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MEXICAN LAND SNAILS OF THE
GENUS HENDERSONIELLA

Fred G. Thompson and Alfonso Correa S.

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MEXICAN LAND SNAILS OF THE GENUS *HENDERSONIELLA*

Fred G. Thompson and Alfonso Correa S.*

ABSTRACT

The taxonomy of the genus is revised. Four species and subspecies are recognized: *H. palmeri* (Dall, 1905), *H. lux* new species, *H. lux lux* new subspecies, *H. l. chonomphix* new subspecies and *H. christmani* new species. *H. palmeri simplex* Pilsbry, 1953 is synonymized with *H. palmeri*. *Hendersoniella* is most closely related to *Holospira* on the basis of shell characters and soft anatomical features. The shell is discoidal in shape, not cylindrical, in contrast to other genera of the Holospirinae. This is an adaptation for living in narrow crevices under spalding surfaces of limestone boulders. The species are obligate calcicoles. The genus occurs over a large area of eastern México in the states of Nuevo Leon and San Luis Potosi.

KEY WORDS: Land snails, Gastropoda, Urocoptidae, Holospirinae, *Hendersoniella*, systematics, biogeography, México, San Luis Potosi, Nuevo Leon, obligate calcicole.

RESUMEN

La taxonomía de género esta revisada. Cuatro especies y subspecies son reconocidas: *H. palmeri* (Dall, 1905), *H. lux* nueva especie, *H. lux lux* nueva subespecie, *H. l. chonomphix* nueva subespecie y *H. christmani* nueva especie. *H. palmeri simplex* Pilsbry, 1953 se considera sinónimo de *H. palmeri*. *Hendersoniella* está más estrechamente relacionado con *Holospira*, en base a las características de su concha y la anatomía de sus partes blandas. La concha tiene forma discoidal no cilíndrica, en contraste con otros géneros de Holospirinae. Esta es una adaptación para vivir en estrechas grietas debajo de superficies desprendidas en rocas calizas. Las especies son calcífilas obligadas. El género se distribuye sobre una extensa región al Este de México, en los estados de Nuevo León y San Luis Potosí.

*Dr. Thompson is Curator in Malacology at the Florida Museum of Natural History, University of Florida, Gainesville FL 32611-2035, USA. Sr. Correa is Biologo at the Instituto Tecnológico de Ciudad Victoria, Ciudad Victoria, Tamaulipas, México.

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INTRODUCTION

Hendersoniella are medium-sized land snails with a thin discoidal shell. In this respect they contrast strongly with all other species in the Holospirinae and the Urocoptidae, which have cylindrical shells. Until recently the genus was thought to be monotypic and restricted to a very small area on the eastern slope of the Mexican Plateau east of the city of San Luis Potosí. The east slope of the plateau and the Sierra Madre Oriental cover a very large area of eastern México. The northern half of this area, in the states of Coahuila, Nuevo León, San Luis Potosí, Tamaulipas, and Querétaro, contain numerous mountain ranges of calcareous rocks, each highly suitable for diverse molluscan assemblages. The molluscan fauna of this area remains poorly known. Thus, it is not surprising that additional species of *Hendersoniella* have been discovered, and that the genus is more widely distributed than had been previously thought.

Hendersoniella occurs in northeastern México in the states of Nuevo León and San Luis Potosí. Within this area it is found on limestone mountain ranges at intermediate elevations of about 1300-2100 m in submesic oak-juniper thickets and forests. Colonies apparently are sparse, and the species seldom are collected. The snails are highly specialized to retreat under the spalding caps of huge limestone boulders and outcrops and deep within limestone crevices. Seldom are their shells found elsewhere. They have not been found associated with other Holospirinae, although *Holospira* occurs throughout its range.

Hendersoniella are obligate inhabitants of limestone substrates (obligate calcicoles). As is typical of the Holospirinae, populations are ecologically restricted to particular limestone outcrops. They do not inhabit or readily

disperse across intervening alluvial basins and clay deposits, nor are they uniformly distributed over seemingly suitable limestone substrates. Such isolation favors local speciation, and small distances between colonies can be manifested in great differences in shell morphology.

Recent field work in San Luis Potosí and in Nuevo León have brought to light two new species of *Hendersoniella*. One is represented by two subspecies. Another species also was discovered in southeastern San Luis Potosí near the Querétaro border (27°18'N, 99°05'W), but the material is unsatisfactory for taxonomic treatment.

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METHODS

Hendersoniella differ in shell shape from other Holospirinae because of their discoidal shape. With cylindrical species, such as other holospirines, the aperture may be attached to the previous whorl or it may project free on a short neck. The neck may also be deflected laterally. The degree to which the aperture may be forward projected or laterally deflected is highly variable within even small samples. Conventionally the width of such shells is taken as the width of the spire and does not include modifications of the last whorl associated with the aperture. This contrasts with the convention used for measuring most helicoid or discoid snails where the deflection of the last whorl and aperture is incorporated in the width measurement. *Hendersoniella* resembles other holospirines in the variability associated with the aperture projection. Thus, the conventional methods for measuring cylindrical shells are used in this study. Most holospirines, as well as the vast majority of other cylindrical snails, have an imperforate or narrowly perforate base. A distinct umbilicus usually is lacking, and seldom is the width of the perforation useful for comparative purposes. *Hendersoniella* differs from other holospirines in this feature, and various umbilical parameters yield useful measurements.

Measurements were made with an ocular micrometer through a WILD M50 dissecting microscope. The height of the shell (H) is from the base to the apex and does not include the aperture projection. The width of the shell (W) is the greatest diameter across the apex posterior to the deflection of the aperture. The umbilical width (Um) is along this same line from within the inside suture of the last whorl that forms the umbilicus periphery. Most population samples have a rounded base on the last whorl, and other measurements of the umbilicus become highly arbitrary. The H/Um ratio is based on the dimensions as defined here. This ratio is a function, in part, of the depth of the umbilicus, and it helps to differentiate two species. Specimens for dissection were removed from the shell by dissolving them in Bouins Solution. Dissections were made in 70% ethanol.

Hendersoniella Dall, 1905

Hendersonia Dall, 1905; Smiths. Misc. Coll., 48: 187. Type species: *Hendersonia palmeri* Dall, 1905. Non *Hendersonia* A. J. Wagner, 1905 (Gastropoda, Prosobranchia).

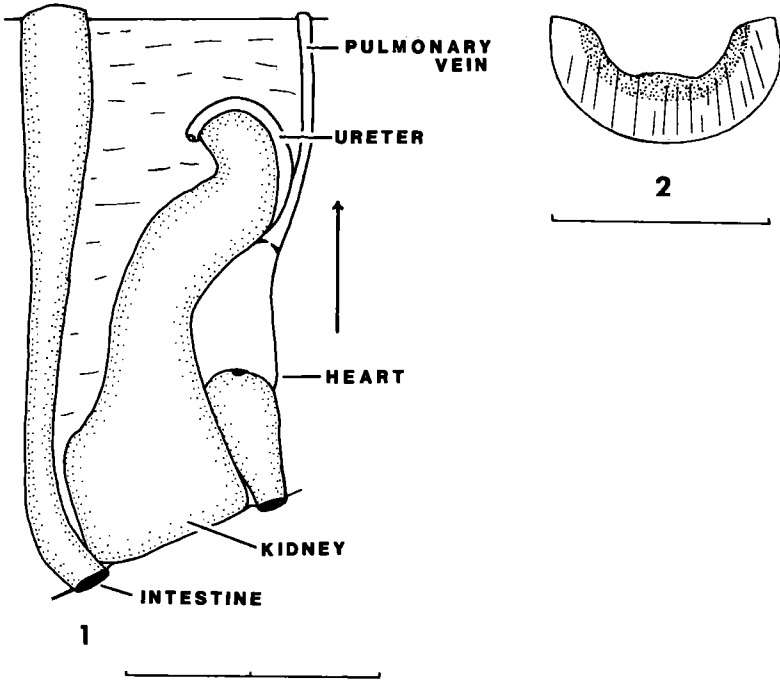
Hendersoniella Dall, 1905; Proc. Biol. Soc. Wash., 18: 189. Bartsch, 1906; Proc. U. S. Nat. Mus., 31: 153-155. Type species: *Hendersonia palmeri* Dall, 1905.

Diagnosis.-- Holospirinae with a discoidal shell, consisting of about 7-9 whorls. Apical 1.5 whorls nipple-shaped and smooth. Sculpture of following whorls consisting of growth striations. Aperture projecting free from last whorl and turned dorsally to about the level of the dorsal surface of the shell. Peristome reflected. Aperture narrowly pear-shaped with the parietal margin indented by a weak lamellar tubercle. Interior of shell with a parietal lamella. The lamella, when present, can easily be seen by immersing fresh shells in toluene or xylene, which renders the shell partially transparent.

DESCRIPTION OF THE ANATOMY

We examined anatomical material of *Hendersoniella palmeri*, *H. l. lux* n. sp. and *H. christmani* n. sp. Five specimens of each were dissected. The following descriptions are based on *H. l. lux*. Differences for the other species are noted.

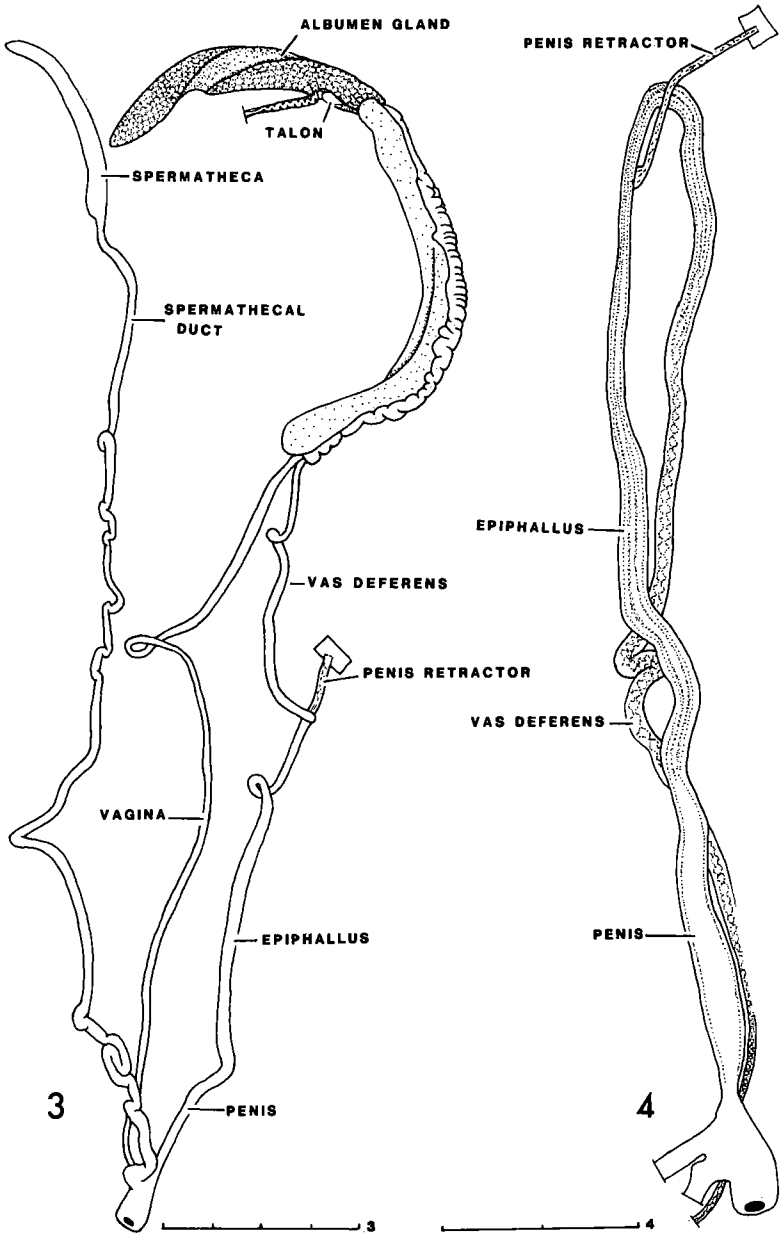
Pallial organs (Fig. 1).-- Pulmonary cavity extending about 1 1/8 whorls posterior to mantle collar. Kidney long and sigmoid, about 1/7 the length of the lung. Primary ureter short and recurved around anterior end of kidney. A



Figures 1, 2. *Hendersoniella l. lux* n. sp. Fig. 1, Pallial organs: arrow indicated longitudinal axis of lung. Scale = 2 mm. Fig. 2, jaw. Scale = 1 mm.

closed secondary (descending) ureter is absent. Heart about $3/4$ the length of the kidney. Ventricle slightly longer than the auricle. Pulmonary vein unbranched to near mantle collar, where it receives numerous fine veinules that are transverse to the surface of the lung and perpendicular to the pulmonary vein.

Digestive system.-- Jaw (Fig. 2). Solid, arcuate with a wide median projection below; hyaline, face with very fine diverging vertical striations from wear on front; lacking ribs on the outer surface. **Radula** (three specimens of each examined). Typical for Holospirinae. Transverse rows arranged in a depressed W-formation. Central tooth unicuspid with a broad lanceolate mesocone. Lateral teeth 4-6, unicuspid and about equal to the central tooth in size and shape. Marginal teeth 13-17; marginals polycuspid with both the entocones and the ectocones subdividing on the outermost teeth. Differences in the numbers of lateral teeth and marginal teeth are given in each of the



Figures 3, 4. Reproductive anatomy of *Hendersoniella lux lux* new species. Scale for 3 = 4 mm; scale for 4 = 2 mm.

species descriptions. Esophagus long and slender, without bulbous enlargement. Salivary gland on long ducts; forming a mat that covers dorsal surface of anterior esophagus. Stomach uniformly thin-walled. Intestinal loop short, reaching middle of intestinal crop. Anus opening at mantle collar.

Reproductive system (Figs. 3, 4).-- Genital atrium very short and stocky. Penis sheath absent. Spermathecal duct very long and slender; originating from genital atrium at junction with vagina; spermatheca extending beyond kidney to anterior 1/4 of albumen gland; spermatheca slightly enlarged in diameter, elongate club-shaped. *No diverticulum present.* Albumen gland 3/8 whorls in length, lying along dorsal side of coelom posterior to pulmonary cavity; posterior end terminating at about 1.5 whorls behind mantle collar. Albumen gland long, slender; posterior loop of intestine forming a sigmoid groove on dorsal surface of anterior half. Hermaphroditic duct (not illustrated) lying along baso-columellar wall of digestive gland; entering albumen gland just above uterus. Talon (FPSC complex) ovate in shape; completely exposed; covered with a thin veil of black pigmented tissue as is also the base of the hermaphroditic duct. Seminal receptacle simple, thick-walled and club-shaped. Fertilization pouch thin-walled, saccular. Vagina very long and slender; thin walled and without clear indication of internal papillae or folds. Penis (Fig. 4) long and slender; interior smooth; without conspicuous folds or papillae. Epiphallus long and slender; demarcated from penis by a slight internal constriction; interior with 4-6 longitudinal folds. Vas deferens demarcated from epiphallus internally by lining of papillae. Flagellum and caecum absent. Penis retractor muscle originating on middle of epiphallus; relatively stout and short; attaching to dorsad inner wall of lung about 1/4 of whorl behind mantle collar.

The dissected specimens of *Hendersoniella palmeri* (ANSP 164173) were collected by Pilsbry in 1934 from near the type locality. The reproductive system is similar to that of *H. l. lux* in essential characteristics.

In *Hendersoniella christmani* the reproductive anatomy is similar to that of *H. l. lux*, except as follows. The spermatheca is more ovate in shape and lies at the base of the albumen gland. The penis retractor muscle is highly variable in length and inserts on the middle of the pallial cavity wall.

Retractor muscle system.-- The retractor muscles are alike in the three species. Retractor muscles forming a sheath along ventro-columellar side of body and extending about 3.5 whorls posteriorly from mantle collar and attaching to mantle; no apparent connection to shell. Columellar retractor very long and slender, subdividing into a right and a left pedal retractor and a pharyngeal retractor. Right ocular retractor originating from right pedal retractor and passing between pharynx and genital atrium, not passing through angle between penis and vagina as in *Bostrichocentrum* (Thompson 1964). Left

ocular retractor originating from left pedal retractor. Pharyngeal retractor divided into four equal slips that attach to base of pharynx, and a slightly wider dorsal slip that attaches to posterior end of pharynx.

RELATIONSHIPS OF *HENDERSONIELLA*

The basic internal shell structure in the Holospirinae consists of four lamellae within the last whorl, the columellar, parietal, palatal, and basal lamellae. This is the typical arrangement in *Holospira*. Various of these lamellae are lost in different genera and subgenera, and similar internal shell structures appear to have evolved independently within the subfamily. The single lamella of *Hendersoniella* is homologous in position and function to the parietal lamella in *Holospira* (also referred to as the superior lamella). It impresses into the right side of the snail's body to partially separate the intestine from the rest of the pallial cavity. *Hendersoniella* is unique within the subfamily by possessing only a parietal lamella.

The anatomy of the Holospirinae is very poorly known, and most intra-generic comparisons are not possible at present. Reviews for anatomically known genera are given in Thompson (1964 1976). Among the genera for which data are available the anatomy of *Hendersoniella* differs but little from that of *Holospira* (Pilsbry 1903). The reproductive system is most similar to *Holospira sensu stricto* by lacking a diverticulum (appendix) on the spermathecal duct. It differs from *Holospira*, as well as most other Holospirinae, by having a very long slender penis, as opposed to a short, bulbous penis. *Epirobia* is similar in penis morphology, but differs by having a long flagellum at the end of the penis, and by having a diverticulum on the spermathecal duct. The location of the right ocular retractor muscle is unique within the Holospirinae, as far as is known. In *Hendersoniella* the muscle passes between the pharynx and the genital atrium. In other genera (*Coelostemma*, *Holospira*, *Bostrichocentrum*, *Epirobia*) the right ocular retractor passes through the genital atrium between the penis and the spermathecal duct. Other aspects of the soft anatomy, including the jaw and radula, are similar to *Holospira* but are non-conclusive.

Hendersoniella palmeri (Dall, 1905)

Hendersonia palmeri Dall, 1905; Smiths. Misc. Coll., (1590): 187-190; pl. 48, figs. 1-4.

Hendersoniella palmeri (Dall, 1905). Dall, 1905; Smiths. Misc. Coll., 18: 189. Bartsch, 1906; Proc. U. S. Nat. Mus., 31: 153-155; text figs. 13-16; pl. 5, figs. 1-4. Pilsbry, 1953; Proc. Acad. Nat. Sci. Phila., 105: 160.

Hendersoniella palmeri simplex Pilsbry, 1953; Proc. Acad. Nat. Sci. Phila., 105: 160.

Diagnosis.-- The shell is discoidal with a flat dorsal surface and an H/W ratio of 0.23-0.27. The periphery is acutely carinate with the carina lying above the middle of the whorl. The parietal lamella, when present, is about 1/8 whorl long and extends only about halfway across the lumen of the whorl. The umbilicus is shallow and concave with an H/Um ratio of 0.32-0.45; it is dish-shaped, not funnel-shaped as in other species. The aperture projects dorsolaterally on a short neck and is narrowly pear-shaped. The radula has 6 lateral teeth and 16 marginal teeth on each side.

Shell (Figs. 5-11).-- Discoidal, about 9-10 mm wide, about 0.21-0.26 times as high as wide. Shell consisting of about 8.1-8.8 whorls. Sculpture consisting of irregular incremental striations that become more strongly developed as coarse riblets on the neck of the aperture.

Apical whorl raised. Body whorl with a sharp peripheral keel that lies above the middle of the whorl. Body whorl strongly convex above the keel, concave and then flattened below the keel and obtusely rounded on the base. Aperture projecting upward between level of periphery and apex; neck directed dorsolaterally, relatively short, with a strongly impressed longitudinal furrow on dorsal side posterior to parietal tubercle of peristome. Neck semi-lunar in cross-section. Plane of aperture slightly oblique to dorsal surface of shell. Longitudinal axis of aperture tangential to periphery of shell disc (Fig. 9, 14). Umbilicus broad and dish-shaped; 0.59-0.63 times the width of the shell (Fig. 6, 10, 16). Height of the shell usually 0.32-0.42 times the width of the umbilicus. Interior of body whorl with a parietal lamella that lies about 1/8 of a whorl behind the aperture (Fig. 8). The lamella is about 1/8 of a whorl in length, and projects outward nearly perpendicular to the inner wall and about halfway across the lumen of the whorl toward the peripheral keel (Fig. 21). The lamella is highest in its mid-section and is slightly oblique so that its anterior end converges toward the umbilicus. Its outer edge is thickened and cord-like.

Three samples of *Hendersoniella palmeri* are available. The type series (USNM 110385) consists of six specimens, two of which are immature. A second series, collected by H. A. Pilsbry in the immediate vicinity of the type locality (ANSP 164173), consists of 47 adults and many juveniles. In addition we examined 20 adult shells of the type series of the form described as *H. palmeri simplex*. Measurements for these three lots are summarized in Table 1.

Type localities.-- *H. palmeri*: SAN LUIS POTOSÍ, Alvarez Mountains. HOLOTYPE: USNM 110385 + 5 paratypes. *H. p. simplex*: SAN LUIS POTOSÍ, Alvarez, in crevices and under stones in a very rocky pasture north of the railroad, 7400 ft alt. Alvarez (22°01'53"N, 100°36'41"W) is located in a valley east of the Sierra de Alvarez, and is about 4 km by road south of San

Table 1. Shell measurements in mm of three population samples of *Hendersoniella palmeri* (Dall, 1905). H = height, W = width, Um = umbilicus, Wh = whorls.

	H	W	Um	Wh	H/W	Um/W	H/Um
USNM 110385, type series of <i>palmeri</i>							
holotype	2.3	8.9	5.6	8.7	0.26	0.61	0.41
paratype	2.3	9.1	5.6	8.5	0.25	0.62	0.41
paratype	2.4	9.6	6.0	8.7	0.25	0.62	0.40
paratype	2.6	9.5	5.8	8.8	0.27	0.61	0.45
ANSP 164173 (n=43)							
Mean	2.2	9.9	6.0	8.4	0.23	0.61	0.37
S	0.10	0.36	0.29	0.26	0.02	0.02	0.02
min.	2.1	9.4	5.5	8.1	0.20	0.59	0.32
max.	2.3	10.3	6.5	8.7	0.25	0.64	0.42
ANSP 164313, type series of <i>simplex</i> (N=20)							
Mean	2.2	9.4	5.6	8.1	0.23	0.59	0.39
S	0.11	0.32	0.30	0.21	0.02	0.01	0.03
min.	2.0	8.9	5.1	7.9	0.21	0.57	0.34
max.	2.3	10.1	6.1	8.3	0.26	0.62	0.44

Francisco. HOLOTYPE: ANSP 164312. PARATYPES: ANSP 164313 (20 adult and 13 juvenile shells).

Other specimens examined.-- SAN LUIS POTOSÍ: Alvarez, hill north of the railroad at a large quarry; 8000 ft alt. (ANSP 164173, 47 shells, 10 preserved specimens).

Distribution.-- Known only from the immediate vicinity of Alvarez, San Luis Potosí.

Remarks.-- The specimens comprising the type series (USNM 110385) and the series from near Alvarez collected by H. A. Pilsbry (ANSP 164173) differ in their measurements and in the projection of the aperture (Figs. 5-7, 8-11). Almost certainly they came from different populations. Among the populations from near Alvarez, Pilsbry (1953) recognized two subspecies based on the presence or absence of the parietal lamella. The two forms do not differ in other features. The form described as *simplex* was differentiated by the absence of the lamella, although Pilsbry noted that in two specimens of ten that were opened the lamella was weakly developed. Of twenty adult shells in the paratype series (ANSP 164313), three have a weakly developed lamella.

The lamella occupies the same position as occurs in the typical form. Of 47 adult specimens of another sample (ANSP 164173), seven lack a lamella. In light of the variation of this structure in populations from near Alvarez we feel that taxonomic recognition of *H. palmeri simplex* is not warranted.

Hendersoniella lux new species

Diagnosis.-- A species of *Hendersoniella* characterized by having a broad funnel-shaped umbilicus that has an H/Um ratio of 0.40-0.63. The shell has a low dome-shaped spire with an H/W ratio of 0.23-0.34, and an acutely carinate periphery with the carina lying above the middle of the whorl. The aperture is directed upward on a relatively long neck and is broadly pear-shaped. The radula has 4 lateral teeth and 17 marginal teeth on each side.

This species is closely related to *Hendersoniella palmeri*. It differs from the latter by its more funnel-shaped umbilicus, by its dome-shaped spire, by its more dorsally extended and broader aperture, by its much longer and higher parietal lamella, and by having 4 as opposed to 6 lateral teeth in the radula.

Two subspecies are recognized. The nominate subspecies has a long parietal lamella situated within the last half whorl. The second subspecies lacks a lamella and also differs by other features of the shell.

Hendersoniella lux lux new subspecies

Diagnosis.-- The shell has a long parietal lamella that is about a half whorl in length and extends across the lumen of the whorl almost to the opposite side. The base of the last whorl is narrow but rounded. The periphery is strongly keeled with a concave furrow beneath it. The umbilical wall of the whorls tend to be rounded so that the umbilicus is not flat-sided as in the following subspecies. The neck of the aperture is long and is directed upward.

Description.-- Shell (Figs. 23-26) containing 8.3-9.3 whorls; 0.23-0.33 times as high as wide. Sculpture consisting of fine incremental striations that are equally developed on the base and spire, but become irregularly spaced coarse riblets on the neck of the last whorl. Spire low dome-shaped with apical 1.5 whorls forming a low nipple. Periphery of last whorl strongly carinate above middle of whorl; last whorl with dorsal surface strongly convex above carina; side obliquely flattened and weakly concave below carina, and base subcarinate or rounded. Aperture extended above the apex on a relatively long

neck. Neck hemispherical in cross-section; flattened dorsally with a conspicuous dorsal longitudinal furrow that continues to parietal tubercle. Aperture more broadly pear-shaped than in *H. palmeri*; longitudinal axis of aperture tangential to periphery of disc (Figs. 12, 23). Umbilicus broadly funnel-shaped (Fig. 7); outer perimeter formed by last whorl; umbilicus 0.53-0.60 times width of shell; height of shell 0.41-0.60 times width of umbilicus. Interior of last whorl with a high parietal lamella that projects nearly to the opposite wall below the peripheral angle (Figs. 22, 26); middle of the lamella separated from opposite wall by a gap of about 0.1 mm; lamella originating about 1/8 whorl behind neck of aperture and is about 1/4-1/2 whorl in length; sloping downward at its anterior end; arched downward in the middle and conspicuously thickened along its edge. Lamella present in all adult specimens examined.

Measurements based on 49 adult specimens are summarized in Table 2.

Radula (3 specimens) with 4 laterals and 17 marginals on each side.

Type locality.-- SAN LUIS POTOSÍ, Valle de Las Fantasmas, 22 km west of Santa Catarina (22°03'34"N, 100°33'16"W); 2150 m alt. Santa Catarina is a village on the road from Rio Verde to the city of San Luis Potosí, and is 29 km east of San Francisco. The Valle de Las Fantasmas is on the east slope of the plateau between San Luis Potosí and Rio Verde. The valley received its name from numerous grotesque rock formations that were sculpted by the weather over eons. Most of these formations have been destroyed by small-scale

Table 2.- Measurements in mm of *Hendersoniella lux lux* new subspecies (UF 145385) and *Hendersoniella lux chonomphix* new subspecies (UF 143586). H = height, W = width, Um = umbilicus, Wh = Whorls.

	H	W	Um	Wh	H/W	Um/W	H/Um
<i>lux</i> (n = 47)							
holotype	2.6	9.3	5.3	8.6	0.28	0.60	0.49
Mean	2.6	9.6	5.4	8.8	0.27	0.57	0.48
S	0.26	0.39	0.26	0.29	0.03	0.03	0.05
min.	2.3	9.3	5.0	8.3	0.23	0.53	0.41
max.	3.1	10.3	6.0	9.3	0.33	0.60	0.60
<i>chonomphix</i> (n = 31)							
holotype	3.1	9.0	4.8	8.3	0.34	0.53	0.65
Mean	2.7	9.4	5.2	8.1	0.29	0.55	0.52
S	0.28	0.40	0.39	0.24	0.03	0.03	0.07
min.	2.4	8.8	4.8	7.6	0.23	0.52	0.40
max.	3.1	10.3	6.0	8.3	0.34	0.62	0.63

quarry operations during the last twenty years so that little remains to indicate the origin of the name. The area of the type locality is in a mesic oak forest with occasional junipers. Live snails were found aestivating in narrow crevices in limestone boulders. HOLOTYPE: UF 165719; collected 2 April 1965 by Fred G. Thompson. PARATYPES: UF 143585 (31), Museo Nacional de México (5), Instituto Tecnológico Cd. Victoria, ITCVZ 105 (5), Walter B. Miller Collection (5); same data as the holotype. In addition we dissected five specimens from the type series preserved in alcohol.

Distribution.-- This subspecies is known only from the immediate vicinity of the type locality. It was also collected at a station 23 km W of Santa Catarina (22°03'23"N, 100°33'28"W); 2300 m alt (UF 143583).

Remarks.-- The relationship of this subspecies within the genus is discussed below.

Etymology.-- The name *lux* is from the Latin, *lux* (f.), a light, referring to the lamp-shape of the shell.

Hendersoniella lux chonomphix new subspecies

Diagnosis.-- The shell is similar to *H. l. lux* except that it has an average of fewer whorls, it lacks an internal lamella, the periphery of the last whorl is sharply keeled and overhangs a shallow furrow, and the base is sharply keeled. The umbilicus is flat-sided, whereas in *lux* the whorls tend to be rounded along the umbilical wall. The neck of *chonomphix* is shorter and is more laterally directed.

Description.-- Shell (Figs. 27-29) with 7.6-8.8 whorls. Low dome-shaped with the apical 1.5 whorls forming a nipple. Shell 0.23-0.34 times as high as wide. Sculpture similar to that of *H. l. lux*. Last whorl with a strong peripheral keel; weakly arched above keel; distinctly furrowed below keel; side of whorl flat below furrow. Umbilicus deep and sharply defined by a basal keel (Figs. 18, 29). Umbilical wall nearly flat-sided; umbilicus 0.53-0.62 times as wide as shell; height of shell 0.40-0.63 times width of umbilicus. Aperture with a moderately long neck that extends dorsolaterally to about halfway between the periphery and the apex; neck hemispherical in cross-section; dorsal surface of neck flattened with a strongly impressed longitudinal furrow extending to peristome tubercle. Plane of aperture lying at about 30° to plane of shell. Aperture broadly pear-shaped with its longitudinal axis tangential to periphery of shell (Fig. 13). Interior of shell lacking lamella.

Thirty-one adults from the type series were examined. Eight were opened or had perforations that permitted the interior to be viewed for the presence of a parietal lamella. The others were immersed in toluene to render the shell transparent. None showed a trace of a lamella.

Measurements for the type series are given in Table 2.

Radula not examined.

Type locality.-- SAN LUIS POTOSÍ, Valle de Las Fantasma, hillside 15.5 km west of Santa Catarina, (22°04'01"N, 100°31'44"W); 1770 m alt. The area of the type locality is in a dry oak-juniper forest. Snails were crawling on limestone outcrops during a late afternoon misty rain. HOLOTYPE: UF 166310; collected 19 September 1967 by Fred G. Thompson. PARATYPES: UF 143586 (22), Museo Nacional de México (5), Instituto Tecnológico Cd. Victoria, ITCVZ 106 (5); same data as the holotype.

Distribution.-- Known for certain only from the type locality. A series of 7 specimens from the "Valle de Fantasma" (UF 92981), collected by a speleological expedition in 1983, is not accompanied by more precise information.

Remarks.-- The relationship of this subspecies to *Hendersoniella lux lux* suggests a similarity to that between *simplex* and *H. palmeri*. However, this is not the case. We regard *chonomphix* as a taxon distinct from *lux*; *chonomphix* consistently lacks a parietal lamella whereas *lux* consistently possesses the lamella. Other characteristics of the shell, such as the projection of the aperture, the structure of the umbilicus and the presence or absence of a basal keel on the last whorl also warrant taxonomic separation. This degree of differentiation does not occur between *simplex* and *palmeri*. A strong argument could be made for recognizing *lux* and *chonomphix* as distinct species on the basis of these differences. Additional samples from this area of San Luis Potosí are needed to clarify the relationship between the two.

Etymology.-- The name *chonomphix* is from the Classical Greek *choane*, a funnel, and *omphalos*, an umbilicus, in allusion to the funnel-shaped umbilicus characteristic of this subspecies.

Hendersoniella christmani new species

Diagnosis.-- The shell is low dome-shaped with a raised apical whorl. The periphery is obtusely angulate at the base. The aperture is deflected dorsally on a long neck. The greatest length of the aperture is on an axis that

passes across the top of the shell, not tangential to the disc as in other species. The umbilicus is confined within the antipenultimate whorl and is about $1/3$ the width of the shell. The parietal lamella is $1/2-5/8$ whorls in length and is deeply immersed within the last whorl. Radula with four lateral teeth.

Description.-- Shell (Figs. 30-34) discoidal with a low dome-shaped spire; shell about 0.23-0.30 times as high as wide; consisting of about 8.6-9.6 whorls. Sculpture consisting of coarse and numerous incremental striations that are stronger on the base than on the spire and increase as thread-riblets on the ventral side of the neck. Periphery obtusely angulate, lying nearly at the base of the last whorl; outer side of whorls nearly flattened; rounded dorsally with a moderately impressed suture. Base flat; outermost 3 whorls of base planular with umbilicus circumscribed by antipenultimate whorl. Umbilicus deep and thimble-shaped; 0.33-0.39 times the width of the shell (Figs. 19, 31). Neck of last whorl deflected upward so that the aperture is raised to or above apex; neck triangular in cross section; without a longitudinal impressed dorsal furrow. Aperture auriculate in shape with its greatest length nearly aligned across the center of the shell (Figs. 15, 30). Parietal lamella (Figs. 33, 34) $1/2-5/8$ whorls long; deeply immersed, anterior end terminating $3/4$ whorls behind aperture; anterior end lowest, lying below middle of parietal wall, directed outward toward opposite wall; lamella ascending inward along parietal wall with its edge arched upward along the posterior half so that it almost touches the dorsal wall of the whorl (Fig. 20).

Seven adult shells comprise the type series. One was opened to determine the size and course of the parietal lamella (Fig. 33); six others were cleared in toluene, and they conform very closely with the opened specimen.

Measurements are given in Table 3.

Radula with 4 lateral teeth and 13 marginal teeth on each side.

Type locality.-- NUEVO LEON, Municipio Santiago, limestone hillside on south side of Arroyo San Juan, 2.5 km west-northwest of La Ciénega, $25^{\circ}22'34''N$, $100^{\circ}14'55''W$; 1350 m alt. La Ciénega lies in a deep canyon at the fork of the Arroyo San Juan and a smaller arroyo from the east just before they enter the Cañon San Cristóbal. For most of the year the river is dry or has intermittent seeps. The valley is bordered on the north side by the high limestone cliffs of the Sierra de San Cristóbal and to the south by steep limestone hills and bluffs. The type locality is to the west of La Ciénega where the road passes between a low limestone hill and the south bank of the river. The hillside was covered by the thicket of small oaks and shrubs. Live snails were found under limestone slabs that were spalding from the underlying rock. HOLOTYPE: UF 166309; collected 26 December 1989 by Steven P. Christman. PARATYPES: UF 159249 (6); same data as the holotype. Five additional specimens from the type locality were preserved for dissection.

Table 3. Measurements in mm of three population samples of *Hendersoniella christmani* new species. H = height, W = width, Um = umbilicus, Wh = whorls.

	H	W	Um	Wh	H/W	Um/W	H/Um
Type Series							
holotype	2.3	8.9	3.1	9.2	0.26	0.35	0.47
paratype	2.3	9.6	3.8	9.6	0.24	0.39	0.68
paratype	2.3	8.9	3.3	9.3	0.26	0.37	0.78
paratype	2.3	8.4	3.8	9.1	0.27	0.36	0.74
paratype	2.3	8.8	3.1	9.5	0.26	0.36	0.74
paratype	2.2	8.6	3.1	9.3	0.26	0.36	0.71
paratype	2.1	8.9	3.3	9.4	0.24	0.37	0.64
UF 159189 (n = 13)							
Mean	2.2	8.2	2.9	9.1	0.27	0.35	0.77
S	0.14	0.52	0.16	0.19	0.02	0.01	0.07
min.	2.8	6.9	2.6	8.7	0.23	0.33	0.68
max.	2.4	8.6	3.1	9.4	0.30	0.38	0.88
UF 126730 (n = 18)							
Mean	2.1	7.6	2.6	8.9	0.28	0.34	0.89
S	0.14	0.34	0.19	0.15	0.02	0.02	0.11
min.	2.8	7.0	2.3	8.6	0.25	0.31	0.72
max.	2.4	8.5	2.9	9.1	0.32	0.35	1.16

Distribution.-- This species is known from dry valleys east-northeast of Santiago. It was collected at two other stations in addition to the type locality. NUEVO LEON: 2 km north of La Ciénega (25°22'09"N, 100°14'15"W), 1350 m alt. (UF 159189); El Tejocote, 3.4 km ESE of Laguna de Sánchez, (25°19'54"N, 100°14'56"W), 1920 m alt (UF 126730).

Remarks.-- This species is strikingly distinct from other *Hendersoniella* because of the numerous differences in the shell as noted above in the diagnosis. It is geographically separated from other known *Hendersoniella* by a distance of about 400 km.

The two population samples from near La Ciénega are alike in all essential features. The two localities are on opposite sides of the Arroyo San Juan, but regardless of this physical isolation, no significant differences are apparent. The population from El Tejocote (UF 126730) is referred to *H. christmani* with less certainty because of the less receded parietal lamella. In the typical form from near La Ciénega the anterior end of the parietal lamella originates about 3/4 of a whorl posterior to the aperture (Fig. 33). The

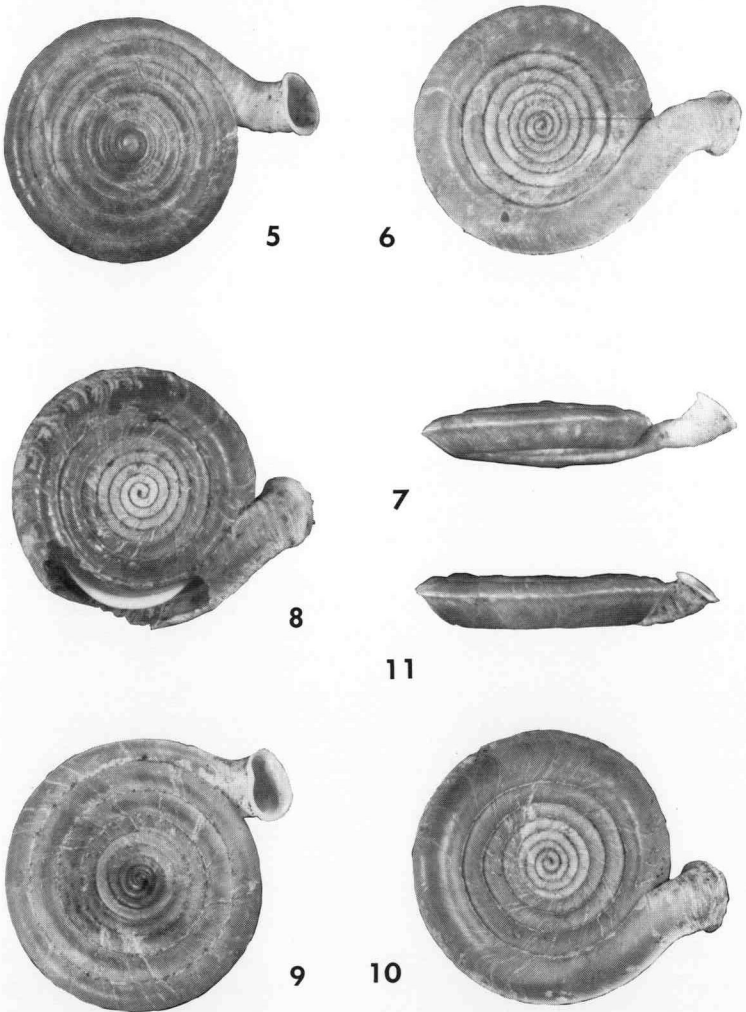
Tejocote have the anterior end of the lamella originating about 1/2 of a whorl posterior to the aperture (Fig. 34). The two forms do not differ in other salient features.

We hesitate to recognize the population from El Tejocote as taxonomically distinct. No doubt many populations of *Hendersoniella* occur in this region of southern Nuevo León. Until geographic variation of this genus in southern Nuevo León is further investigated we favor recognizing only one taxon in the region.

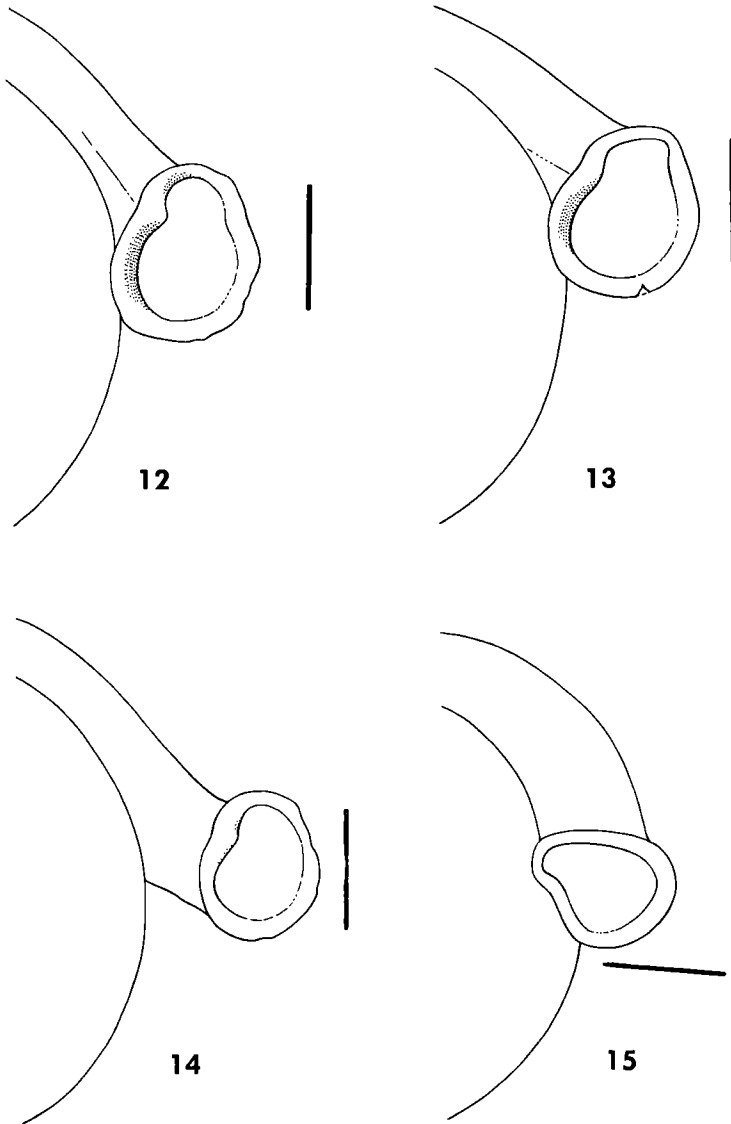
Etymology.-- This snail is named in honor of Steven P. Christman who discovered, after much difficulty, the live specimens that comprise the type series.

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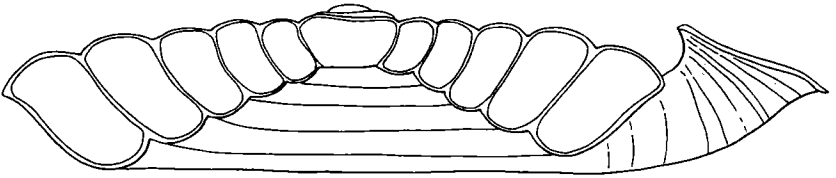
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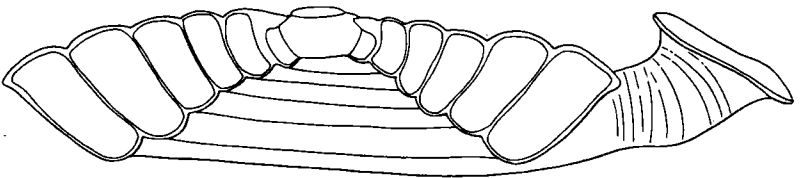
Figures 5-11. *Hendersoniella palmeri* (Dall). Figs. 5-7, Holotype (USNM 110385); Figs. 8-11, ANSP 164173.



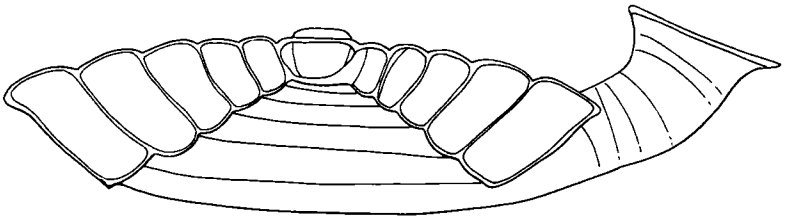
Figures 12-15. *Hendersoniella*. Drawings of the aperture. Bars indicate direction of major axis of the aperture. Fig. 12, *H. lux lux* n. sp. HOLOTYPE (UF 165719). Fig. 13, *H. lux chonomphix* n. ssp. HOLOTYPE (UF 166310). Fig. 14, *H. palmeri* (Dall) HOLOTYPE (USNM 110385). Fig. 15, *H. christmani* n. sp. HOLOTYPE (UF 166309).



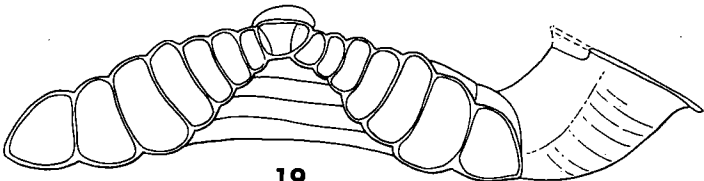
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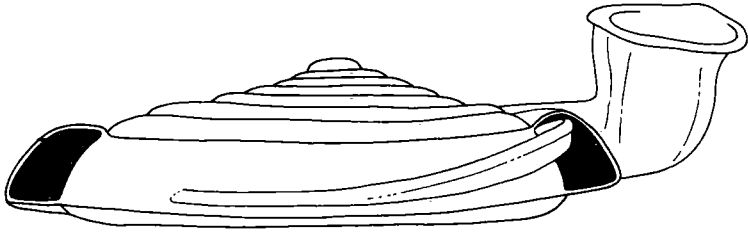


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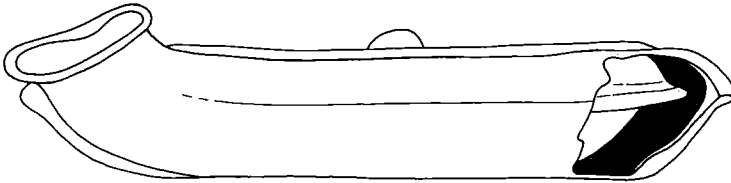


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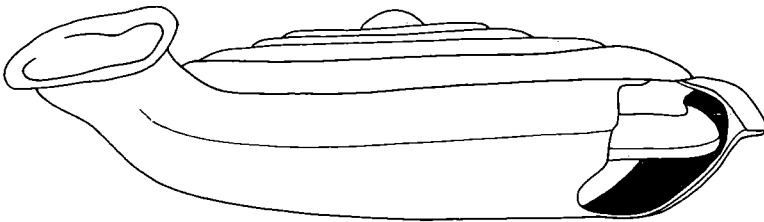
Figures 16-19. *Hendersoniella*. Cross-sections of shells showing configuration of umbilicus and whorls. Fig. 16, *H. palmeri* (Dall) (ANSP 164173). Fig. 17, *H. l. lux* n. sp., PARATYPE (UF 143585). Fig. 18, *H. l. chonomphix* n. sp., PARATYPE (UF 143586). Fig. 19, *H. christmani* n. sp. (UF 159189).



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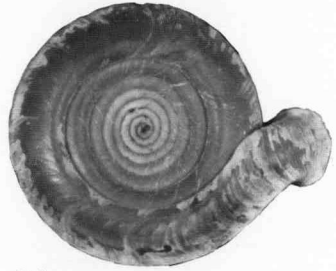


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Figures 20-22. *Hendersoniella*. Shells partially opened to show curvature and projection of parietal lamella. Fig. 20, *H. christmani* n. sp. (UF 159189). Fig. 21, *H. palmeri* (Dall) (ANSP 164173). Fig. 22, *H. l. lux* n. sp. PARATYPE (UF 143585).



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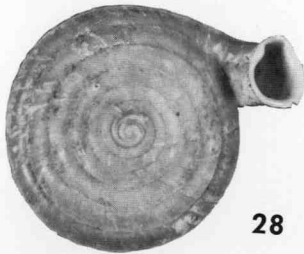
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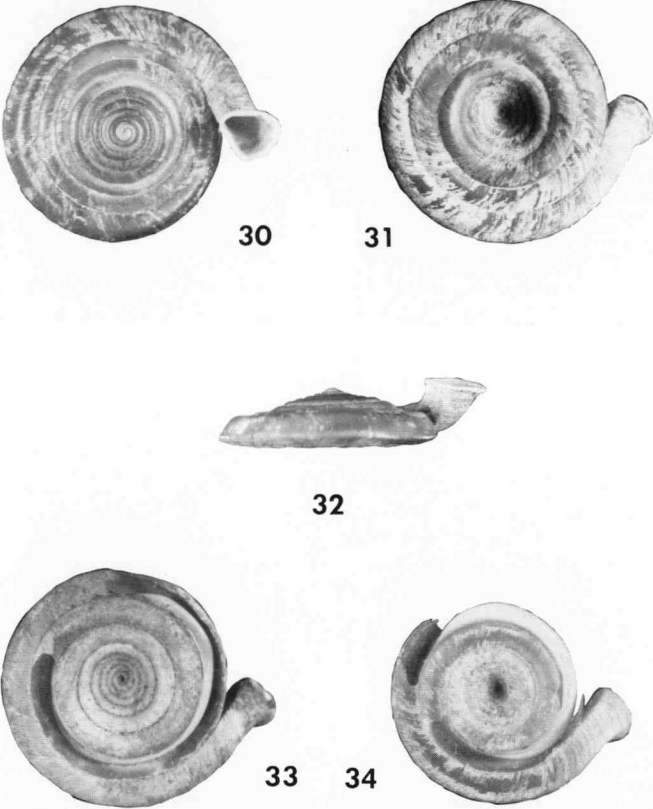


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Figures 23-29. *Hendersoniella lux* n. sp. Figs. 23-25, *H. l. lux* n. ssp. HOLOTYPE (UF 165719). Fig. 26, PARATYPE (UF 143585). Figs. 27-29, *H. l. chonomphix* n. ssp. HOLOTYPE (UF 166310).



Figures 30-34. *Hendersoniella christmani* n. sp. Figs. 30-32, HOLOTYPE (UF 166309). Fig. 33, PARATYPE (UF 159249). Fig. 34, El Tejocote (UF 126730).

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