5 mi W of Pena Blanca Lake), Cochise Co. (San Pedro Riv at Fairbank, Benson, and The Narrows 10 mi N of Benson), and Graham Co. (Turkey Creek of Galiuro Mts, 10 mi NW of Klondyke, 3,400 ft). Form *perversa* occurs also in New Mexico, Sonora (Rio Nacozari, 7 mi S of Nacozari, in drift, B. A. Bransom, 1964:104; two Stations near Nacozari, at 3,550 and 4,200 ft, in leaf litter, junior author, 1965), and Chihuahua (S side of Rio Piedras Verdes, 9 km above Colonia Juarez, Pilsbry, 1953:162; Presa Chihuahua, 7 mi S of city of Chihuahua, 4,800 ft, 28° 35' N, 106° 5' W, southernmost Station of species, R. H. Russell, 1971).

107. ***Gastrocopta (I.) cochisensis*** (H. A. Pilsbry and J. H. Ferriss, 1910, as *Bifidaria*). T.L.: Tanner [now Garden] Canyon, Huachuca Mts, 6,000 ft, Cochise Co. Sporadic in SE Arizona at 4,000 to 7,200 ft, mostly in canyons of Upper Sonoran Life-Zone. Known from leaf litter in Gila Co. (upper Cherry Creek, 1 mi E of Young, 5,100 ft), Pima Co. (Baboquivari Mts, W slope in Baboquivari Canyon, 3,500 to 4,000 ft. Quinlan Mts, Kitt Peak, 6,300 to 6,700 ft. Santa Catalina Mts: Rose Canyon, 7,000 ft; Alder Springs; SW ridge from Marble Peak, 7,200 ft [not 8,000 as given]. Santa Rita Mts, NE slope, 1.5 mi S of Helvetia, 4,500 ft. Rincon Mts, N slope of Rincon Peak, 6,100 ft), Santa Cruz Co. (Santa Rita Mts: Gardner Canyon on E slope, near Onyx Cave, 6,000 to 6,200

ft; Madera Canyon on N slope, 5,200 to 6,200 ft; Temporal Gulch on E slope, 4,000 ft. Patagonia Mts: ravine on SE slope, 1 mi W of pass to Washington Camp, 5,400 ft; E slope near Mowry, 9 mi SE of Patagonia, 5,200 ft), Cochise Co. (Huachuca Mts: Garden Canyon, 6,000 ft; Ramsey Canyon, 5,800 ft; Brown Canyon; Miller Canyon, 5,800 to 6,500 ft; Scotia Canyon on W slope, at Sylvania Springs, 5,200 ft; Huachuca Canyon, 6,000 ft. Chiricahua Mts: Morse Canyon at head of West Turkey Canyon, 7,200 ft; South Fork of Cave Creek, 4 mi SW of Southwestern Research Station, 5,100 to 5,800 ft; Crystal Cave off Cave Creek, 0.5 mi SW of Southwestern Research Station, 5,500 to 5,600 ft; Rucker Canyon, 5,900 to 6,000 ft; Limestone Mtn near mouth of Rucker Canyon; lower Pinery Canyon, 5,000 ft; Whitetail Canyon, 5,500 ft; Big Emigrant Canyon, at N foot of Rough Mtn, 5,400 ft), and Graham Co. (Pinaleno Mts: Wet Canyon on SE slope of Mt Graham, 6,300 ft). Dead in riparian drift of Pima Co. (Gardner Canyon, 5 mi N of Sonoita, 4,700 ft), Santa Cruz Co. (Santa Cruz Riv at Amado), Cochise Co. (Dragoon Mts in Stronghold Canyon West, 5,000 ft. San Pedro Riv at Palominas and Hereford), and Navajo Co. (Little Colorado Riv at Winslow, 4,810 ft; Carrizo Creek, 1 mi S of Carrizo, 5,200 ft). Not recorded from New Mexico or trans-Pecos Texas. Known from Sonora (arroyo 8 km S of Guaymas, Pilsbry, 1953:162), Chihuahua (Rio Piedras Verdes, below Pacheco, 5,900 ft; Sierra de la Breña, ca 17.5 km from Pearson [Mata Ortiz], on road to Pacheco, 7,000 ft; both Stations Pilsbry, 1953:162), and Sinaloa (Rio Fuerte at San Blas, Pilsbry, 1953:162). Not known fossil.

108. **Gastrocopta (I.) prototypus** (H. A. Pilsbry, 1899, *Proc. Acad. Nat. Sci. Philadelphia* 51:400, as *Bifidaria*; 1904, *ibid.* 55 [for 1903]:766, figs. 7-7a. [copied by Pilsbry and Ferriss:1910:142, 2 figs. 35]; 1916, in 1916-1918:47, Pl. 7, figs. 1-5). T.L.: Huingo, near Lago de Cuitzco, 40 km NW of Morelia, ca 19° 50' N, 100° 50' W, ca 4,500 ft, Michoacan, Mexico. Recent in Arizona at a few Stations in Upper Sonoran Life-Zone of SE mountain canyons at 4,700 to 5,300 ft; in drift at lower elevations. Alive in leaf litter in Santa Cruz Co. (Patagonia Mts, S slope at 0.5 mi E of Mowry, 9 mi SE of Patagonia, 5,200 ft), and Cochise Co. (Huachuca Mts: SE slope in Ash Canyon, 5,000 ft; W slope in Scotia Canyon, at Sylvania Springs, 5,200 ft. Chiricahua Mts, W slope in lower Rucker Canyon, 4,700 to 5,300 ft, Pilsbry, 1916, in 1916-1918:46). Dead shells, mostly washed-up fossils in riparian drift in Gila Co. (Salt Riv, 4 mi N of Seneca, 3,000 ft; tributary of East Verde Riv, 5 mi NW of Payson, 4,500 ft, ca 34° 10' N, 111° 35' W, northernmost Station of species), Pima Co. (Santa Cruz Riv at South Tucson, 2,450 ft),

Santa Cruz Co. (Santa Cruz Riv at Amado, 3,050 ft, at 5.5 mi NE of Nogales, 3,600 ft, and at 2.5 mi E of Lochiel, 4,600 ft), and Cochise Co. (San Pedro Riv at Hereford, 4,100 ft, Fairbank, 3,840 ft, and Benson, 3,570 ft. Dragoon Mts, wash in Stronghold Canyon West, 4,700 to 5,300 ft). Fossil in Late Pleistocene of San Pedro Valley at Lehner Mammoth and Murray Springs Sites, Cochise Co., associated with mammoth remains 10,000 to 11,000 yrs old. Known in New Mexico from riparian drift only, in Luna Co. (Mimbres Riv at Deming) and Dona Ana Co. (Rio Grande at Mesilla). Also in Mexico from Jalisco (Guadalajara, 5,220 ft, 20° 20' N, 103° 20' W) and Michoacan (T.L.), and in Guatemala (Guatemala City, 4,850 ft, 14° 37' N, 90° 30' W); not thus far in Sonora or Chihuahua. Synonyms: *Bifidaria* (Sect. *Immersidens*) *cochisensis oligobasodon* H. A. Pilsbry and J. H. Ferriss, 1910:141, figs. 34A-C [copied poorly by Pilsbry, 1948:901, figs. 487A-C, the basal folds, small but distinct in originals, being unclear] (T.L.: Ash Canyon, SE slope of Huachuca Mts, Cochise Co.; elevation not given, but ca 5,000 ft); *oligobasodon* raised to specific rank by Pilsbry, 1916, in 1916-1918: 45, figs. 16A-C [copies of 1919 figs.] and Pl. 7, figs. 8-11 (Ash Canyon cotypes); Pilsbry, 1948:900, figs. 480 (6, 8, and 9) [copies of figs. 8-11 of 1916] and figs. 487A-C [poor copies of 1910 figs.]. *Gastrocopta (Immersidens) prototypus basidentata* H. A. Pilsbry, 1916, in 1916-1918:48, Pl. 7, figs. 6-7 (T.L.: Guatemala City, southernmost Station of species). The complex of *B. prototypus* (1899), *B. cochisensis oligobasodon* (1910), and *G. prototypus basidentata* (1916) is here treated as a single species without recognized subspecies. All three forms agree in an essential character of the aperture; the parietal and angular lamellae, although fully separated over much of the length, are reduced in size and more simplified than in other members of subg. *Immersidens*—a feature separating it in particular from *cochisensis* when full-grown shells are compared. Other supposed differences between the three forms are unreliable, such as the presence or absence of the basal apertural lamella (usually but not always present, though small in *oligobasodon*; said to be always absent in *prototypus*, but well-developed in *basidentata*), or the shape of the columellar lamella, are too variable in shells seen from Arizona. Present discontinuous general distribution discussed in section on Zoogeography.

109a. **Gastrocopta (I.) d. dalliana** (V. Sterki, 1898, as *Bifidaria*). T.L.: Nogales, Santa Cruz Co.; more precisely Ephraim Canyon in Nogales, ca 3,800 ft, by V. Sterki, 1899:14. Nominate subsp. widespread in Lower and Upper Sonoran Life-Zones of S half of Arizona at 2,800 to 6,500 ft, rarely more (7,600 ft in Chiricahua Mts, 9,300