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TWO NEW SPECIES OF *ASHMUNELLA* FROM DOÑA ANA COUNTY, NEW MEXICO, WITH NOTES ON THE *ASHMUNELLA KOCHII* CLAPP COMPLEX (GASTROPODA: PULMONATA: POLYGYRIDAE)

Artie L. Metcalf and Richard A. Smartt

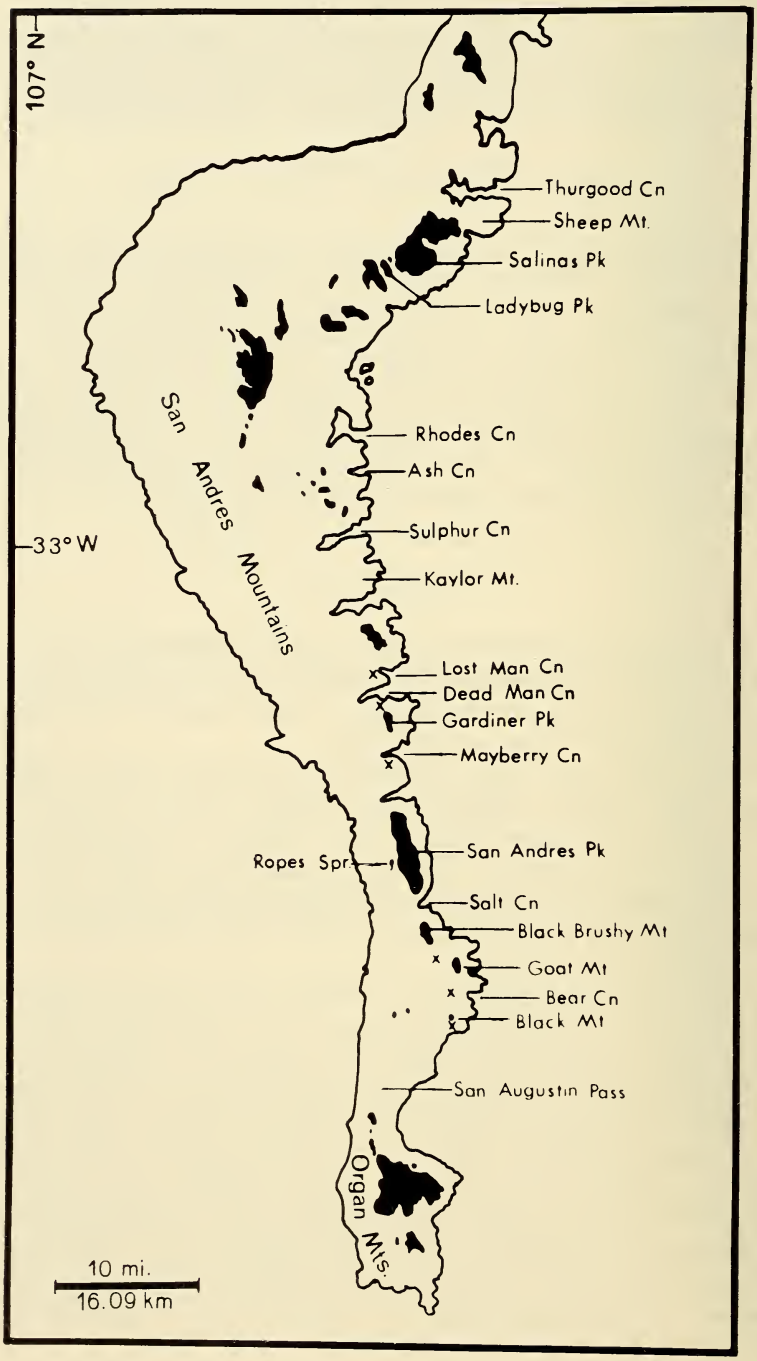
Abstract.—Metcalf, A. L., Department of Biological Sciences, University of Texas at El Paso 79968; and Smartt, R. A., National Fish and Wildlife Laboratory, Department of Biological Sciences, University of New Mexico, Albuquerque 87131.—Two new species of the polygyrid land snail genus *Ashmunella* are described from Doña Ana County, New Mexico: *A. harrisi* from the San Andres Mountains and *A. todseni* from the Organ Mountains. These species are judged to belong to the group of *Ashmunella kochii* Clapp, 1908. Additional species of this complex are enumerated and some aspects of their phylogeny and evolution are discussed.

Introduction

Two new species of the land snail genus *Ashmunella* from the San Andres and Organ Mountains, New Mexico, are described herein. Relationships of the species of *Ashmunella* in these ranges and those of the Franklin Mountains, Texas, are discussed.

The San Andres and Organ Mountains are located mainly in Doña Ana County, New Mexico, although the northern end of the San Andres range extends into Sierra County, New Mexico. Topographically, the two ranges are continuous, although, geographically, they are separated by San Augustin Pass (1,743 m), east of Organ, New Mexico (Fig. 1). The Franklin Mountains are directly south of the Organ Mountains in El Paso County, Texas.

The San Andres Mountains are ca. 120 km long, with their highest point on Salinas Peak (2,730 m) in the northern end of the range (Fig. 1). The southern three-fourths of the range are comprised of completely faulted and tilted blocks, predominantly of Paleozoic limestones. Most mountains in this southern section are 2,100–2,280 m high, with San Andres Peak, the highest, reaching 2,510 m. Although the upper slopes of Salinas Peak are forested, montane forest is lacking in the southern part of the range. Scattered Pinyon Pine (*Pinus edulis* Engelm.), One-seeded Juniper (*Juniperus monosperma* (Engelm.)), scrub oaks (*Quercus* spp.) and other small trees and shrubs occur in canyons and on higher slopes. Members of the *Ashmunella kochii* Clapp complex, discussed herein, inhabit the southern part of the range.


107° N
33° W
Thurgood Cn
Sheep Mt.
Salinas Pk
Ladybug Pk
San Andres Mountains
Rhodes Cn
Ash Cn
Sulphur Cn
Kaylor Mt.
Lost Man Cn
Dead Man Cn
Gardiner Pk
Mayberry Cn
Ropes Spr.
San Andres Pk
Salt Cn
Black Brushy Mt
Goat Mt
Bear Cn
Black Mt
San Augustin Pass
Organ Mts.
10 mi.
16.09 km

Monzonitic igneous rocks predominate in the northern part of the Organ Mountains where impressive spires and pinnacles have formed. Prominent among these features are "Rabbit Ears," "The Needles," and "Organ Needle," this latter peak being the highest in the range, at 2,727 m. The southern part of the range is predominantly of rhyolitic igneous rock with the highest peak being Organ Peak (2,704 m). The Organ Mountains support more forest than do the San Andres. Ponderosa Pine (*Pinus ponderosa* Laws.), Alligator Juniper (*Juniperus deppeana* Steud.) and Gambel Oak (*Quercus gambelii* Nutt.) are dominant species.

The Franklin Mountains are a low, narrow, arid range, ca. 25 km long. Their highest peak, North Franklin Mountain, reaches 2,190 m in elevation. Mollusks of this range were discussed in Metcalf and Johnson (1971).

In all the above mountains, accumulations of rock talus are the commonest habitats of Ashmunellas. Limestone and rhyolitic formations are the major producers of such talus.

Unless otherwise noted, terminology of shell characters follows that of Burch (1962: Figs. 11–13). Localities (abbreviated as "Loc." or "Locs.") noted in text are listed at the end of the paper. Criteria utilized in taxonomic allocation of species are conchological, conforming to those previously used in this genus. Where kinds with markedly different shells intergrade, these have been treated as hybrids. These taxonomic assessments may eventually prove inadequate but seem to be useful at present in discussing the fauna of a region poorly known malacologically.

Abbreviations used in reference to types and paratypes are: ANSP = Academy of Natural Sciences of Philadelphia; DelMNH = Delaware Museum of Natural History; DMNH = Dallas Museum of Natural History; UA = University of Arizona; USNM = National Museum of Natural History, Smithsonian Institution; UTEP = University of Texas at El Paso. We are unaware of museum specimens of the new species described other than those listed below.

Descriptions of New Species

Ashmunella harrisi, new species
Plate I, Figs. a, d; Fig. 2A, B

Description of shell of holotype.—Shell thin, glossy, depressed, spire low, forming angle of 160°, sharply angular peripherally, with angularity

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Fig. 1. General overview of San Andres and Organ Mountains, New Mexico, indicating major canyons, peaks and some other features. Lower contour line is drawn at 5,000 ft (1,524 m) and upper contour line is drawn at 7,000 ft (2,134 m). Thus, elevations in black are above 7,000 ft. × = localities at which *Ashmunella pasonis pasonis* was taken.

slightly above mid-height; body whorl not descending, umbilicus greatly expanding on body whorl; aperture oblique, at angle of 50° to vertical; upper, outer and lower lip thin, moderately flared, only slightly reflected, bearing a rounded palatal tooth compressed obliquely to lip, rising 0.7 mm above lip callus; palatal tooth separated by 1.4 mm from upper of 2 basal teeth, which are laterally compressed, 1.1 mm apart, both rising 0.6 mm above lip callus, the upper basal tooth slightly longer. Parietal callus thin, transparent (no thickening at edge), bearing an oblique tooth at angle of 40° to vertical, descending gradually anteriorly to form a vertical oriented "tail" and giving rise at inner upper end to a low, indistinct, horizontal branch 1.4 mm long (not white, as in oblique part of tooth). Embryonic half whorl smooth, minute growth wrinkles appearing near suture on remainder of embryonic whorl and gradually grading to low, smooth, regularly spaced growth wrinkles on remaining dorsal surface. Periphery of angularity slightly thickened but not keeled; ventral surface with low, widely spaced growth lines. Shell pale grayish-tan except for whitish lip and denticles.

Variation in shells.—Range of variation for some characters in 25 paratypes from the type locality is indicated in Table 1. Shells vary considerably in size with a difference of 3.55 mm between diameters of largest and smallest mature shells. The upper branch of the parietal tooth is, at best, a low, indistinct swelling and in some specimens is absent. Shape and relative size of other denticles is uniform. A fulcrum is lacking in all specimens.

Soft anatomy.—The following description derives from 5 paratypes that were dissected. General dorsal aspect of animals dark gray to blackish but with considerable variation among specimens. Two specimens blackish dorsally from tentacles to end of tail, grading to slightly lighter ventrally (sulci between raised areas lighter). One specimen with only tentacles and stripes extending posteriorly from them blackish, with remainder of body above sole grading from dark gray above to light gray below. Two other specimens intermediate between the two patterns of pigmentation described. Sole gray, lighter medially in some specimens.

Mantle unpigmented except for some pale, minute, brown punctulations found (1) anteriorly alongside capillaries and (2) along and anterior to left afferent branchial blood vessel.

Penis relatively long for genus with upper sac elongate, slender, narrower than lower sac, with 2 oblong patches of granular tissue, upper sac slightly wider than epiphallus (Fig. 2A, B). Vagina relatively long and slender, free oviduct ⅓–½ length of vagina. Spermatheca almost as long as uterus plus albumen gland. Measurements (all are lengths of organs and in mm) are as follows for specimens dissected (mean outside, range inside parentheses): Penis, 3.68 (3.1–4.8); Upper sac of penis, 2.27 (1.8–2.8);

Table 1. Some measurements (in mm) for holotype and 25 paratypes (from type-locality) for each of 2 new species of *Ashmunella*. Length of parietal tooth refers to lower branch only. Palatal tooth is measured parallel to peristome. For each entry under paratypes, upper numerals indicate extremes and lower numerals mean and standard deviation (latter in parentheses).

	Ashmunella harrisi		*Ashmunella todseni*	
	Holotype	Paratypes	Holotype	Paratypes
Shell diameter	16.6	13.7–17.25 15.69(.907)	13.5	11.6–14.3 12.80(.679)
Shell height	5.7	4.4–5.9 5.27(.379)	5.4	5.1–7.1 5.66(.421)
Number of whorls	5.65	5.2–5.75 5.47(.164)	5.0	4.85–5.65 5.19(.196)
Height of aperture	4.6	3.6–4.7 4.20(.289)	3.7	3.2–4.4 3.92(.281)
Width of aperture	5.5	4.9–6.0 5.42(.331)	5.4	4.8–5.6 5.14(.240)
Width of umbilicus	4.4	3.4–4.9 4.06(.374)	2.7	2.0–2.9 2.42(.205)
Parietal tooth length	2.8	2.3–3.1 2.62(.204)	2.5	2.4–3.0 2.67(.149)
Palatal tooth length	1.0	0.8–1.9 1.24(.274)	1.2	1.0–1.7 1.30(.204)
Width of reflected part of lip	1.0	0.8–1.5 1.22(.191)	1.6	0.9–1.4 1.16(.138)

Epiphallus, 27.45 (24.6–31.5); Vas deferens, 29.37 (22.0–33.1); Spermatheca plus duct, 30.77 (26.4–35.4); Vagina, 4.85 (4.4–5.7); Free oviduct, 2.05 (1.8–2.5).

Diagnosis.—An *Ashmunella* with genitalia typical of the *A. kochii* group (discussed below): differentiable from other members of the group by the combination of thin, glossy, smooth shell, absence of fulcrum and with no or an extremely reduced upper branch of the parietal tooth. It is far smaller than *A. k. kochii*, its neighbor to the northwest. Populations judged to be hybrids between *A. harrisi* and *A. pasonis pasonis* occur in the eastern part of Bear Canyon. These are discussed below.

Etymology.—The species is named in honor of Dr. Arthur H. Harris, University of Texas at El Paso, who first collected the species.

Distribution.—*Ashmunella harrisi* is known from 2 canyons on the east side of Goat Mountain in the southeastern part of the San Andres

Mountains (Locs. 10 and 11). The type-locality is Loc. 10, with the holotype and associated paratypes collected on 11 April 1975.

Disposition of types.—Holotype, ANSP 340724. Paratypes: ANSP 340725; DelMNH 106682; DMNH 4535; UA 6218; USNM 758527; UTEP 3139, 4413.

Ashmunella todseni, new species
Plate I, Figs. b, e; Fig. 2C, D, E

Description of shell of holotype.—Shell thick, depressed, spire low, forming angle of ca. 150°, sharply angular (subcarinate) peripherally, with angulation approximately midway of height. Five whorls, body whorl not descending; umbilicus moderately narrow, 3.78 times in shell diameter. Aperture markedly oblique, at angle of 50° to vertical. Upper, outer and lower margin of peristome rounded, lip broad and reflected, outer reflected part of lip thin, inner part thickened, calluslike, especially at upper end, where a thick callus extends back 0.7 mm along roof of body whorl. Lip continuous with thickened, anterior, raised edge of parietal callus, raised edge of callus white, remainder of callus translucent but bearing large oblique parietal tooth; lower ⅓ of tooth parallel to raised anterior parietal callus margin, upper ⅔ of tooth at angle of 115° to lower part, slightly sinuous; upper end of parietal tooth giving rise to short, low, arcuate branch. Lip peristome giving rise to rounded palatal tooth, rising 0.5 mm above callus and 2 compressed basal teeth, the uppermost slightly larger and rising 0.65 mm, the lower only 0.5 mm above callus; all 3 lip teeth evenly spaced, ca. 1 mm, from each other. Embryonic half whorl slightly roughened, surface of whorls 0.5–1.75 finely wrinkled, remainder of dorsal surface with regularly spaced, moderately strong growth wrinkles. Peripheral angularity slightly thickened, almost keeled. Ventral surface with low, regularly spaced growth wrinkles, becoming stronger near aperture. Rows of minute cuticular "hairs" on walls of umbilicus. Shell light reddish brown except for strongly contrasting whitish lip, teeth and raised margin of parietal callus.

Variation in shells.—Range of variation in shell characters for 25 paratypes from the type locality is indicated in Table 1. The anterior edge of the parietal peristome varies from appressed to strongly raised. The oblique parietal tooth varies in length and height, being relatively massive in some specimens. The upper branch of the parietal tooth is, at best, a weak swelling and is absent in some specimens. The palatal tooth varies from short and rounded to longer and rectangular. A fulcrum is lacking in all specimens. Cuticular hairs and scales occur on the entire ventral surface and on the dorsal surface of younger whorls in specimens from Loc. 21.

Soft anatomy.—(Fig. 2C, D, E). The following description is derived from 5 paratypes dissected. Head, including all tentacles, uniformly black. Posteriorly and ventrally on body, color lightening but with raised areas

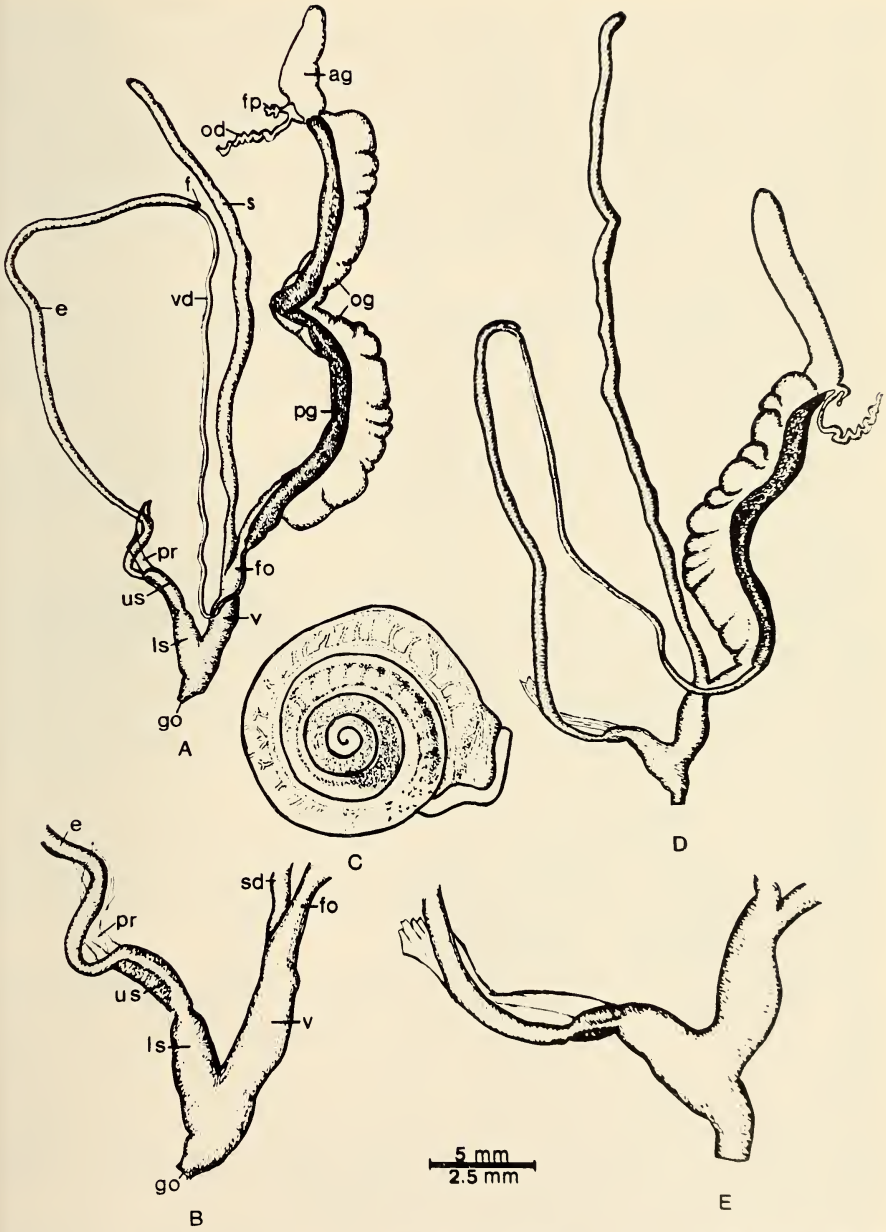

Fig. 2. A and B, Genitalia of *Ashmunella harrisi*; C, Dorsal view of mantle of *Ashmunella todseni*; D and E, Genitalia of *A. todseni*. ag = albumen gland; e = epiphallus; f = flagellum; fo = free oviduct; fp = fertilization pouch or talon; go = genital orifice; ls = lower sac of penis; od = ovotestis or hermaphroditic duct; og = oviducal gland; pg = prostate gland; pr = penial retractor muscle; s = spermatheca; sd = spermathecal duct; us = upper sac of penis; v = vagina; vd = vas deferens.

darker than intervening sulci. Margin and sole of foot uniformly light gray. Collar of mantle gray with dark brown margin. Mantle especially well pigmented for members of genus (Fig. 2C) with area immediately posterior to collar prominently flecked and streaked with black pigment. Efferent and left afferent branchial blood vessels and their capillaries outlined with black punctulations. Kidney outlined with interrupted dark punctulations. Mantle pigmented dorsally on part or all of first 2 whorls and atop third whorl with 2 rows of dark punctulations with ladderlike cross-connections.

Penis with upper sac narrower than lower sac; upper sac with 2 oblong patches of granular tissue visible externally (Fig. 2E). Free oviduct ca. one-half length of vagina. Spermatheca extending beyond uterus and albumen gland. Fertilization pouch (= talon) comprising 2 or 3 globular bodies. Genitalia are shown in Fig. 2D, E.

Measurements of genital organs for the specimens dissected (given as in *A. harrisi*, above) are: Penis, 3.36 (3.2–3.5); Epiphallus, 24.8 (22.6–28.2); Vas deferens, 24.9 (21.5–26.1); Spermatheca plus duct, 31.48 (27.2–35.2); Vagina, 5.1 (4.9–5.3).

Diagnosis.—An *Ashmunella* with genitalia typical of the *A. kochii* group but with mantle more heavily pigmented than in other species of the group. Shells differentiable in being subcarinate with large, sinuous lower and rudimentary or no upper parietal denticle, and lacking fulcrum. Its nearest neighbor, *A. organensis* Pilsbry, 1936, has greatly reduced denticulation and rounded, rather than subcarinate, shells. *Ashmunella auriculata* Vagvolgyi, 1974, also of the Organ Mountains, has a thinner, smoother, angular shell with a wider, shallower umbilicus.

Etymology.—This species is named in honor of Dr. Thomas K. Todsen, White Sands Missile Range, New Mexico, to whom we are especially indebted for escort provided on the Missile Range, for his knowledge of the area and for his good companionship.

Distribution.—*Ashmunella todseni* has been collected only in Maple and Texas Canyons in the northeastern part of the Organ Mountains (Locs. 21, 22, 24). The type-locality is in Maple Canyon, Loc. 24, with holotype and associated paratypes collected on 24 May 1975. At this time it is not possible to ascertain to what extent *A. todseni* may extend around the southeastern part of the Organ Mountains from the localities listed here. This area, mainly on Fort Bliss Military Reservation, is used as an artillery range and access is not authorized.

Habitat.—Ecologically, *A. todseni* may differ from the other species of *Ashmunella* in the Organ Mountains. At its type-locality, where especially abundant, it was found only in the upper 10 cm of small, rubbly talus of igneous rock. At lower depths, where other species of *Ashmunella* in the Organ Mountains are usually found, *A. todseni* did not occur. It seems

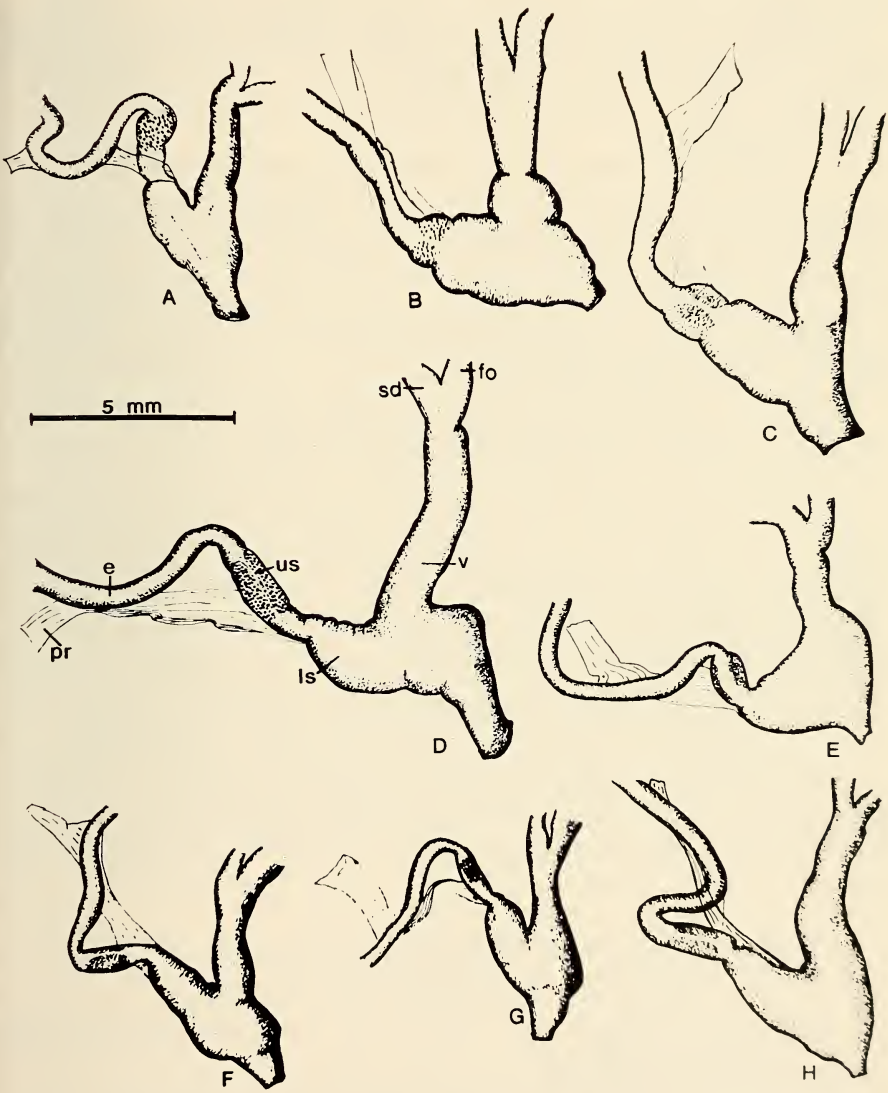

Fig. 3. Distal region of genitalia of some species of *Ashmunella* from southern New Mexico and adjacent Texas. Abbreviations as in Fig. 2. A, *A. organensis* (Loc. 29); B, *A. amblya amblya* (Pine Spring Canyon, Guadalupe Mts., Texas); C, *A. amblya cornudasensis* (Flattop Mt. of Cornudas Mts., New Mexico); D, *A. kochii kochii* (Loc. 7); E, *A. kochii sanandresensis* (Loc. 6); F, *A. pasonis pasonis* (Loc. 1); G, *A. pasonis pasonis* (Loc. 36); H, *A. auriculata* (Loc. 18).

to be, then, a species especially well adapted to an arid microhabitat, probably subject to pronounced extremes of temperature.

Disposition of types.—Holotype, ANSP 340726. Paratypes: ANSP 340727; DelMNH 106683; DMNH 4534; UA 6217; USNM 758528; UTEP 4476, 4744, 4746.

Additional Species of the *Ashmunella kochii* Complex

Including the 2 species described above, 7 species of *Ashmunella* are known from the San Andres, Organ and Franklin Mountains. *Ashmunella salinasensis* Vagvolgyi, 1974, occurs on Salinas Peak in the northern part of the San Andres Mountains. It clearly belongs to the group of *Ashmunella rhyssa* (Dall, 1897), a complex widespread in the Sacramento and Sierra Blanca Mountains on the east side of the Tularosa Basin (Metcalf, 1973:38).

Similarities in morphology of genitalia suggest that the remaining 6 species of the mountains treated here belong to a single complex, termed the "*Ashmunella kochii* complex," in reference to the first-named member of the group (Clapp, 1908). In this group the penis is of the kind described by Pilsbry (1940:913, 914): "the upper part of the penis is only about half as wide as the lower, and sometimes hardly distinguishable from the epiphallus." (See Figs. 2; 3A, D–H).

Also belonging to the *A. kochii* complex are (1) *A. rileyensis* Metcalf and Hurley, 1971, from Mount Riley, 40 km west of the Franklin Mountains (in New Mexico) and (2) *A. kochii caballoensis* Vagvolgyi, 1974, from the Caballo Mountains, ca. 55 km west of the San Andres Mountains.

Remaining taxa of the *A. kochii* group in the San Andres, Organ and Franklin Mountains are treated below. Some shell characters utilized in delimiting taxa of *Ashmunella* in these mountains are given in the accompanying key. (Upper parietal denticle = upper branch of parietal denticle.)

A Key to Shells of the Taxa of the Genus *Ashmunella* of the San Andres, Organ and Franklin Mountains

1a. Shell heavily ribbed — *A. salinasensis* Vagvolgyi
1b. Shell not heavily ribbed — 2
2a. Parietal denticles fused into a subtriangular or subquadrate placque that occupies most of parietal wall — 3
2b. Parietal denticles not forming placque on parietal wall — 4
3a. Shell keeled, bearing cuticular scales — *A. pasonis pasonis* (Drake)
3b. Shell angular rather than keeled; lacking cuticular scales — *A. pasonis polygyroidea* Vagvolgyi
4a. Fulcrum (internal denticle on floor of body whorl) lacking — 5
4b. Fulcrum present — 8

5a. Body whorl subcarinate peripherally; adult shells bearing cuticular hairs in umbilical region *A. todseni* n. sp.
5b. Body whorl angular or rounded peripherally; adults with no cuticular hairs 6
6a. Parietal and lip denticles rudimentary or absent *A. organensis* Pilsbry
6b. Well developed denticles present both in lip and on parietal wall 7
7a. Upper parietal denticle well developed *A. auriculata* Vagvolgyi
7b. Upper parietal denticle absent or rudimentary *A. harrisi* n. sp.
8a. Shells larger than 18.5 mm in diameter; upper parietal denticle rudimentary or absent *A. kochii kochii* Clapp
8b. Shells smaller than 18.5 mm in diameter; upper parietal denticle well developed *A. kochii sanandresensis* Vagvolgyi

Ashmunella kochii kochii Clapp
Plate I, k; Fig. 3D. Locs. 7, 8, 9

Ashmunella kochii G. H. Clapp, 1908:77; Pl. 8, figs. 1–3.

Clapp (1908) described the type-locality of *A. kochii* thus: "Black Mountain, at the southern end of the San Andreas Range, Donna Ana county, New Mexico, at an elevation of about 6,800 feet." Pilsbry (1940:977) named a subspecies, *A. kochii amblya*, from the Guadalupe Mountains of New Mexico and Texas, ca. 180 km to the east-southeast. Vagvolgyi (1974: 143) suggested that Clapp's type of *A. k. kochii* might actually have come from the Guadalupe rather than from the San Andres Mountains.

The problem of type-localities is further complicated by the existence of 2 mountains indicated as "Black Mountain" on maps of the southern San Andres Mountains. The more southern of these is located south of Bear Canyon (Figs. 1, 6) and centers around the northeast corner of Sec. 1, T. 21S, R. 4E. The more northern peak is located on San Andres National Wildlife Refuge, south of Salt Canyon (Figs. 1, 6) and centers around Sec. 3, T. 20S, R. 4E. Mr. John Kiger, manager of the Refuge (pers. comm.) has informed us that the more northern mountain is locally called "Black Brushy Mountain" and we shall use that name here.

On the southern and northern sides of (the southern) Black Mountain, we have collected, respectively, *A. pasonis pasonis* (Loc. 16) and hybrids between *A. p. pasonis* and *A. harrisi* (Locs. 13–15). At Loc. 7, on the northern side of Black Brushy Mountain, we have collected a large *Ashmunella*, shells of which seem indistinguishable from the type of *A. k. kochii* Clapp. We think it most likely, then, that the type of *A. k. kochii* did come from the southern San Andres Mountains, as originally indicated by Clapp, and probably from Black Brushy Mountain. It is understandable that Vagvolgyi (1974:143) considered the Guadalupe Mountains to be the type-

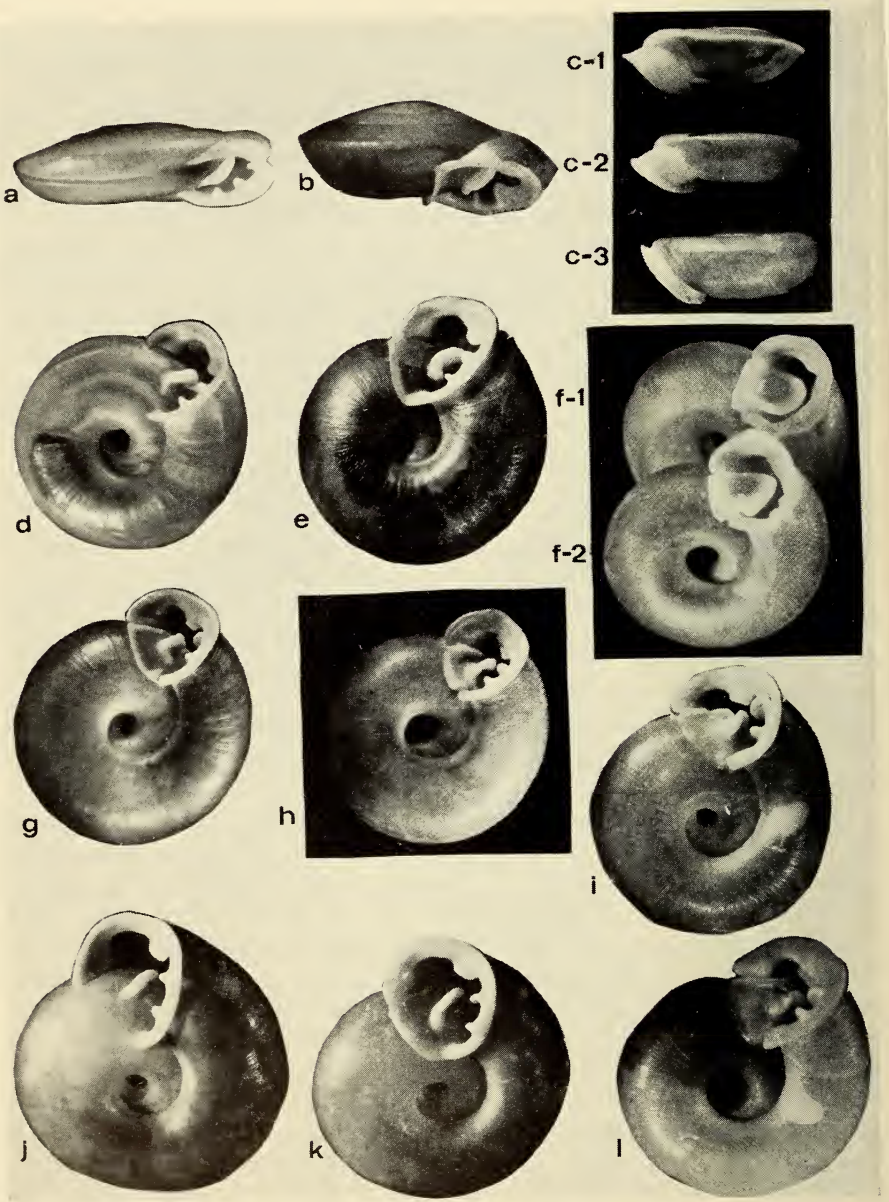

Plate I. Shells of some kinds of *Ashmunella* from southern New Mexico and adjacent Texas. Measurements are for diameter of shell. a–c, viewed from side, toward aperture; d-1, umbilical view. a, d, Holotype of *A. harrisi*, ANSP 340724 (16.6 mm); b, e, Holotype of *A. todseni*, ANSP 340726 (13.5 mm); c-1 and f-1, *A. pasonis pasonis*, Loc. 1 (12.45 mm); c-2 and f-2, *A. pasonis pasonis*, Loc. 36 (12.45 mm); c-3, *A. pasonis polygyroidea*, Loc. 42 (12.9 mm); g and h, hybrids of *A. pasonis pasonis* × *A. harrisi* from Loc. 15 (g—16.2 mm) and Loc. 14 (h—14.5 mm); i, *A. kochii sanandresensis* from

locality because the shells of *A. k. kochii* from Black Brushy Mountain (not seen by him) and those of *A. k. amblya* from its type-locality in Pine Spring Canyon in the Guadalupe Mountains are strikingly similar (Pl. I, j, k). There are slight differences, however. The (lower) parietal tooth of *A. k. amblya* is straighter and more rectangular in shape (as shown in Pilsbry, 1940: Fig. 566d), whereas in specimens from Black Brushy Mountain this tooth is slightly sinuous and incurved basally to form a "tail" (op. cit., Fig. 566a, b). On the average, the palatal tooth of shells of *A. k. amblya* is shorter and more rounded than in specimens from Black Brushy Mountain.

The genitalia of the 2 kinds show marked differences. The upper sac of the penis is unusually short, for the genus, and much broader than the epiphallus in *A. k. amblya* (Fig. 3B). In specimens from Black Brushy Mountain (Fig. 3D) the upper sac is long and only slightly broader than the epiphallus, as in other species from the southern San Andres and Organ Mountains. In view of the differences enumerated above, we propose that *A. amblya* be accorded specific rank.

Vagvolgyi (1974) described *A. kochii cornudasensis* from the Cornudas Mountains, 70 km west of the Guadalupe Mountains and 115 km southeast of Black Brushy Mountain. This *Ashmunella* has genitalia (Fig. 3C) of the kind seen in *A. amblya*. Thus, we propose that 2 subspecies be recognized in *A. amblya*: (1) the nominal subspecies from the Guadalupe Mountains and (2) *A. ambyla cornudasensis* Vagvolgyi from the Cornudas Mountains.

Herein, we deem *A. kochii* to comprise 3 subspecies: (1) the nominal race (Black Brushy and Goat Mountains), (2) *A. k. sanandresensis* Vagvolgyi, 1974, from San Andres Peak, immediately north of Black Brushy Mountain, and (3) *A. k. caballoensis* Vagvolgyi, 1974, from the Caballo Mountains, west of the San Andres Mountains.

Ashmunella kochii sanandresensis Vagvolgyi
Plate I, i; Fig. 3E. Loc. 6

Ashmunella kochi amblya H. A. Pilsbry, 1940:977 (provisionally referred).
Ashmunella kochi G. H. Clapp, 1908.—Metcalf, A. L. and P. A. Hurley, 1971:122.
Ashmunella kochi sanandresensis J. Vagvolgyi, 1974:145; Pl. I, 3, 3a; fig. 4c.

Shells of this race from near its type-locality on the western slope of San Andres Peak differ from *A. k. kochii* in being smaller and having a

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Loc. 6 (17.1 mm); j, *A. amblya amblya* from Pine Spring Canyon, Guadalupe Mountains, Texas (20.9 mm); k, *A. kochii kochii* from Loc. 7 (19.6 mm); l, Hybrid of *A. p. pasonis* × *A. kochii sanandresensis* from Loc. 4 (13.95 mm).

well developed upper parietal tooth (see Pl. I, i, k). No living intergrades between the 2 subspecies were found in the lower mountains between San Andres Peak and Black Brushy Mountain. However, on the south wall of Ash Canyon (32°37′50″N; 106°32′18″W) occur fossils (probably late Pleistocene) that seem to be intergrades. These are of the smaller size of *A. k. sanandresensis* but lack an upper parietal tooth. In the northwesternmost part of San Andres Peak (Locs. 4, 5), *A. k. sanandresensis* shows evidence of hybridizing with *A. pasonis pasonis*, which occurs in the mountains to the north.

Ashmunella pasonis pasonis (Drake)

Pl. I, c-1, c-2, f-1, f-2; Fig. 3F, G; Fig. 4A, B. Locs. 1–3, 9, 16, 34–40

Polygyra pasonis R. J. Drake, 1951:44–46; Figs. 1–4.
Ashmunella pasonis.—R. J. Drake, 1952, Ibid., 9:30.

Drake (1951) described *Polygyra pasonis* from shells collected in Vinton Canyon in the northern Franklin Mountains, El Paso County, Texas. He later (1952) reassigned *P. pasonis* to the genus *Ashmunella*. Vagvolgyi (1974:156) partitioned *A. pasonis* of the Franklin Mountains into a more northern, nominal subspecies and a more southern subspecies that he named *A. pasonis polygyroidea*. Pleistocene fossils, closer in shell morphology to *A. p. polygyroidea* than to the nominal subspecies, have been found in the northern part of the Franklin Mountains where *A. p. pasonis* presently occurs. This indicates (1) that in an earlier Quaternary time probably all of the range was inhabited by *A. p. polygyroidea* and (2) in subsequent time, populations in the northern part of the range have been evolving toward the shell morphology of *A. p. pasonis*. Shells of living populations demonstrate intergradation from north to south. Salient characters showing such clinal intergradation include (listing the more plesiomorphic condition of *A. p. polygyroidea* first and the more apomorphic *A. p. pasonis* second): (1) shell higher and more rounded peripherally *to* shell more depressed and carinate; (2) shell without *to* shell with cuticular scales; (3) smaller *to* larger lip teeth; (4) parietal placque that is smaller, more triangular and less raised anteriorly *to* placque that is larger, more quadrate and more raised anteriorly; (5) lip less reflected and with less development of a "neck" behind the aperture *to* lip greatly reflected and with well developed "neck." Apertural features distinguishing the 2 subspecies are shown in Fig. 4.

The nominal subspecies of *A. pasonis* also occurs in the San Andres Mountains. It has been found in 2 areas there, one to the north and one to the south (see "x's" in Fig. 1). In the more northern area, *A. pasonis pasonis* occurs at least from Lost Man and Dead Man Canyons (Locs. 1, 2) south to Mayberry Canyon (Loc. 3) and it hybridizes with *A. k. sanandresen-*

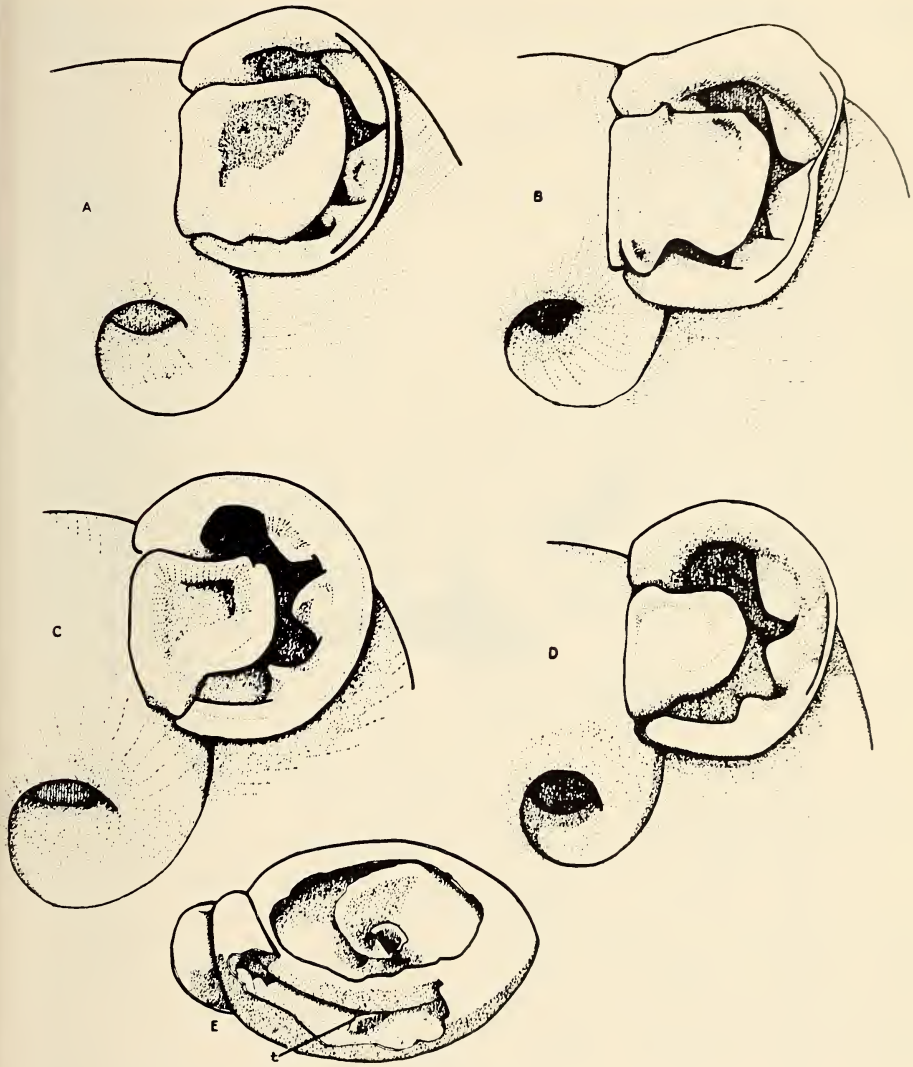
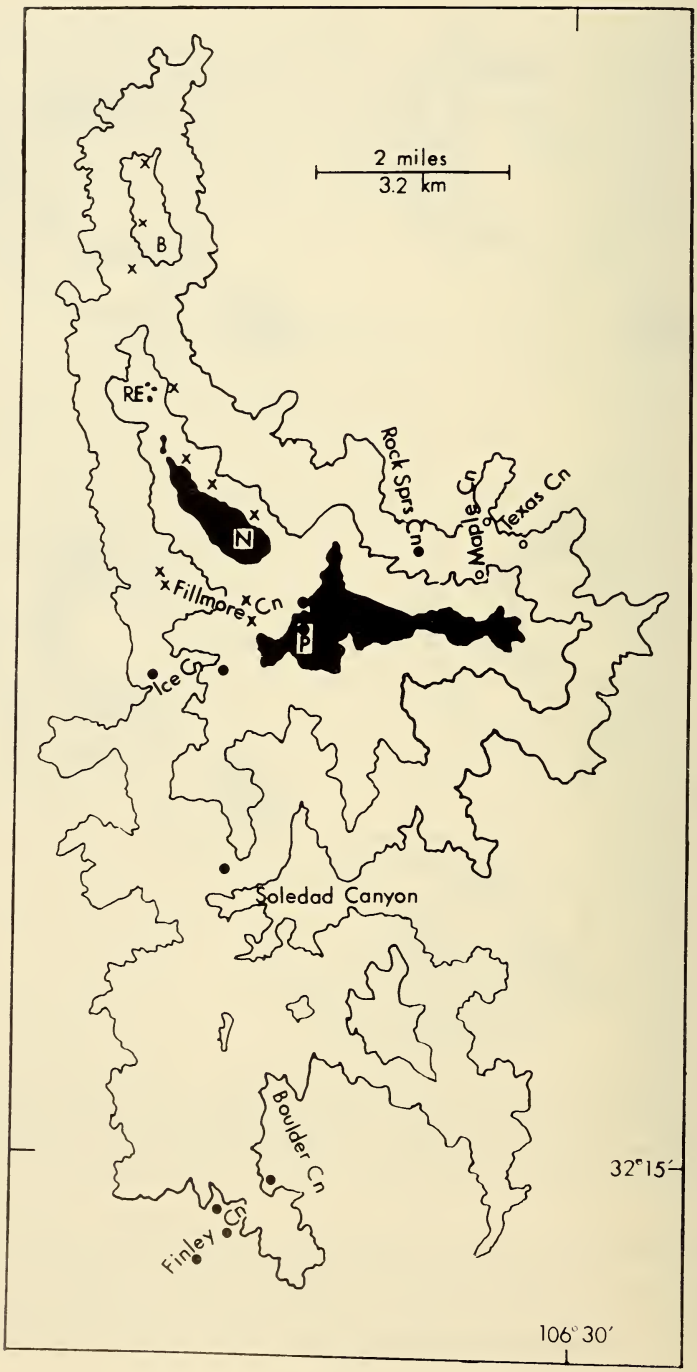


Fig. 4. Shells of *Ashmunella pasonis* from the Franklin Mts., El Paso County, Texas. A–D, Apertural areas showing graduation from apomorphic *A. pasonis pasonis* (A and B—Locs. 34 and 36) to plesiomorphic *A. pasonis polygyroidea* (C and D—Locs. 41 and 42); E, Shell with part of body whorl removed to show fulcrum (t).

sis in the northern part of San Andres Peak (Locs. 4, 5). In the south, *A. p. pasonis* occurs in upper Little San Nicholas Canyon together with *A. k. kochii* (Loc. 9) with which it does not hybridize. The 2 species seem to occupy slightly different habitats. In the southern area it also occurs on


2 miles
3.2 km
B
RE
N
P
Rock Spgs Cn
Maple Cn
Texas Cn
Fillmore Cn
Ice Cr
Soledad Canyon
Boulder Cn
Finley Cr
32°15′
106° 30′

Black Mountain (Locs. 12, 16), although on its northern slope in Bear Canyon (Locs. 13–15) it hybridizes with *A. harrisi*.

Ashmunella pasonis polygyroidea Vagvolgyi
Plate I, c-3; Fig. 4C, D. Locs. 41–42

Ashmunella pasonis R. J. Drake, 1951.—Metcalf, A. L. and W. E. Johnson, 1971:94, 100.
Ashmunella pasonis polygyroidea J. Vagvolgyi, 1974:156, Pl. I, fig. 10.

This race of *A. pasonis* presently is found living only in the central part of the Franklin Mountains. Pleistocene fossils indicate that it previously inhabited the southern and northern parts of the range as well. Subsequently, it has become extinct in the southern part of the range and has seemingly evolved into *A. pasonis pasonis* in the northern part. Vagvolgyi (1974:157) suggested that *A. p. polygyroidea* might represent hybrids between *A. pasonis pasonis* and some race of *A. kochii*. However, the nature of the fossils of *A. pasonis* in the Franklin Mountains seems clearly to demonstrate that *A. p. polygyroidea* is the ancestor of *A. p. pasonis* and that its resemblance to *A. kochii* results from plesiomorphic features derived from an *A. kochii*-like ancestor.

Ashmunella auriculata Vagvolgyi
Fig. 3H. Locs. 17–20, 25, 26

Ashmunella mearnsii (Dall, 1895).—Cockerell, T. D. A., 1897:69.
Ashmunella kochi G. H. Clapp, 1908.—Pilsbry, H. A., 1915:329.—Metcalf, A. L., 1969: Table 1.—Metcalf, A. L. and P. A. Hurley, 1971:122, 126.
Ashmunella auriculata J. Vagvolgyi, 1974:150; Pl. I, figs. 5, 5a.

Vagvolgyi (1974:150) indicated the type-locality of *A. auriculata* to be in Boulder Canyon in the southern part of the Organ Mountains. This species also occurs in the northern, monzonitic "Needles" area of the mountains, on Baylor Peak, and in the lower part of Fillmore Canyon (Fig. 5). Between these northern populations and the type-locality *Ashmunella organensis* occurs.

←

Fig. 5. Organ Mountains, Doña Ana County, New Mexico. Contours are drawn at 6,000 ft (1,829 m), 7,000 ft (2,134 m) and 7,500 ft (2,286 m). Thus, elevations in black are above 7,500 ft. Open circles = localities of *Ashmunella todseni*; filled circles = localities of *Ashmunella organensis*; × = localities at which *Ashmunella auriculata* was taken in this survey (type-locality is in Boulder Canyon). B = Baylor Peak; N = Organ Needle; P = Organ Peak; RE = Rabbit Ears.

Ashmunella organensis Pilsbry
Fig. 3A. Locs. 23, 27–33

Ashmunella organensis H. A. Pilsbry, 1936:101.

Pilsbry (1936:101) described this species from an upper branch of Ice Canyon in the west-central part of the Organ Mountains. We have found it to occur in the central and southwestern parts of the range (Fig. 5) and even on the west wall of Boulder Canyon (Loc. 32), the canyon that Vagvolgyi (1974:151) recorded as the type-locality of *A. auriculata*. *Ashmunella organensis* is not known to hybridize with other species of the Organ Mountains (*A. todseni* and *A. auriculata*). In regard to shell characters it bears little resemblance to the *A. kochii* complex, having a high spire (more pronounced at higher elevations) and with rudimentary or no apertural teeth. However, morphology of the genitalia indicates alliance with the group of *A. kochii*.

Hybridization

In 2 areas in the San Andres Mountains hybridization seems to occur between *Ashmunella pasonis pasonis* and another species, suggesting some genetic plasticity on the part of *A. p. pasonis*.

1. *Ashmunella p. pasonis* × *A. harrisi*. Pl. I, g, h; Locs. 13–15. Having a shell morphology judged to be among the most plesiomorphic of the *A. kochii* complex, it is surprising that *A. harrisi* hybridizes with *A. p. pasonis*, deemed the most apomorphic member of the complex in regard to shell morphology. A cline grading from one species to the other is shown in 4 collections taken along the south wall of Bear Canyon, which lies south of Goat Mountain (with type-locality of *A. harrisi* on its east slope) and north of Black Mountain (Fig. 6). At the easternmost locality (Loc. 15, Fig. 6) shells resemble types of *A. harrisi* except for the parietal area, in which the interdental callus has become thickened and an upper branch of the parietal tooth has become a salient feature (Pl. I, g). At Loc. 14, 2.4 km west-northwest of Loc. 15, the parietal callus has become greatly thickened and placquelike and the 2 branches of the tooth with the anterior margin of the callus, form a triangular, raised rim around the placque. The outer lip has become slightly recurved with the result that lip teeth are more deeply set. A weak keel has appeared and cuticular scales cover much of the shell (Pl. I, h). Shells from Loc. 13 (Fig. 6), 0.4 km northeast of Loc. 14 are still smaller, scalier and more flattened and keeled than those from Loc. 14. An anteriorly elevated parietal placque covers almost all the parietal wall. The lip is flared and recurved. These shells approach the shell type of *A. p. pasonis* and shells from Loc. 12, 0.39 km north of Loc. 13, seem indistinguishable from those of *A. p. pasonis* except for lacking a fulcrum. Specimens of *A. p. pasonis* from Locs. 9 and 16 also lack the fulcrum (see Fig. 4E), which is found in this species in the Frank-

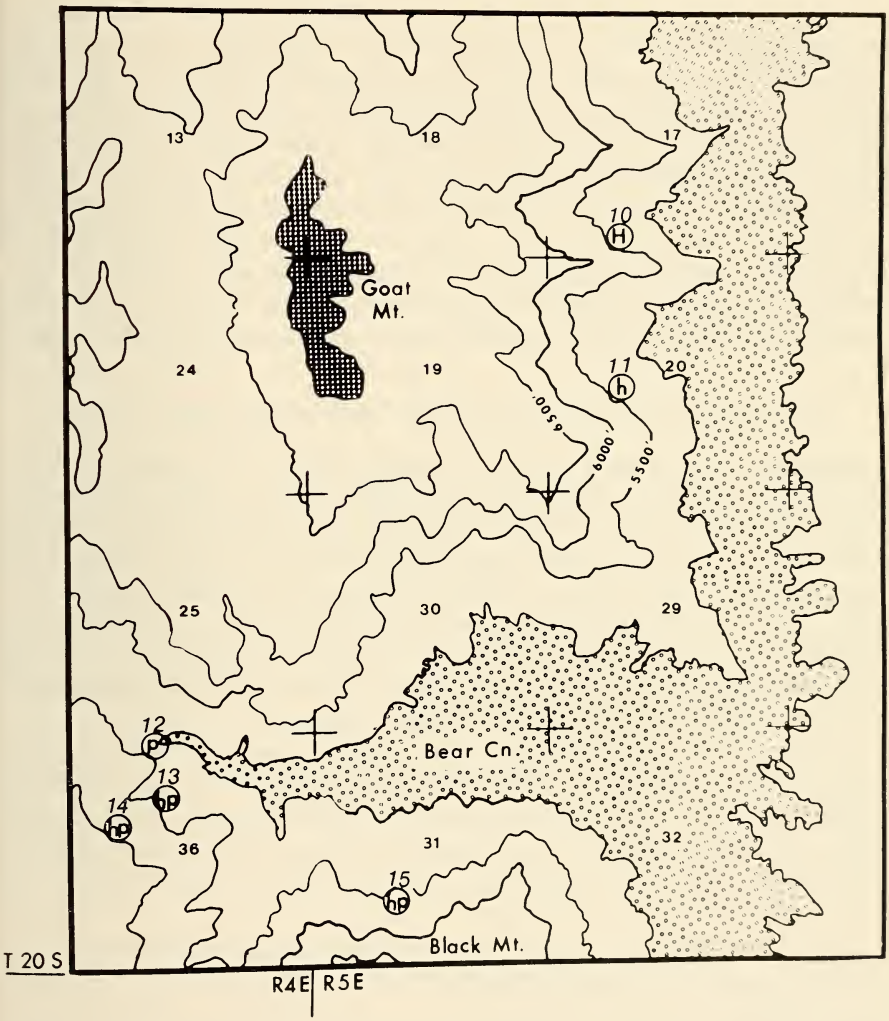


Fig. 6. Environs of Goat Mountain and Bear Canyon, San Andres Mts., Doña Ana County, New Mexico. Numbers in italics are localities of collections; non-italicized numbers are of surveyed sections. H = type locality of *Ashmunella harrisi*; h = another locality of *A. harrisi*; p = locality of *Ashmunella pasonis pasonis*; hp = localities with intergrades between *A. p. pasonis* and *A. harrisi*. Contour lines are at 500 ft (152.4 m) intervals with black, dotted area above 7,000 ft (2,134 m) and open-dotted area 4,500–5,000 ft (1,372–1,524 m).

lin Mountains and in northern populations of the San Andres Mountains (Locs. 1–3). Perhaps this lack of a fulcrum in southern populations of the San Andres Mountains reflects a genetic contribution from *A. harrisi*, which also lacks this structure.

2. *Ashmunella p. pasonis* × *A. kochii sanandresensis.* Pl. I, 1; Locs. 4–5. Typical specimens of *A. p. pasonis* occur in Lost Man, Dead Man and Mayberry Canyons in the San Andres Mountains (Fig. 1). The type-locality of *A. k. sanandresensis* is to the south in the central, western part of San Andres Peak near Loc. 6. In the northern part of San Andres Peak hybridization occurs between the two kinds (Locs. 4 and 5). Specifically, towards the north on San Andres Peak, there is thickening of the parietal callus between the upper and lower branches of the parietal tooth to produce a parietal placque approaching that, which is typical of *A. p. pasonis.* There is also an increase in relative size of the teeth of the outer lip. Shells become smaller towards the north, approaching the size of *A. p. pasonis* (Pl. I, i).

Phylogenetic Trends in Shells in the *Ashmunella kochii* Complex

Genitalia of the members of the *A. kochii* complex exhibit much similarity. Shells, however, show considerable variability and may offer clues to phylogeny within the group. Pilsbry (1905:255) hypothesized that, as regards denticulation in *Ashmunella*, a tridentate condition (teeth in palatal and basal positions on the lip and a tooth on the parietal callus) might be regarded as primitive. From this presumed plesiomorphic tridentate condition some phyletic lines have evolved towards a loss of some or even all denticles while others have increased their armature. This increase seems generally to have taken place in 3 different ways:

1. In some lines the basal lip tooth has bifurcated to produce 2 teeth, subtended by a common callus; these teeth have, then, in subsequent evolution, become more widely separated. *Ashmunella ruidosana* Metcalf, 1973, a fossil species, and *A. thomsoniana* (Ancey, 1887) and *A. pseudodonta* (Dall, 1897), both living species, seem to demonstrate a condition in which this bifurcation is taking place.

2. The parietal tooth seems, independently, in several lines, to have gained an upper branch oriented at an acute angle to the lower branch, thus yielding a V-shaped appearance. In a few species there has been, subsequently, a trend in which the parietal callus between the upper and lower arms of the tooth has become thickened. In the extreme example of *A. pasonis* the interdental callus has thickened greatly, becoming elevated anteriorly from the underlying shell wall and forming, in an earlier stage of evolution, a triangular placque as seen in *A. p. polygyroidea* (Fig. 4C, D). In subsequent evolution, producing *A. p. pasonis*, the placque has become even larger and more quadrate in shape (Fig. 4A, B).

3. In some species a tooth has appeared several mm behind the aperture on the inner basal part of the body whorl. This tooth has been termed a fulcrum by Vagvolgyi (1974: Fig. 1). A fulcrum is present in all species of the *A. kochii* complex except those inhabiting the Organ Mountains, in *A. rileyensis*, *A. harrisi* and in hybrids of *A. pasonis* × *A. harrisi.*

Primitively, shells of *Ashmunella* were probably generally rounded peripherally and moderately high spired as in the shells of *A. organensis* from higher elevations. Evolution towards a more depressed and often carinate shell seems, somehow, to be related to living at lower (hence, more arid) elevations. Even specimens of *A. organensis* from lower elevations exhibit more depressed shells than their relatives at higher elevations. Carination seems especially common in *Ashmunella* inhabiting talus of flat limestone rocks.

Cuticular scales have developed in several lines of *Ashmunella*. Again, this seems to be most often exhibited by species living in lower, more arid habitats, as in *A. lepiderma* Pilsbry and Ferriss, 1910, in *A. bequaerti* Clench and Miller, 1966, and in *A. todseni* and *A. p. pasonis*.

A Suggested History of the *A. kochii* Complex

On the basis of present and past known distributions and on shell-morphological evidence provided by living and fossil materials, the following model is suggested. We present it to be tested against further discoveries and more refined analytical methods.

1. With its relatively high-spired shell and weak denticulation, *A. organensis* seems to be somewhat removed from other members of the complex. It may long have inhabited the area. Fossils of *A. hawleyi* Metcalf, 1973, from deposits of probable mid-Quaternary age along the Rio Grande Valley resemble *A. organensis* as does also a single fossil taken from deposits along Salt Canyon on the north side of Black Brushy Mountain in the San Andres range, northwest of Loc. 7. In younger deposits on the same hillslope occur fossils of *A. kochii kochii*, which presently inhabits this slope. There is, then, some evidence that *A. organensis* is an ancient and formerly more widespread member of the *A. kochii* complex, now restricted to the Organ Mountains.

2. The remaining species of the complex have dispersed widely in the mountain ranges treated here. A vicariance model could be employed to account for their initial occupation of the ranges; however, some instances of later dispersal by propagules seem likely, as suggested below. Probably a plesiomorphic shell of this latter group would have 4 denticles, 3 in the outer lip and a parietal tooth (bearing, at most, a very weak upper branch), and lacked a fulcrum. Only *A. harrisi* and *A. todseni* retain this kind of denticulation today. These species may stem from a relatively early stage in the evolution of the *A. kochii* complex. Restricted in small eastern enclaves of their respective mountain ranges, one (*harrisi*) has retained a more conservative shell; the other (*todseni*) has evolved into a xeric-tolerant species with a more specialized shell.

3. A slightly more advanced shell might have acquired a stronger upper parietal branch but still lacked a fulcrum. Such a shell is possessed by *A. auriculata* and *A. rileyensis*. These species are similar and *A. rileyensis*

may have been derived from a propagule of *A. auriculata* from the Organ Mountains. A still more advanced shell might have acquired the fulcrum, found in *A. kochii* sspp. and *A. pasonis* sspp. *Ashmunella kochii caballoensis* is close in shell morphology to *A. k. sanandresensis* suggesting that it might have been derived, as a propagule, from the population of San Andres Peak.

4. In the Franklin Mountains, evolution progressed from an *A. kochii*-like ancestor through the intermediate shell-type of *A. p. polygyroidea* to the highly apomorphic shell of *A. p. pasonis*.

5. *Ashmunella p. pasonis*, developing in the northern Franklin Mountains, seems, subsequently, to have reinvaded the southern San Andres Mountains, still retaining sufficient genetic similarity to its relatives there to be able to hybridize with both *A. kochii sanandresensis* and *A. harrisi*. This suggests that *A. p. pasonis*, in addition to having acquired the most apomorphic shell of any known *Ashmunella*, may also possess exceptional ability to disperse among the arid mountains of the region. Certainly it is highly tolerant of arid conditions. In Vinton Canyon in the Franklin Mountains it survives for months in gravelly soil only a few cm below the surface.

The above interpretation regarding the dispersal of *A. pasonis* is taken with some trepidation. However, fossil evidence seems clearly to indicate that *A. pasonis* evolved in the Franklin Mountains and there is no comparable evidence that it has long inhabited the San Andres, where fossils recovered are all of the apomorphic *A. pasonis pasonis* and found in relatively young deposits.

Consideration should be given to the possibility, not broached heretofore, that the taxon "*A. kochii sanandresensis*" actually represents hybrids between *A. p. pasonis* and *A. k. kochii*. The intermediacy of *A. k. sanandresensis* between these species is shown, to some extent, in Plate I, i, k, l.

One might conjecture whether *A. pasonis pasonis* of the Franklin and of the San Andres Mountains might only be exhibiting convergence in shell morphology as was suggested above to be the case with *A. k. kochii* and *A. a. amblya*. However, in the case of *A. p. pasonis* the genitalia of snails from the 2 ranges are of the same kind (Fig. 3F, G). Also, *A. k. kochii* and *A. a. amblya* have retained a relatively plesiomorphic shell as regards Ashmunellas of the region, whereas *A. p. pasonis* has an extremely apomorphic shell. It seems unlikely that such indistinguishable apomorphic features would have evolved twice, in the Franklin and in the San Andres Mountains.

Intergradation and Hybridization

Some instances of intergradation noted above were interpreted as involving subspecies of a species and others as involving hybridization between species. The former interpretation seems to apply to *A. pasonis*

in the Franklin Mountains and *A. kochii* in the San Andres Mountains. Here, clinal change from northern (*A. p. pasonis* and *A. k. sanandresensis*) to southern (*A. p. polygyroidea* and *A. k. kochii*) populations fits the conventional pattern of intergrading subspecies (intergrades known only as fossils in the case of *A. kochii*). Stern (1973) found a similar pattern of clinal intergradation in *Ashmunella rhyssa* sspp. in the Sacramento and Sierra Blanca Mountains, New Mexico.

In contrast to the above, *A. p. pasonis* differs greatly in shell characters from *A. harrisi* and there is a relatively narrow zone of intergradation between the two. Shells of *A. p. pasonis* and *A. k. sanandresensis* also differ morphologically, but these seem to have a broader zone of hybridization. Possibly, as mentioned above, those characters that differentiate *A. k. sanandresensis* from the nominal subspecies reflect a genetic contribution from *A. p. pasonis*, which may be in the process of invading San Andres Peak from the north.

In contrast to the above instances, involving intergradation, *A. p. pasonis* and *A. k. kochii* coexist without intergrading at Loc. 9.

Hybridization, as discussed above, is not unexpected for gastropods. Hybrids were obtained between species of *Ashmunella* in the laboratory by Webb (1977). Van der Schalie et al. (1962) produced intergeneric hybrids between the truncatellids *Pomatiopsis* from North America and *Oncomelania* from Asia. In one instance an F_2 generation was obtained. Mayr (1963:374–375) noted: "Usually morphological differentiation seems to take place more rapidly than the acquisition of isolating mechanisms. This sequence is shown to a particularly striking degree in the snail genus *Cerion* . . . ." As in *Cerion* (a land snail), it seems likely that morphological differentiation of shells in the *A. kochii* complex has outstripped acquisition of genetic isolating mechanisms, allowing hybridization of kinds of snails with markedly different shells.

Localities of Collections

The following are localities from which specimens of *Ashmunella* were collected; listed from north to south. Collections in the San Andres Mountains were made in the years 1971–1976 and those from the Organ and Franklin Mountains in the years 1966–1976. Additional localities in the Franklin Mountains are listed in Metcalf and Johnson (1971). Last entry in each description is elevation in meters.

San Andres Mountains, Doña Ana County, New Mexico:

1. 32°52′7″N; 106°34′42″W. Slightly N of center, S boundary of SW¼, Sec. 31, T. 16 S, R. 4 E. Limestone talus on west-facing wall of short canyon, tributary, from south, to Lost Man Canyon. 1,676 m.

2. 32°50′31″N; 106°34′19″W. S½,NW¼,SE¼, Sec. 7, T. 17 S, R. 4 E.

Limestone talus on upper, north-facing walls of short canyon, tributary, from south, to Dead Man Canyon. 1,600 m.

3. 32°46′57″N; 106°34′29″W. NE¼,SE¼,SW¼, Sec. 31, T. 17 S, R. 4 E. From shallow limestone talus on west-facing wall of steep-walled canyon, entering Mayberry Cn. from south. 1,615 m.

Ashmunella p. pasonis was taken at 3 other places on the south side of Mayberry Cn. in the quarter-section noted in Loc. 3.

4. 32°43′39″N; 106°34′W. 0.15 km W of center, E section line, Sec. 19, T. 18 S, R. 4 E. Northwesternmost part of San Andres Peak, below steep cliffs on northeast-facing wall of prominent canyon, entering San Andres Cn. from S and SE (canyon deeply entrenched in limestone strata). 1,660 m.

5. 32°43′15″N; 106°32′53″W. Extreme NE corner, Sec. 29, T. 18 S, R. 4 E. Limestone talus on northwest-facing wall of prominent, recessed (towards south) "bowl" on NE flank of San Andres Peak. 2,134 m.

6. 32°40′25″N; 106°32′37″W. SE¼,NW¼,NW¼, Sec. 9, T. 19 S, R. 4 E. West-facing slope of San Andres Peak, 1.45 km ESE of Ropes Spring. Under shrubs in soil-talus mixture. 2,165 m.

7. 32°36′14″N; 106°31′37″W. Immediately S of center, N section line of NW¼, Sec. 3, T. 20 S, R. 4 E. Mixture of soil and limestone rocks on northeast-facing wall of canyon, which enters Salt Cn. from SE. 1,830 m.

8. 32°34′16″N; 106°29′21″W. NE¼,SE¼,NW¼, Sec. 13, T. 20 S, R. 4 E. Northwestern part of Goat Mt. above and below prominent "falls" (with trickle of water) in deep canyon debouching northward into Little San Nicholas Cn. 1,173–1,770 m.

9. 32°33′8–13″N; 106°30′18–31″W. SE¼,NW¼, Sec. 23, T. 20 S, R. 4 E. Along and on both sides of divide between Little San Nicholas Cn. and Bear Cn. drainages. *A. k. kochii* in area of cliffs and in rocky area with shrubs; *A. p. pasonis* under isolated, large limestone rocks on sparsely vegetated slope. Ca. 1,875 m.

10. 32°33′41″N; 106°27′24″W. SW¼,SE¼,SW¼, Sec. 17, T. 20 S, R. 5 E. In limestone talus on north-facing wall of canyon indenting E side of Goat Mt. Type-locality of *A. harrisi*. 1,684 m.

11. 32°33′9″N; 106°27′25″W. NW¼,NE¼,SW¼, Sec. 20, T. 20 S, R. 5 E. Talus on north-facing wall of a canyon indenting E side of Goat Mt. Below prominent limestone cliffs. 1,660 m.

Series of *A. harrisi* were also taken in several other accumulations of talus in the canyons noted in Locs. 10 and 11.

12. 32°31′53″N; 106°29′21″W. .16 km W of center, N section line, Sec. 36, T. 20 S, R. 4 E. At base of cliffs on S side of Bear Cn. arroyo in limestone talus. 1,539 m.

13. 32°31′43″N; 106°29′24″W. SW¼,NE¼,NW¼, Sec. 36, T. 20 S, R. 4 E. Below cliffs along steep-walled tributary canyon entering Bear Cn. from SW; .16 km SSE of domelike rock feature, 1,638 m.

14. 32°31′35″N; 106°29′34″W. SE¼,SW¼,NW¼, Sec. 36, T. 20 S, R. 4 E. Shallow accumulations of talus below limestone cliffs on north-facing wall of Bear Cn. 1,798 m.

15. 32°31′18″N; 106°28′22″W. SW¼,NE¼,SW¼, Sec. 31, T. 20 S, R. 5 E. Talus of igneous rock on north-facing wall of Bear Cn. (N side of Black Mt.). 1,707 m.

16. 32°30′N; 106°28′52″W. S½,NE¼,NE¼, Sec. 12, T. 21 S, R. 4 E. Limestone talus on walls of south-draining canyon on S flank of Black Mt. 1,828 m.

Organ Mountains, Doña Ana County, New Mexico:

17. 32°23′41″N; 106°34′50″W. .08 km W of center, E section line, Sec. 13, T. 22 S, R. 3 E. From prominent rhyolitic talus accumulation on W side of Baylor Peak. 2,134 m.

18. 32°22′14″N; 106°34′30″W. SW¼,NE¼,NW¼, Sec. 30, T. 22 S, R. 4E. Monzonitic talus on NE slope of Rabbit Ears Peaks and directly below valley between the two "Ears." 2,073 m.

19. 32°21′29″N; 106°34′14″W. Area immediately S of center, N section line, Sec. 31, T. 22 S, R. 4 E. In rock-soil mixture in grove of Gambel Oak on E side of "The Needles." 2,225 m.

20. 32°20′52″N; 106°33′27″W. SW¼,NE¼,SW¼, Sec. 32, T. 22 S, R. 4 E. Upper end of Indian Hollow Cn., below (east of) Organ Needle in talus-soil mixture in grove of Bigtooth Maple. 2,225 m.

Both north and south of Baylor Peak and along the east side of The Needles, *A. auriculata* seems generally to occur where there is talus above 2,000 m in light forest of Gambel Oak and Ponderosa Pine.

21. 32°20′58″N; 106°30′59″W. SW¼,NE¼,SE¼, Sec. 34, T. 22 S, R. 4 E. Talus accumulation near mines at upper, SW end of Texas Cn. 1,814 m.

22. 32°20′43″N; 106°30′41″W. SW¼,SW¼,SW¼, Sec. 35, T. 22 S, R. 4 E. Upper end of a S branch of Texas Cn., in "bowl" distinguished by tall Ponderosa Pines, under high cliffs, in talus. 1,860 m.

23. 32°20′39″N; 106°31′46″W. Northwesternmost corner of Sec. 3, T. 23 S, R. 4 E. Rhyolitic talus on west-facing wall of Rock Springs Cn. 1,920 m.

24. 32°20′26″N; 106°31′2″W. NW¼,SE¼,NE¼, Sec. 3, T. 23 S, R. 4 E. Talus accumulation of igneous rock on E side of E branch of Maple Cn. Type-locality of *A. todseni*. 2,042 m.

25. 32°20′11″N; 106°33′36″W. NE¼,NW¼,SW¼, Sec. 5, T. 23 S, R. 4 E. Rhyolitic talus on west-facing wall of "The Narrows" in Fillmore Cn. 2,164 m.

26. 32°20′9″N; 106°34′23″W. NE¼,NE¼,SW¼, Sec. 6, T. 23 S, R. 4 E. Rhyolitic talus on north-facing wall of Fillmore Cn., 0.4 km SW of Fillmore Spring, below small cave, higher on canyon wall. 1,996 m.

27. 32°20′4″N; 106°32′54″W. SE¼,NE¼,SE¼, Sec. 5, T. 23 S, R. 4 E.

In leaf litter and loose talus on east-facing wall of narrow canyon, .15 km SE of Rock House Spring. 2,408 m.

28. 32°19′53″N; 106°32′56″W. SW¼,SE¼,SE¼, Sec. 5, T. 23 S, R. 4 E. North slope of Organ Peak. 2,620 m.

29. 32°19′30″N; 106°34′31″W. NW¼,SE¼,NW¼, Sec. 7, T. 23 S, R. 4 E. Rhyolitic talus on south-facing wall of mouth of Ice Cn., .48 km NW of Dripping Spring. 1,920 m.

30. 32°19′29″N; 106°33′51″W. E½,SE¼,NE¼, Sec. 7, T. 23 S, R. 4 E. Upper slope of short canyon entering Ice Cn. from S. Narrow slides of rhyolitic talus in groves of Gambel Oak, interspersed with grassy areas. Probably at or near the type-locality of *A. organensis*. 2,225–2,255 m.

31. 32°17′42″N; 106°33′46″W. Along section line between Secs. 19 and 20, T. 23 S, R. 4 E and .6 km S of N section line. Rhyolitic talus below massive, rounded peak on south-facing wall of Soledad Cn. 1,920 m.

32. 32°14′52″N; 106°33′33″W. SW¼,NE¼,SW¼, Sec. 5, T. 24 S, R. 4 E. Rhyolitic talus high up on northeast-facing wall of Boulder Cn. 1,966 m.

33. 32°14′17″N; 106°33′48″W. Along section line between Secs. 7 and 8, T. 24 S, R. 4 E., .48 km S of N section line. Large accumulation of rhyolitic talus on northeast-facing wall of Finley Cn., directly opposite mouth of Long Cn. 1,623 m.

Specimens of *A. organensis* were also taken from rhyolitic talus .5 km SW, .5 km NNW (in Long Cn.) and .8 km NE (upper end of Finley Cn.) of Loc. 33.

Franklin Mountains, El Paso County, Texas (not surveyed to township and sections):

34. 31°59′51″N; 106°30′45″W. Rubble of limestone of Mississippian age, immediately W of "saddle" and 30 m above it; 1.2 km SE of Anthony Gap. 1,524 m.

35. 31°59′7″N; 106°30′34″W. Talus of limestone of Mississippian age, high up on north-facing canyon wall, 2.8 km S of Anthony Gap. Canyon debouches NE into Hueco Bolson. 1,584 m.

36. 31°58′1″N; 106°30′45″W. Mouth of Vinton Cn., immediately E of a salient outcrop of massive La Tuna Limestone (Pennsylvanian), which produces a "gateway" in mouth of canyon. From talus derived from the La Tuna Limestone, on north-facing wall of canyon and only slightly above arroyo floodplain in shadow of cliffs. 1,494 m.

Ashmunella p. pasonis has been taken at several other places in Vinton Cn., from whence Drake (1951) obtained the type.

37. 31°57′25″N; 106°30′30″W. North-facing wall of first canyon south of Vinton Cn.; .97 km WSW of Anthony's Nose; from talus of Mississippian limestone. 1,585 m.

38. 31°57′18″N; 106°29′52″W. Elongate mound of limestone talus at

head of an east-draining canyon on E side of Franklin Mts., .4 km south of Anthony's Nose. 1,920 m.

39. 31°56′33″N; 106°30′23″W. North-facing wall of SE branch (of 3 branches) of second canyon S of Vinton Cn., on steep slope immediately north of a "saddle" connecting this canyon with canyon noted in next locality. Talus of Mississippian limestone. 1,600 m.

40. 31°56′3″N; 106°30′14″W. Rubble of Silurian (Fusselman) limestone at upper, SE end of first canyon N of Tom Mays Park. 1,630 m.

41. 31°54′30–31″N; 106°30′2″W. Rhyolitic talus accumulation in canyon indenting N side of North Franklin Mt. and debouching NW into Tom Mays Park. 1,828–1,860 m.

There are numerous accumulations of rhyolitic talus and at least one of sandstone talus on the northern slopes of North Franklin Mt. All such accumulations inspected yielded *A. pasonis polygyroidea.*

42. 31°53′39″N; 106°28′54″W. Rhyolitic talus on south-facing slope of NW arm of Fusselman Cn., near a spring. A grove of trees near spring is readily identifiable from the trans-mountain highway, which crosses the canyon farther to the SE. 1,554 m.

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