NUMBER 167 FEBRUARY 15, 1926

OCCASIONAL PAPERS OF THE MUSEUM OF ZOOLOGY

UNIVERSITY OF MICHIGAN

ANN ARBOR, MICHIGAN PUBLISHED BY THE UNIVERSITY

THE MOLLUSCA COLLECTED BY THE UNIVERSITY OF MICHIGAN-WILLIAMSON EXPEDITION IN VENEZUELA

BY H. BURRINGTON BAKER

PART IV

This is the third of a sequence of studies on the mollusks collected from the mainland by the University of Michigan-Williamson Expedition to Venezuela (1920). Part II (1923, this series, No. 137, pp. 8–59) deals with the terrestrial operculates while Part III (1924, this series, No. 156) discusses the families Pupillidae to Oleacinidae.

Since the publication of Part III, dissections have been made of certain species in three of these families, while a new species has turned up in a fourth. In order to include these new data, the discussions of the Succineidae, Scolodontidae, Streptaxidae and Oleacinidae are continued in the present part.

The additional families (Helicidae, Acavidae and Bulimulidae) are here treated like those in Part III (see page 1); all of the species that are known to occur in Venezuela are listed and, with von Martens' "Die Binnenmollusken Vene-

zuela's'' (1873, Festschr. Ges. Nat. Fr. Berlin, pp. 157–225) as a starting point, an attempt is made to quote the citations of localities down to date. The habitat and locality symbols (preceded by the letter H) are the same as those used in the preceding parts (Part II, pp. 8–12, note 1).

SUCCINEIDAE

Omalonyx felina Guppy

Part III, p. 4, fig. vi–22

The animal of some of the specimens from near Bejuma (H, XII, 9) is almost colorless (in alcohol) while that of others has a dark streak along the sides of the foot and slight pigmentation around the mantle edge. Foot: large, bluntly terminated posteriad; sole very thin, so that liver can be seen through it, margins sharp but without grooves; sides almost smooth anteriad but with fine granulation posteriad and above tail. Visceral mass: oval, convex, with liver posterior and to left, completely surrounded by mantle edge. Mantle: projects slightly around visceral dome, with a shell fold (much retracted in preserved specimens) which is continuous anteriad but incomplete posteriad a little to right of center line, at place where left flap slightly overlaps right one; also with two small lappets which partially surround pneumostome (fig. xvi–80).

Lung (fig. xvi–79): roughly crescentic, with left limb about half as long as right one, which slightly overlaps hind-gut; wall very thin near visceral mass but abruptly thickened so as to form a zone around mantle edge; principal vein very large, transverse, bent around into right limb. From the large size of the tributaries to this pulmonary vein and their continuation into the mantle, it seems probable that the latter and its shell fold play important rôles in respiration. Atrium and ventricle: elongate, much narrower than very large pericardium. Kidney: roughly lanceolate but curved around visceral mass, with its broader end against pericardium, its narrower one against hind-gut and its long axis almost par-

allel to that of body (but transverse with respect to pneumostome); richly vascular, especially on its dorsal surface; internal ureteric opening near pericardium. Primary ureter: thin-walled and so large that it covers half of ventral surface of kidney and overlaps its outer edge; continued by narrower, secondary ureter which follows posterior margin of lung (loops slightly over hind-gut); external ureteric opening outside of lung. Pneumostome: on right side, considerably behind middle of visceral dome; internally appears as a circular hole surrounded by a band of muscle; externally (fig. xvi–80), it lies between two small mantle flaps; opening of secondary ureter (U) under front edge of posterior lappet and connected with breathing pore by an open groove; opening of hind-gut (H) under edge of mantle (E) just behind this posterior flap.

Genitalia (fig. xvi–81) exceptionally bulky. Ovotestis: roughly circular, almost flat on one side and convex on other; with two subequal lobes, each of which is composed of radiating, club-shaped lobules; imbedded in posterior end of liver. Ovisperm duct: arises from center of ovotestis; short, widely looped; talon with club-shaped diverticulum imbedded in shorter, elliptical mass; below talon, duct runs along albumen gland for short distance before enlarged into spermoviduct. Albumen gland: tongue-shaped, weakly-lobed, acinous; on right of liver, scarcely imbedded in it. Spermoviduct: thin-walled, transversely folded and sacculate, almost immediately divided into uterus and vas deferens. Uterus: very long but closely coiled into a rounded mass not much longer than prostate; upper portion similar in structure to spermoviduct but narrower; cavity of lower portion with a few (5 to 7 counted), deep, longitudinal folds which are broken by transverse grooves into minute, papilliform projections; passes gradually into oviduct. Vagina: rather short and stout, with thick muscular walls which are internally thrown up into coarse, longitudinal plicae. Bursa: stalk slender; elliptical, flattened enlargement imbedded between lobes of liver. Spermoviducal gland: mainly free from uterus although enclosed in same

sheath; attached along vas deferens and so probably represents prostate. Vas deferens: branches off near anterior end of spermoviduct, lies between latter and prostate, is slightly convoluted along vagina, passes under right ocular retractor and then up along penis, and finally enters penial apex; portion along penis slightly enlarged with thick, muscular walls (A). This thick-walled portion is very elastic and can be stretched out almost as long as penis; while scarcely an epiphallus, it is the only part of the system that remotely resembles one. Penis: extremely long and slender, enclosed in a sheath which is thick and muscular near the base but thin and elastic near the apex; apical 5/6 (in specimen figured) coiled in terminal portion of sheath; apex (A) slightly enlarged, almost solid but pierced by a slender, convoluted duct; about 3 mm. below apex, lumen greatly enlarged so that major portion has rather thin walls which are thrown up internally into irregular, anastamosing, transverse folds (B); towards the base (C), these folds are farther apart so as to mark off areas which are roughly diamond-shaped; near cloaca (D), lumen is small with longitudinal plicae. In another specimen, the sheath is much more elongated and the penis much less complexly coiled than in the animal figured. Penial retractor: inserted at apex of penial sheath, attached to diaphragm between liver and kidney near apex of visceral mass. Cloaca very short.

Free retractor system: without distinct tail retractors; columellar muscle attached to shell at right of spire near apex of albumen gland; consists of two bands which are connected under ovisperm duct but almost immediately separate again; one of these, the right ocular retractor, passes under albumen gland while the other is imbedded along left side of same; left and larger band soon divides into left ocular retractor and two (left and right) pharyngeal muscles; each of these four, long, slender bands divides into a large ventral and a small dorsal strip; the small branch of each ocular attaches at tip of tentacle while the large branch inserts just below its base.

Buccal mass: almost spherical, with short, radular pouch posteriad. Salivary glands: thin and fimbriate. Liver: with

two lobes, one in visceral mass, other extended into cavity of foot. Jaw (fig. xvi–83): large but thin, with only the basal plate shallowly imbedded in dorsal side of buccal mass, from which it can be easily dissected away; similar to that of Succinea but with broader basal plate and longer, narrower true jaw; lateral portions of both the basal plate and the jaw proper very thin and transparent. Radular formula (fig. xvi–82): (20–21)–(10–11)–1–(10–11)–(20–21); transverse rows (113 counted) almost straight in lateral fields, curved obliquely anteriad in marginal. Central and ten to eleven inner laterals tricuspid, very similar to those of Succinea, but apparently with shorter cusps and heavier backs than is usual in that genus. Marginals: rather sharply differentiated, small, with almost square bases and with major cusps much divided.

SCOLODONTIDAE

As discussed in another paper (1925, Naut. XXXVIII, pp. 86–9), the "Streptaxidae" of Part III must be divided into two families: (1) the Scolodontidae (Aulacopoda), which probably include Austroselenites, Happia, Drepanostomella, Scolodonta, Miradiscops and Tamayoa, and (2) the Streptaxidae (Agnathomorpha), with Rectartemon and Streptaxis as two of the genera.

Scolodonta (*Systrophiella*) *eudiscus* H. Burrington Baker

Part III, p. 31, figs. viii–43, ix–50, x–53, 54

Re-examination of the animals shows the following additional points. Mantle: with two quite broad, overlapping, frontal lappets. Foot: aulacopod, margined on either side by a distinct pedal groove, both of which terminate at a caudal mucous pore under a small, dorsal projection; above each pedal groove, a rounded ridge is marked off, except near caudal end (fig. xvii–87), by another, less regular furrow; each longitudinal ridge terminates anteriad as a small suprapedal lobe under snout. Seminal duct: fused with walls of uterus from bladder-like talon to just above entrance of bursa (spermatheca); lumina appear to be separate for entire dis-

tance. Spermoviducal gland: apparently restricted to tongue-shaped prostate beside base of albumen gland. Penis: apical half with walls developed into somewhat coarser internal columns than lower region, where these plicae are crenulate, but an epiphallus is not separable. Columellar muscle; joined by long penial retractor near upper border of haemocoele, by pharyngeal muscle at about middle of cavity, then by two right oculars and finally by the left two, which unite with tail retractors near foot.

Happia (*Happiella*) *guildingi* (Bland)

Part III, p. 20, figs. vi–28, vii–33

Foot: aulacopod, very similar to that of *Scolodonta eudiscus,* but with caudal projection prolonged into noticeable spike.

STREPTAXIDAE

Streptaxis (*Odontartemon*) *glaber normalis* (Jousseaume)

Part III, p. 39, figs. 59, x–57

Animal (one specimen in alcohol, from near Palma Sola, H. II, b, 22): very similar to that of *Rectartemon jessei*; foot holopod, with coarse granulations on sides, tip bluntly pointed. Mantle: with two, overlapping, frontal lappets.

Ovotestis (fig. xvii–84): small, with a few, tubulo-alveolar lobes; duct weakly convoluted, with bladder-like enlargement just before entrance into apex of spermoviduct. Albumen gland long-ovoid. Spermoviduct: entirely in haemocoele, large, with thin, sacculate walls. Prostate: acinous, rather slender, attached along side of spermoviduct and between it and diaphragm. Free oviduct: short and stout, with narrowed, longitudinally plicate cavity. Vagina: with ovoid enlargement, at base of oviduct almost filled with a complex series of anastamosing folds. Bursa (spermatheca): stalk thin-walled and slender; ovoid, terminal enlargement imbedded in base of liver above loop of aorta. Vas deferens: arises near base of spermoviduct, runs straight across to upper edge of penial sheath, enters this (fig. xvii–85), becomes

slightly enlarged, extends almost to base of penis, then turns abruptly, and finally passes up along side to enter at apex of penis; penial papilla represented by a very slight, rounded elevation on apical wall. Penis: small, tapers anteriad, shorter and stouter than that in *Rectartemon jessei*; basal half surrounded by heavy, muscular sheath, which is attached along vas deferens; upper portion with large lumen which has numerous, recurved, corneous hooks (fig. xvii–86) on its walls; lower portion with narrower, longitudinally plicate cavity; apparently entire structure everted for copulation. Penial retractor: very broad at its insertion on apex of penis; tapers gradually towards its attachment on diaphragm near side of spermoviduct.

Columellar muscle: pharyngeal retractor branches off at high level; eye retractor given off at about level of mantle edge as a common band, which is half as long as the short, right and left, free ocular bands; right eye retractor not associated with genitalia.

Rectartemon jessei H. Burrington Baker

Part III, p. 36, figs. x–55, 56, xi–A, B

Course of vas deferens very similar to that in *S. glaber normalis*; the portion along the penis above sheath is shown in my figure although I did not recognize it at the time. Penis: with similar hooks, which are relatively much smaller, somewhat stouter and very widely spaced. Free retractors: similar to *normalis,* but major portion of each ocular muscle inserted at base of tentacle, with only a small branch to tip.

OLEACINIDAE

Pseudosubulina (Rectaxis) decussata,
new subgenus and species

Type locality: abandoned cacao plantation on flats of Quebrada La Fría (H, V, b, 41); fifteen specimens, mainly immature.

Shell (fig. xix–93): small, subturrite, quite thin; color whitish. Whorls: 7, convex, slightly shouldered below suture,

last whorl noticeably flattened laterally; sutures very deeply impressed. Nepionic whorls: about 2, first almost smooth but with very faint growth wrinkles which become more prominent away from apex, second with regular growth ribs but without spiral sculpture; more depressed than in Melaniella. Last whorl: growth ribs prominent, quite regular, and evenly spaced (about 8 to the mm.), interspaces and sides with minute, nodulose, but quite regular and evenly spaced (about 72 to the mm.), spiral ridgelets. Earlier whorls with similar sculpture. Imperforate. Aperture: oblong-ovate, with long axis slightly oblique to that of shell. Peristome: incomplete, simple and sharp; palatal edge slightly sinuous; columella very weakly subtruncate, almost straight, thickened and slightly reflexed. Internally, the columella is still almost straight, scarcely thickened and quite without spiral inflection.

Measurements[1]

	Shell		Aperture		Whorls
	alt.	maj. diam	alt.	diam.	
Type	4.39	35(1.53)	28(1.23)	59(.73)	7
chaperi	8	28(2.25)			7½
coronata	7	29(2)	18(1.25)	40(.5)	8–9
fimbriata	9	22(2)	22(2)	50(1)	7–8

[1] 1924; this series, No. 152, p. 34, note 33.

This species appears to differ from most of the other forms of the genus by its exceptionally straight, simple columella and by the regular, spiral sculpture of raised lines. It is considerably smaller than any related species described from South America.

Jaw: vestigial, quite similar to that of *Pseudosubulina berendti* (Strebel and Pfeffer; 1882, V, fig. xviii–8), but very thin and transparent. Radular formula (fig. xix–94): about 12–2–1–2–12; transverse rows chevron-shaped, directed obliquely anteriad either side of the center. Central: tricuspid, cusps subequal, base elongate. Two radulae were examined; in one of them, only two of the cusps were well developed, but the breadth of the base was normal and I

believe this reduction to be due to some malformation. Inner two laterals: bicuspid, cusps stout and conical. Other laterals: with inner cusp developed into a long, slender needle; outer cusp shorter, slightly recurved. All of the laterals have bases somewhat similar to those in the Scolodontidae.

In order to ascertain the generic position of this species, the radulae of *Pseudosubulina berendti occidentalis, Spiraxis* (*Volutaxis*) *sulciferus* (Morelet), *Varicella* (*Melaniella*) *gracillima floridana* Pilsbry, *Varicella nemorensis* (C. B. Adams), *V. dissimilis* Pilsbry, and *V. denticulata suturalis* Pilsbry were also studied from material in the collection of the Academy of Natural Sciences of Philadelphia, generously put at my disposal by Dr. Pilsbry.

Pseudosubulina berendti occidentalis Pils.; one dried specimen from Uruapam, Michoacan, Mexico, A. N. S. P. 82821, collected by S. N. Rhoads (1899). Radular formula (fig. xix–95): about 14–2–1–2–14; transverse rows chevron-shaped, much as in the next species. This radula differs from that of *P. decussata* in the single, stout cusp on its central, in the broader anterior portions of its inner two laterals, and in the relatively shorter needles and stouter outer cusps of its other teeth. Strebel and Pfeffer's figure of the dentition of *P. berendti* (1882, figs. xviii, 5–7) represents the inner two laterals quite correctly, but does not show the bicuspid condition of the outer teeth. The radular differences, together with the very simple columella of my species, appear to be sufficient reason for the separation of a new subgenus, Rectaxis, type *P. decussata.*

Spiraxis sulciferus (Morelet); one dried specimen from Misantla, Mexico, A. N. S. P. 131770, collected by H. Strebel. Radular formula (fig. xix–96): about 15–2–1–2–15; transverse rows chevron-shaped. This radula is very similar to that of *P. berendti,* but the outer teeth show still smaller needles and considerably stouter and more prominent outer cusps. Both this radula and that of *P. berendti* have a slight tendency to split the tips of the cusps on individual teeth. The radulae of Rectaxis, Pseudosubulina and Volutaxis agree in

the development of these peculiar, needle-like cusps, but that of Rectaxis, with its tricuspid central, is the most divergent.

Varicella gracillima floridana Pils.; one dried specimen from Sugar Loaf Key, Florida, A. N. S. P. 100022, collected by Dr. H. A. Pilsbry. Radular formula (fig. xix–97): at least 12–1–12; transverse rows chevron-shaped. Central: asymmetrical, tricuspid; central cusp much the largest, left lateral cusplet more prominent than right. Laterals: all similar in form, mainly tricuspid; inner cusp developed into a broad, heavy blade quite unlike the needles of the preceding groups, outer cusps aculeate. Three of these outer cusps are sometimes present in individual laterals, quite regardless of their position in the rows. As will be seen from the following descriptions, the radular differences between Melaniella and Varicella s. s. are the tricuspid central of the former and the more numerous cusps of its laterals.

Varicella nemorensis (C. B. Adams); one radula mounted by Dr. Pilsbry, A. N. S. P. 65406, from Jamaica, and one dried specimen from Morant Bay, Jamaica, A. N. S. P. 61758, collected by Wm. J. Fox (1891). Radular formula (fig. xix–98): about 39–1–39; transverse rows almost straight (this is partially dependent on the mount, as all of these Oleacinid radulae are trough-shaped). Central: with a single, long-aculeate cusp. Laterals: similar to those of the preceding species, but almost always bicuspid; outermost teeth very small. This radula is probably characteristic of Varicella s. s., type *V. leucozonias* (Gmelin); the type of Melaniella is *V. acuticostata* (d'Orb.).

Varicella dissimilis Pilsbry; one dried specimen from Bog Walk, Jamaica, A. N. S. P. 61760, collected by Wm. J. Fox (1891). Radular formula: about 33–1–33; transverse rows much as in preceding species, as is also the entire radula. Central: base commonly with minute notch on one or both sides; this apparently demarcates a weak vestige of the lateral cusp (or cusps). Laterals: tricuspid condition more common.

Varicella denticulata suturalis Pilsbry; one radula mounted by Dr. Pilsbry from the type specimen, A. N. S. P. 85636, col-

lected at Sans Souci, Haiti. Radular formula (Pilsbry; 1908, M. C. XIX, fig. xxxvii–24): about 43–1–43; transverse rows broadly chevron-shaped. What I take to be the central has quite the same shape as the inner laterals, and is commonly tilted either to the right or the left; in other words, the central is not distinctly differentiated. Laterals: somewhat similar to those of *V. nemorensis,* but with only one, hooked, aculeate cusp which juts out from the base in a much more prominent manner than in that species (Pilsbry's figure represents the teeth as seen when tilted inwards). This is certainly a rather divergent radula for a member of the same section (Varicella s. s.).

Pseudosubulina (*Rectaxis*?) *chaperi* (Jousseaume)

Opeas chaperi Jouss. (1889, 238, fig. ix–5), Valencia, Caracas.

According to Jousseaume's description, this species must be quite similar in form to *P. decussata,* although it is almost twice the size. However, his figure does not show the deep sutures or the scalariform tendency that he describes. Both this species and *Stenogyra coronata* Guppy (1868, 438), described from a single specimen thought to be introduced into Trinidad, apparently lack spiral sculpture; the definitions of both are insufficient for their exact separation. *Bulimus fimbriatus* Forbes (1850, P. Z. S., 56, fig. ix–7), with Panamá as its very doubtful type locality, is also somewhat similar, but apppears to have some form of spiral sculpture.

HELICIDAE

Thysanophora santanaensis (Pfeiffer)

Helix santanaensis Pfr. (1854, P. Z. S. XXII, 52), Santa Ana, New Granada;[2] Reeve (1854, Conc. Ic., fig. cxci–1344). ?*Trichia rojasi* Jouss. (1889, 249, fig. ix–9, 10), Caracas, ?? *T. venezuelensis* Jouss. (1889, 248, fig. ix–12, 13), Tovar and Valencia.

[2] Since the publication of the third part (p. 19, note 3), I have found a Rio Santa Ana near the boundary line of Colombia and Venezuela (L 9° 31′, 72° 50′), which seems more probable than the other four, previously cited.

One specimen from valley of Rio Macuto (H, I, b, 1), near La Guaira. The A. N. S. P. has two lots (28259, 28262) from Cariaco. Although the original description is inadequate, it appears to satisfy these shells which are close to *Helix impura* Pfr. (1866, Mal. Bl. XIII, 79), a quite typical Thysanophora from Mirador, Mexico. The Venezuelan shells are larger for the same number of whorls, are slightly more elevated, and their sculpture is much more delicate and widely-spaced. Both of these forms are quite similar to the type species of Thysanophora, *Helix conspurcatella* Morelet (1851), from Guatemala and Yucatan. All three agree in the broken, irregular, epidermal ridgelets or rows of granules which obliquely cross the growth wrinkles so as to approach the suture at a more oblique angle. However, in *T. santanaensis,* these are more delicate and wavy, or are broken into rows of minute, raised punctations, while in *T. impura* the coarser and closer growth wrinkles tend to anastamose and almost completely obscure them. In *T. conspurcatella,* on the other hand, the oblique sculpture usually appears as rows of higher and heavier, crescentic projections. In addition, the last species has somewhat higher whorls and relatively smaller umbilicus than has either of the other two (umbilicus 2.8 times in major diameter in *T. santanaensis*). *Trichia rojasi* Jouss. is probably a synonym of *T. santanaensis,* as the description calls attention to the scale-like sculpture; however, the figure represents a markedly hirsute shell.

Another somewhat similar species of Thysanophora that may occur in Venezuela is *Trichodiscina crinita* Fulton (1917, P. Mal. Soc. XII, 240), from Cartagena, Colombia. This last shell is closely covered with more delicate, anastamosing wrinkles which are almost parallel to the growth lines, and in addition develops long, irregularly scattered hairs. It is just possible that this is *Trichia venezuelensis* Jouss., as the description of the latter mentions hair-like structures, although the figure lacks them completely. As a matter of fact, the confusion in the descriptions and figures of Jousseaume's two species renders them quite unidentifiable.

	Shell			Aperture		Whorls
	alt.	maj. diam.	min. diam.	alt.	diam.	
T. santanaensis						
(1854)	2.0	225(4.5)	200(4.0)			5
A.N.S.P. 28262	2.60	172(4.47)	155(4.04)	65(1.70)	98(1.66)	4¼
T. rojasi						
(1889)	2.0	150(3.0)	125(2.5)			4
T. venezuelensis						
(1889)	2.5	180(4.5)	140(3.5)			4½

Thysanophora plagioptycha (Shuttleworth)

Helix plagioptycha Shuttl. (1845, Mit. Ges. Bern, 37), Porto Rico and Vieque. *H. ierensis* Guppy (1869, P. Sc. As. Trinidad, 242), Trinidad; (1871, A. J. C. VI, 307, fig. xvii–4), Venezuelan Guiana. *T. plagioptycha* Vanatta (1915, Naut. XXIX, 82), Cariaquita; Pilsbry (1920, Naut. XXXIII, 94–95, fig. 2), Cariaco.

Seven specimens, from the valley of Rio Macuto (H, I, b. 1), a quebrada near Aroa (H, I, b, 23), and Quebrada La Fría (H, V, b, 41).

Thysanophora canalis Pilsbry

T. canalis Pils. (1910, P. A. N. S. Phila., LXII, 507, fig. 3), Canal Zone.

Two lots (10218, 28263) in the A. N. S. P., from Cariaco (Cocking). This species agrees with *T. plagioptycha* in the development of high, regular, oblique riblets, instead of the broken, irregular ridgelets, or rows of projections, which characterize the typical group of the genus.

None of the comparatively smooth species of this genus, such as *Thysanophora vanattai* (1924, this series, No. 152, p. 79, figs. xiv–50, 51, xv–57), have been reported from Venezuela, but it may not be out of place to present here the anatomy of this species from the Island of Aruba, Dutch West Indies. Animal (specimens in alcohol): almost white except the dark tentacles and slight shading on the sides of the body. Sole and foot: holopod, quite narrow, bluntly pointed posteriad; sides with weak, vertical wrinkles; without special groove on dorsum of tail. Mantle edge: simple with the exception of a small frontal lappet under and to the left of the

pneumostome. Lung (fig. xii–62) : about 1 2/3 as long as its anterior margin and about 4 times the length of its posterior; weakly vascular and scarcely pigmented; principal vein receives several large branches, including a renal vein which brings back the blood from the region between the kidney and hind-gut. Ventricle of the heart larger than the atrium. Kidney: narrow triangular, its length about 3 times its basal width and about 3 times the length of the pericardium, which is imbedded in its side. Primary ureter: greatly swollen along kidney, passes across posterior end of lung; completed by a large, thin-walled, secondary ureter; external ureteric opening at apex of a narrowly triangular vestibule, somewhat similar to that in *Pleurodonte plicata* (see later page). Pneumostome and anus: contiguous but separate. Ovotestis (fig. xii–63) : small, imbedded in middle ¼ of liver; irregularly tubuloalveolar lobes few in number; duct at first straight but simply convoluted for about 2/3 of its length, with a digitiform enlargement (''talon'') just before it enters the upper end of the spermoviduct. Albumen gland: long ovoid, imbedded in base of liver. Spermoviduct (''uterus'') : comparatively short, but broadly sacculate; interior complexly folded; empty in 5 specimens examined. Spermoviducal gland (''prostate'') : acinous, along entire length of spermoviduct. Free oviduct: almost as long as spermoviduct and quite stout. Vagina: comparatively short; narrowed at cloacal end. Bursa or spermatheca: stalk long and quite stout, tapering to where aorta loops over it; terminal sac imbedded in base of liver. Vas deferens: externally issues from base of spermoviduct near end of spermoviducal gland; internal path not established (cf. *Pleurodonte plicata*) ; passes under right ocular muscle between vagina and penis; enters epiphallus opposite attachment of penial retractor. Epiphallar appendix (flagellum?) : very large, curled spirally and imbedded between middle of spermoviduct and salivary glands; asymmetrically fusiform, almost as long as epiphallus and penis combined. Epiphallus: comparatively short and stout. Penial retractor: short, inserted on epiphallus near base of appendix; attaches

to diaphragm near right side of spermoviduct. Penis: about 1½ times length of epiphallus; cloacal end very narrow and thin-walled. The entire genital system was mounted on a slide and flattened slightly with a cover-glass, so that the lumen could be traced under a microscope (fig. xii–64). Epiphallar appendix: consists of a heavy, transversely divided, glandular pilaster, with the narrow, longitudinally plicate lumen along the shorter side. Cavity of epiphallus: wider, with heavy, but low, longitudinal folds along its walls; constricted near apex of penis by a heavy, circular fold (penis papilla). Lumen of penis: slightly narrower than greater portion of epiphallus; longitudinal folds narrower and more numerous. Jaw and radula: already described and figured (*l. c.*). Columellar muscle: divides into a small right and a large left band a short distance below base of liver; right division gives off a relatively small contribution to the tail group, some small bundles to pharyngeal retractor system, and is continued as right ocular muscle; left division contributes most of tail retractor, the major portion of the pharyngeal system, and the left ocular; both portions of the pharyngeal system are connected by anastamosing bundles, while entire tail retractor is fused for a short distance into a broad band.

Dr. Pilsbry advises me that, although the structure of this animal superficially resembles the Camaeninae more than the Sagdidae, the plaited jaw, the high attachment of the penial retractor, the peculiar form and structure of the epiphallar appendix, and the comparatively short kidney and lung, comprise an assemblage of characters different from any known Helicid type. In addition, practically nothing is known about the soft parts of any other member of the miscellaneous collection of small species that constitute the present genus Thysanophora. On a conchological basis, the new subgenus **Hojeda,** genotype *Thysanophora vanattai* (*l. c.*), is now proposed for the comparatively smooth species that do not develop the peculiar, epidermal structures which characterize Thysanophora s. s.

Xenodiscula venezuelensis Pilsbry

X. venezuelensis Pils. (1919, P. A. N. S. P. LXXI, 206, fig. 1), Cariaquita.

Pleurodonte (*Labyrinthus*) *plicata* (Born)

Helix plicata Born (1780, Test. M. C. Vinob., 368); von Martens (1873, 168), Puerto Cabello, Chino near San Felipe, Cumbres between Puerto Cabello and Valencia, Caracas; Pilsbry (1889, M. C. V, 163, fig. lxiii, 1–9). ?*H. bifurcata* Mart. (*l. c.*), Puerto Cabello.

Fifty-eight adults, from San Esteban Valley below Las Quiguas (H, II, b, 2; one dead shell), from coffee plantation on west quebrada of Banco Largo near Bejuma (H, I, b, 11; juvenile and dead shells), from around Palma Sola (H, II, b, 20, 21, 22; quite common), and from near Quebrada Sucremo at Boquerón (H, II, b, 29; dead shell). This species is purely terrestrial and is usually found under logs and debris in heavy, rich leaf-humus of luxuriant forest.

As will be seen from the measurements, this species is very variable, both in size and shape. The least depressed specimens usually show a slight scalariform tendency so that the inner suture of the last whorl falls below the carina of the preceding one. Shells with the peristome still thin (probably newly formed) have rather sharp teeth in the aperture, but the heavier specimens may develop a crenulate or even distinctly bifid condition of the outer, basal tooth (apparently due to the addition of later layers of material). One specimen has a third denticle about half way between this basal tooth and the carinal emargination of the peristome. Probably the citation of *P. bifurcata* from Puerto Cabello is either an error in locality or was based on specimens of *P. plicata* with similar accessory denticles.

	alt.	maj. diam.	min. diam.	whorls
Flattest shell	16.8	273(45.9)	236(39.7)	5¼
Highest shell	20.2	217(43.9)	186(37.5)	5¼
Smallest shells	17.9	197(35.2)	180(32.2)	5
	16.4	231(37.9)	204(33.5)	5
Means (58 shells)	17.8	231(41.5)	205(36.0)	5.1
Minimums (ditto)	16.3	197(35.2)	180(32.2)	4¾
Maximums (ditto)	20.2	273(45.9)	236(39.7)	5¼

Animal (specimens preserved in alcohol) darkly pigmented. Sole and foot: holopod, terminated obtusely posteriad; sides minutely granulate, more coarsely so towards posterior end. Mantle: with small frontal lappets which cause its anterior portion to appear weakly trilobate as viewed from below.

Lung (fig. xii–65): little less than 6 times as long as its greatest breadth; anterior end richly vascular and darkly pigmented on both sides of the principal vein; gut side of the posterior portion with much heavier network and darker pigmentation than that on cardiac side. Spongy ventricle of the heart larger than the atrium.

Kidney: long and slender, about ½ the length of lung and 6 times as long as pericardium; inside thrown up into vascular folds and columns which form a spongy portion ventrally and along the right side. Renopericardial opening: at about ¼ the distance from anterior to posterior end of pericardium; guarded by a long fold along left wall inside of kidney. Internal ureteric opening: almost at posterior end of kidney; surrounded by a circular sphincter. Primary ureter: enlarged opposite both anterior and posterior ends of kidney; passes across gut side of lung a short distance from posterior end of latter; continued by a large, thin-walled, secondary ureter along hind gut. External ureteric opening: at apex of a small, narrowly triangular space, of which the pneumostome forms the right half of the base, and which is bounded on the right side by the rectum and on the left by a thin, valve-like, dorsal fold which partially separates it from the true lung; urinary path along a short groove which is incompletely bounded by another, triangular fold which juts out on the left of the breathing pore. This little cavity must act as a sort of a urinary vestibule which apparently can be closed off from the true lung; as it is flesh-colored, it contrasts sharply with the darkly-pigmented lung. At the junction of the "valve" with the end of the secondary ureter, inside of the true lung, is a small, light-colored, almost spherical body, which appears to be glandular in structure. Pneumostome and anus: contiguous but separate.

Genitalia (fig. xii–66): very similar to those in Pleurodonte s. s. (Pilsbry; 1894, M. C. IX, 88, fig. xxiv–5, 6). Ovotestis: acinous; its duct at first straight, but becomes much convoluted throughout most of its course, and is enlarged into a small bladder just above entrance into spermoviduct (fig. 66–A is a transverse section just below this point). Albumen gland: long and slender; imbedded in basal half of liver. Spermoviduct: common to both male and female sex-products; externally crenulated by transverse grooves; bears a gland ("prostate") along its left side and between it and diaphragm; internally so complexly folded as to almost obliterate the lumen (fig. 66–B). When split open along the thin portion next to the diaphragm (seminal groove?), the body of the spermoviduct shows three columns of heavy, transverse folds, which are dovetailed together and further complicated by the fact that each fold overlaps the one preceding it (i.e., against the path of the sex-products). Spermoviducal gland ("prostate"): acinous, along entire length of spermoviduct. Free oviduct: short, with heavy walls and internal, longitudinal folds (fig. 66–C). Vagina: large and stout; interior heavily and longitudinally plicate. Bursa or spermatheca: similar to that of *Thysanophora vanattai*; stalk with heavy, longitudinal, secondarily-folded plicae (fig. 66–C). Vas deferens: branches off at base of spermoviduct (fig. 66–C); passes under right, ocular retractor between vagina and penis. Epiphallus: flagellar portion blunt, almost as stout, and but little shorter than portion proximad to entrance of vas deferens; greatest breadth at this point of entrance; tapering proximal portion bends back on penis to which it is attached by a thin sheet of muscle. Penis retractor: inserted just above apex of penis; attached to diaphragm near base of spermoviduct. Penis: comparatively short, fusiform; surrounded by a muscular sheath which is attached to epiphallus; basal portion with distinct sheath which is connected to that of penis by a narrow band. Internally (fig. xii–67): penis coarsely and longitudinally plicate (fig. 66–F); proximal portion of epiphallus weakly ribbed in same direction and with a very

minute papilla opposite the attachment of the retractor; flagellar portion very coarsely and heavily folded, in addition to the large pilaster (fig. 66–D), which is pierced near its proximal end by the slit-like opening of the vas deferens (fig. 66–E).

Jaw: arcuate; beautifully striate, both longitudinally and parallel to the anterior border; broadly and shallowly warped into a longitudinal sulcus at the center with a rounded, median projection to correspond, and similarly waved upward on either side of the center so as to form a pair of broad, vague ridges; otherwise without ribs.

Radular formula (fig. xiv–73): (62–65)–1–(62–65); transverse rows (185 counted) wave very slightly anteriad either side of the center, then posteriad, and finally curve obliquely anteriad; small outer teeth more closely-spaced than the larger, inner ones. Central: symmetrical; unicuspid, but with narrow, lateral wings. Inner laterals: similarly cusped but asymmetrical; cusps increase in length from the center out until the 12th tooth is markedly aculeate. A notch begins to appear in the entoconal wing on about the 16th tooth, in the entoconal on about the 30th. The outer teeth decrease in size and are mainly tricuspid, but considerable variation occurs; beyond the 40th, the mesocones are usually blunt. The outermost teeth are reduced to mere denticles. This radula does not differ markedly from that of Pleurodonte s. s. (Pilsbry; 1894, 88, fig. xxiv–7).

Columellar muscle: divided into a right and left half just below the base of the liver; an ocular retractor, a base to the short, heavy, pharyngeal-retractor system and a group of tail retractors arise from each half; the right and left ocular retractors remain separate, but the two halves of the pharyngeal system are united by anastamosing bundles, while the two groups of tail muscles are fused for a short distance before they unite with their respective ocular retractors, This system is similar to that of *Thysanophora vanattai,* but the two divisions, and their contributions to the pharyngeal and tail retractors, are almost equal in size.

Pleurodonte (*Labyrinthus*) *leucodon* (Pfeiffer)

Helix leucodon Pfr. (1847, Zeit. Mal. IV, 81); Martens (1873, 169), Tovar, Caracas, Chino; Pilsbry (1889, 167, fig. lxi, 9–11, 14–16).

From the localities cited, I suspect that this species usually occurs at higher altitudes than those collected.

Pleurodonte (*Labyrinthus*) *tamsiana* (Dunker)

Helix tamsiana Dunker (1847, Zeit. Mal. IV, 81), Puerto Cabello; Martens (1873, 169), Chino; Pilsbry (1889, 169, fig. xli, 5–8). *Labyrinthus tamsianus* Jouss. (1889, 248), San Esteban.

Twenty-eight adults, from ledges of rock and in leaf humus on slopes of Cumbres Mountains (H, I, ab), at San Esteban (3, 5), opposite La Quiguas (6), and near Bejuma (7, 11, 15). As will be seen from the measurements, this species also is quite variable in size and shape. The specimens from near Bejuma average noticeably larger and higher than those from around San Esteban, but they also have a greater number of whorls. In addition, the palatal tooth varies considerably; it appears quite absent in some specimens. The epidermis is thickly scattered with fine points, which render it almost puberulent.

	alt.	maj. diam.	min. diam.	whorls
H, I, b, 3; means (12 shells)	8.2	170(14.0)	157(12.9)	4.9
Minimums (ditto)	8.0	160(13.2)	147(11.7)	4¾
Maximums (ditto)	8.9	184(14.9)	169(13.9)	5¼
H, I, b, 5; means (7 shells)	9.1	170(15.5)	161(14.7)	5.0
Minimums (ditto)	8.4	157(14.9)	149(14.1)	4¾
Maximums (ditto)	10.1	184(16.0)	175(15.2)	5¼
Bejuma; means (6 shells)	9.9	163(16.2)	153(15.1)	5¼
Minimums (ditto)	9.6	154(15.7)	145(14.7)	5¼
Maximums (ditto)	10.4	172(17.2)	163(16.3)	5¼

Animal (specimens preserved in alcohol): almost without pigment but otherwise quite similar to *P. plicata,* as are also the frontal lappets of the mantle. Lung: about 5 times as long as greatest breadth; scarcely pigmented; arrangement of main vessels and heart as in *P. plicata,* but venation much weaker and network along principal vein vestigial. Kidney,

ureter, pneumostome and anus similar to those of *plicata*. Urinary vestibule: broader than long, valve and secondary fold (along urinary groove) well developed; glandular body not differentiated.

Genitalia (fig. xiii–68): fundamentally similar to *P. plicata*; only divergences will be noted. Free oviduct much shorter. Vagina: much longer and more slender; externally with circlet of knobs near lower end; internally coarsely and longitudinally plicate with a break just below the external knobs so as to mark off a sort of vaginal epicloaca. Vas deferens: branches off at base of uterus. Epiphallus: relatively longer and more slender; flagellar portion less than ¼ as long as remainder, tapering bluntly. Penis: relatively shorter and more nearly cylindrical; sheath attaches to vas deferens. Internally: longitudinal plications of penis with little mammilliform papillae; lower portion of epiphallus with three, low, broad, longitudinal folds, each of which ends in two or three mammillate protuberances (fig. xiii–70); upper portion with only two, very broad thickenings; flagellar portion with vestigial pilaster, little more than a papilla bearing opening of vas deferens (fig. xiii–69).

Jaw: quite similar in shape and striation to that of *P. plicata* but much more delicate; outer ends show distinctly the edges of the fused plaits that compose it. Radular formula (fig. xiv–74): (38–40)–1–(38–40); transverse rows (140 counted) almost straight but slightly waved as in *P. plicata*, although less markedly. Central: more aculeate; lateral wings often with small but definite notches (i.e., weakly tricuspid). All inner laterals with definite ectocones; entocone usually appears on 15th tooth. Majority of outer teeth tricuspid with rather blunt mesocones; on some of the broad, irregular ones near outer margin of radula, the cusps break up into additional denticles.

Solaropsis venezuelensis Preston

S. venezuelensis Preston (1909, Ann. Mag. Nat. Hist., 508, fig. 12), Merida.

If the dimensions given by the author are correct, this shell is actually discoid. The description is totally inadequate and the vague figure looks more like an Averellia.

	Shell			Aperture		Whorls
	alt.	maj. diam.	min. diam.	alt.	diam.	
Preston (1909)...	7.25	255(18.5)	166(12.0)	97(7.0)	93(6.5)	4½

A single immature specimen of *Solaropsis rosarium* (Pfr.) was obtained by a University of Michigan expedition from Dunoon, British Guiana (see Part III, p. 1).

Averellia (*Trichodiscina*) *coactiliata* (Férussac)

Helix coactiliata Férussac-Deshayes (1838, Hist., 18, fig. lxxii, 1–5), Real-Llejos, Nicaragua.

Five dead shells, from leaf humus in Aroa Mountains (H, I, b, 23) and around Palma Sola (H, II, b, 20, 22). These Venezuelan specimens are considerably larger than most Mexican examples.

	alt.	maj. diam.	min. diam.	whorls
Type (1838)	4.0	300(12.0)		4
H, II, b, 22.....	5.2	242(12.6)	208(10.8)	4¼
H, I, b, 23.....	4.9	249(12.2)	210(10.3)	4
	5.5	247(13.6)	218(12.0)	4½
	5.6	239(13.4)	200(11.2)	4½

ACAVIDAE

Strophocheilus (*Borus*) *oblongus* (Müller)

Helix oblonga Müller (1774, Hist. Verm. II, 86). *Bulimus oblongus* Martens (1873, 171), Valencia, Puerto Cabello, Caracas, Caripe (Caribe), Ejido (Egido, near Merida); Semper (1870–93, Reis. Arch. Phil. IIIa, 150, figs. xiv–10, xvi–25, xvii–1), genitalia, kidney and radula; von Ihering (1891, Bull. Sci. France-Belg. XXIII, 213, fig. v–11), genitalia and spermatophore. *S. oblongus* Pils. (1895, M. C. X., 29, fig. xiv, 70–73); Vanatta (1915, 82), Cariaquita.

Dead shells frequent in most of the wooded localities; collected near Bejuma, Palma Sola, Boquerón and La Fría; ten living specimens obtained from secondary brush (tombas)

near La Fría (H, V, b, 44). This species burrowed in the ground and was difficult to find during the dry season; it showed a marked predilection for cultivated fields and second growth. Near Bejuma, dead shells of this species and *Bulimulus krebsianus* were obtained from an extremely arid, barren, rocky hill, where repeated burnings had destroyed the forest and permitted the erosion of the humus and even the soil (H, IV, 8).

All of the fresh, fully mature shells have lost their epidermis and show the beautiful rose-pink peristome and parietal callus. In two specimens with thin, newly-formed peristome, the pink tinge is practically restricted to the columella, the parietal callus is polished horn-colored, and the thin epidermis, only partially retained, is light yellowish horn in color with numerous varices of dark, smoky brown.

	alt.	maj. diam.	min. diam.	whorls
Means (20 specimens)	100	58(58)	51(51)	6.3 +
Minimums (ditto)	93	53(54)	49(47)	6
Maximums (ditto)	108	61(63)	57(55)	6½

Pallial complex: very similar to that of *S. maximus* (Semper, *op. cit.*, IIIc, fig. F–5); both primary and secondary ureter absent. Semper's figure of the genitalia, although accurate in proportions, shows only the superficial form, while that of von Ihering is highly diagrammatic and lacks the cloaca and most of the vagina.

Ovotestis (fig. xv–78): relatively small; composed of few, irregular lobes which are made up of ovoid lobules, these in turn consist of radiating, club-shaped alveoli; imbedded in middle portion of liver. Ovisperm duct: long and greatly convoluted, with a small reservoir just as it enters the substance of the albumen gland; receives at this point a yellowish, lobed, club-shaped, accessory gland; deeply imbedded in albumen gland for some distance before it expands into the sperm-oviduct. Albumen gland: large, massive, solid and quite homogeneous in texture, dark olive-green in color. Sperm-oviduct: begins along side of albumen gland, where its thin

walls are complexly folded internally (fig. 78–A); lumen soon differentiated into a thin-walled and thick-walled portion which lie on opposite sides of a wedge-shaped column, but are continuous along one side (B, C); thinner walls complexly folded so as to form several columns of short, transverse rugae; thickened ones with quite simple, but heavy, longitudinal plicae; interstitial column with a deep slit (seminal groove) along its inner edge and with spermoviducal gland (prostate) in its base. Free oviduct: stout with thick walls; internally with complexly folded, longitudinal plications; just below spermoviduct, on opposite side from spermoviducal gland, an ovoid enlargement contains a short diverticulum (D) with similarly plicate walls. Bursa: stalk slender with longitudinally folded lumen (D, E), attached along side of oviduct for some distance so that its internal confluence with the latter is below the external union; ovoid terminal sac just below base of liver and included in sheath that surrounds spermoviduct and its gland. Vagina: narrower (F) than oviduct, bound close to the skin by a series of sheathing ligaments. Vas deferens: internal origin (C) near base of spermoviduct but included within wall of oviduct for about half the length of latter (D, E); closely attached by an enclosing sheath to vagina, cloaca and penis and covered by the ligaments which bind the first two to the skin. Although the vas deferens plainly arises from the open seminal groove, a very minute, closed duct runs between the latter and the prostate from near the anterior end of the last to the point where the vas deferens arises. This duct appears to be that of the prostate; it opens into the lower end of the seminal groove, just where the latter separates off from the oviduct to form the vas deferens. Epiphallus: recurved and closely attached by an enclosing sheath along side of penis, so that it looks superficially like an enlargement of the vas deferens; basal half (epiphallus proper, terminal in position) almost as stout as penis (G, H); terminal half (flagellar portion, basal in position) tapers rapidly and ends blindly; lumen complexly folded. The flagellar portion develops a large pilaster along

one side so that its lumen appears horseshoe-shaped in cross-section (K, L). The vas deferens runs in this pilaster for some distance and then opens into a long slit which splits the pilaster for several millimeters (K). At apex of penis (G), epiphallar cavity is somewhat constricted, bends back through an angle of 180° and opens by means of a Y-shaped aperture through the apex of a very stout, but low, penial papilla. Penial retractor: large but without included cavity, bifid where it inserts at apex of penis, almost as long as latter and coiled in retracted specimens; attached to diaphragm opposite middle of spermoviduct. Penis: interior of anterior (basal) portion with heavy, longitudinal plicae (K, L), which break up into series of large, closely-spaced papillae towards penial apex; apical portion largest and with much more spacious lumen (H); surface of penial papilla and adjacent walls of cavity also thrown up into complex mosaic of oval blocks. Cloaca: very short, little more than a shallow vestibule; bound into skin by heavy ligaments, in addition to the right ocular retractor which passes between penis and vagina.

BULIMULIDAE

As this family has been quite recently discussed by Dr. Pilsbry in the Manual of Conchology (Vol. X–XIV), it does not seem necessary to repeat the synonymies here, and only those of collected or discussed species will be included. The other forms will be listed with their localities. As my collection was made during the dry season, it is especially poor in arboreal animals of this family.

Plekocheilus (Drypus) pardalis (Férussac)

Helix pardalis Fér. (1821, Prodr., 48; Hist., fig. cxii–7, 8), near Venezuela. *Bulimus astrapoides* Jonas (1844, Zeit. Mal. I, 35), Guacharos Cave, Caripe, Cumana (L 10.5, 64). *B. leptochilus* Pfr. (1848, P. Z. S. XVI, 111), La Baja, Province Pamplona, New Granada (eastern Colombia). *B. lindeni* Reeve (1848, fig. xxxi–189). *B. pardalis, B. marmoratus* (pars) Martens (1873, 172), Maracaibo (L 10.5, 71.5), 8,000 ft., Varinas (Barinas, L 8, 70).

Ninety-three adults, from rich humus in heavy lowland forest around La Fría (H, II, b, 40, 42; H, V, b, 41; common); also immature shells from the junction of Quebrada Uracá with Rio Lobaterita near Estación Táchira (H, II, b, 37). This is a purely terrestrial species that aestivates in the leaf humus, especially along and between the roots of trees.

Three forms of this species appear to occur in Venezuela; typical *pardalis, leptochilus* and *astrapoides*; the last is by far the most distinct. The typical form is a comparatively light-colored, more globose shell with strong columellar fold. Lot 32999 in the A.N.S.P., from Maracaibo (Antón Cabrera, 1850), represents this form, which I suspect occurs in drier localities. My shells, from heavy, flood-plain forests, all belong to the darker, olive-green, usually more slender form *leptochilus* (+*lindeni,*) which also has a strong columellar fold. Shells from Cumana, which I take to be the form *astrapoides,* are light-colored, like typical *pardalis,* but have much weaker columellar folds than do the specimens from western Venezuela. Also, the spire tends to be somewhat pitted; in both of the last characters, *astrapoides* approaches *P. funcki* from the same region. This last, practically unicolor species is distinguished by its weaker columellar fold, by the much broader reflection of its peristome, and by its distinctly pitted spire.

	Shell			Aperture		Whorls
	alt.	maj. diam.	min. diam.	alt.	diam.	
Typical figure	68.8	46(31.6)		56(38.2)	59(22.5)	6
Fig. *lindeni*	92.3	49(45.1)		56(51.6)	59(30.6)	5–6
astrapoides (text)	95.9	47(44.6)				6
La Fría:						
Means (85 shells)	78.0	48(37.6)	41(32.3)	50(39.3)	66(26.0)	6.2
Minimums (ditto)	67.4	40(32.3)	37(28.7)	45(33.6)	60(22.3)	5¾
Maximums (ditto)	91.4	54(42.7)	46(37.8)	56(45.6)	72(30.7)	6½

All of the deformed shells and those with eroded apices have been excluded from the above resumé of the measurements of my specimens. As will be seen from the extremes, the

variation in shape and size is so great that most divergent specimens would certainly be called separate species if no intermediates were known. The color is almost as variable as the dimensions. Some of the shells have a rather light background; in others, it is so dark that the longitudinal streaks are almost obliterated. In most of the lighter specimens, the ground color has a distinct greenish tinge but in some of the darker it approaches chestnut-brown.

Animal (specimens in alcohol): well pigmented on exposed surfaces. Sole and foot: holopod, terminate obtusely posteriad; sides coarsely granulate on lower portions, vertically wrinkled on higher (all of the grooves tend to run at right angles to margin of sole). Mantle: with two, small, frontal lappets (fig. xiii–71).

Lung (fig. xiii–71): lightly pigmented (brownish): roughly 4-sided, but strongly concave as viewed internally; hind-gut margin about twice length of left one, which is not much longer than curved edge along free mantle and about 1½ times as long as width of upper end; principal vein much coarser than any of its tributaries; venation exceptionally prominent at anterior end and over anterior surface of pericardium, kidney and primary ureter (renal network), close and well-developed over all of the surface between large vein and hind-gut, weak and widely-spaced over broad, thin membrane to left of main vessel (cardiac region). Heart: thin-walled atrium a little larger than spongy ventricle.

Kidney: roughly triangular, at least as short as pericardium. Renopericardial orifice: with circular sphincter, near anterior end of pericardium. Primary ureter: greatly enlarged anteriad to kidney and also swollen near posterior end of latter; crosses at posterior border of lung to be completed by large, thin-walled secondary ureter; external ureteric opening in angle between hind-gut and inner border of pneumostome; urinary vestibule represented by narrow, transverse space between inner lip of breathing pore and a thin, valve-like fold which runs from the urinary opening to near end of principal

vein. A small, light-colored body on this pulmonary vessel, about 12 mm. above anterior edge of lung, may represent glandular body described in *Pleurodonte plicata*. Pneumostome and anus: contiguous but separate. The pericardium of one animal was packed full of little trematodes.

Genitalia (fig. xiii–72): very similar to those of *Plekocheilus blainvilleanus* (Semper, 1870–93, 150, fig. xvii–4), with the exceptions that a flagellum is certainly absent (cf. Pilsbry; 1902, M. C. XIV, p. xvii) and that the retractor muscle does insert on the apex of the epiphallus. Ovotestis: relatively small, composed of finger-shaped alveoli; its duct, at first straight, is mainly much convoluted, and bears curled, finger-shaped talon just before entrance into basal portion of albumen gland. Albumen gland: elongate, complexly but closely lobed, light in color; deeply imbedded in liver. Spermoviduct: upper, straight portion imbedded in liver, transversely crenulate externally, internally longitudinally plicate as well (fig. 72–A); middle portion in haemocoele, complexly folded like a ruffle around a central axis; lower portion flattened with longitudinally folded interior (B, C); throughout its length, a deep seminal groove, on side towards central axis, leads to vas deferens. Spermoviducal glands: two in number; upper one (A), which is acinous and lies along upper and middle portions of spermoviduct, probably represents prostate of most pulmonates; lower one (B, C), in which much larger, club-shaped alveoli radiate from a distinct lumen, opens into oviduct. The duct of this latter, oviducal gland is at first small and runs between gland and spermoviduct, but gradually enlarges until its cavity is more than half as large as that of oviduct and quite similarly plicate (D). Free oviduct: externally short and stout; interior with complex, longitudinal folds (E); lumen distinct from that of bursa for some distance below external union with latter, and enlarged just above their internal confluence (F, G); structurally, it extends from origin of vas deferens (C) to this confluence (H). Vagina: very stout, exceptionally thick-walled and with very small

lumen below entrance of bursa (H). Bursa: stalk swollen near base, twisted around central axis of spermoviduct so as to be imbedded in its folds, and distally tapered to where aorta loops over it; terminally enlarged into a kidney-shaped sac which is embedded in base of liver opposite lower end of straight portion of spermoviduct. Vas deferens: arises at base of seminal groove (C), appears externally a short distance below base of oviducal gland but is imbedded in muscular walls of free oviduct for several millimeters (D), passes under right ocular retractor between vagina and penis; attached along penis and lower portion of epiphallus by a thin membrane; swollen for some distance before its entrance. Epiphallus: long and fully as stout as penis, with retractor and entrance of vas deferens at its apex where its walls are very thick and hard (I); proximad its lumen enlarges, its glandular walls decrease in thickness and the 4 to 5, transversely-grooved, internal columns become lower (K, L). Penis: long, relatively slender and tapered towards epiphallus, from which it is not separable externally; internally with four, longitudinal plicae; walls thick and glandular for some distance below epiphallus (M), from which it is sharply demarcated internally in such a manner that its apex forms a rounded papilla; middle portion with lumen enlarged and glandular tissue restricted to one side (N); proximal end with cavity again reduced but glandular tissue absent (O); passes gradually (P) into cloaca which has comparatively thin walls with lower and more numerous folds. Penial retractor: inserted at apex of epiphallus; attached to diaphragm.

Free retractor system as in family; long pharyngeal retractor fused with left ocular band a short distance below their common origin from columellar muscle.

Jaw: arcuate, heavy, dark brown; 1.1 mm. deep at center and 4 mm. from tip to tip; apparently composed of about 18 oblong plaits, which are completely fused so that their outer edges form heavy, angular ribs on anterior surface; central area narrow oblong, forming a weak median projection; pos-

terior edge with vertical reflection. This jaw is apparently much heavier, simpler and more consolidated than that of *P. blainvilleanus* (Martens; 1873, 174, fig. ii–16).

Radular formula (fig. xiv–75): around 66–1–66; 191 transverse rows counted. Central: symmetrical, with one rather large cusp which bears expanded lateral wings. First lateral: markedly asymmetrical, with one cusp which develops an emarginate ectoconal wing. Inner 12 laterals about equal in size, arranged in a straight row; third acquires definite ectoconal notch which separates a stout cusp in the teeth further out. Beyond the 20th, the marginals diminish rapidly in size and the transverse row curves obliquely anteriad. These outer teeth mainly show a spatulate mesocone and a sharp ectocone, but occasional ones may develop two outer cusps. Longitudinal rows with degenerate, freak teeth are quite common throughout the radula; cusps of anterior transverse rows are much blunted by wear; and the outermost teeth are reduced to mere denticles. As compared to *P. blainvilleanus* (Martens, *l.c.*), this radula appears to have reduced the ectocones of the central region into lateral wings, and to have established the bicuspid condition even in the marginal teeth.

On the basis of this evidence from the soft parts, Dryptus is now taken out of the family of Acavidae and the genus Strophocheilus (Pilsbry; 1902, p. vi) and included as a subgenus of Plekocheilus in the Bulimulidae. The following related forms have been cited from Venezuela:

Plekocheilus (Dryptus) funcki (Nyst), Cumana; Guacharos Cave (Jonas); Caracas, Caripe in rock crevices (Martens). *Bulimus caripensis* "Valenciennes" Martens (1873, 172), is another synonym.

Plekocheilus (Dryptus) funcki, form *adoptus* (Reeve), Orinoco.

Plekocheilus (Dryptus) marmoratus (Dunker), Caracas; Tovar (Jousseaume).

Plekocheilus (Dryptus) venezuelensis (Nyst), Guacharos Cave; Puerto Cabello, Caracas (Pilsbry).

Plekocheilus (Dryptus) moritzianus (Pfr.), Caracas; Trujillo (L 9, 70.5), Puerto Cabello, Merida (Martens).

Plekocheilus fulminans fulminans (Nyst), Cumana; Guacharos Cave (Jonas); Caracas, 4,000–6,000 ft. (Martens).

Plekocheilus fulminans linterae (Sowerby), Mt. Roraima, British Guiana (L 51, 61).

Plekocheilus blainvilleanus blainvilleanus (Pfr.), Zaji, Province Merida, New Granada (Jáji, near Merida?); Cumbres, Caracas, Jali (Jáji), (Martens).

Plekocheilus blainvilleanus loveni (Pfr.), Tovar; Caracas (Martens); Puerto Cabello (Pilsbry).

Plekocheilus (Eurytus) cathcartiae (Reeve), Province Merida, New Granada; Caracas (Martens).

Plekocheilus (Eurytus) quadricolor (Pfr.), Chachopo, Province Merida, New Granada (Chachopo is near Timotes, Venezuela, L 8.5, 70.5).

Plekocheilus (Eurytus) veranyi (Pfr.), Chachopo; Merida, 2,300 meters (Jouss.).

Plekocheilus (Eurytus) argenteus (Jouss.), Merida, 4,000 meters.

Plekocheilus (Eurytus) succinoides (Petit), near Bogotá; Merida, Col. (Pilsbry).

Plekocheilus (Eurytus) dissimulans (Preston; 1909, 509, fig. 5), Merida.

Plekocheilus (Eurytus) castaneus (Pfr.), Vegas on River Quendeu, Colombia; Santa Ana (Pilsbry).

Plekocheilus (Eurytus) plectostylus (Pfr.), Chachopo.

Plekochelius (Eurytus) coloratus coloratus (Nyst), Cumana *(sic)*.

Plekocheilus (Eurytus) coloratus lamarckianus (Pfr.), Andes of New Granada, 8,000 ft. (Funck).

Thaumastus plumbeus (Pfr.), Venezuela *(sic)*.

From the enormous variation in my specimens of *P. pardalis,* I strongly suspect that large series will greatly reduce the number of known "species" described from around Merida. A re-examination of this isolated spur of the Cordillera Oriental must be made before much can be said definitely about its molluscan fauna. Attention is again called to the fact that many of the citations of towns are rather the address of the collector than the actual habitat of the mollusk; Puerto Cabello and Maracaibo, for example, are surrounded by semi-desert and certainly never could have been the home of some of the species ascribed to them.

Auris (Eudolichotis) aurissciuri (Guppy)

Plekocheilus aurissciuri Guppy (1866, Ann. Mag. N. H. (3) XVII, 51), Trinidad. *A. distorta sublaevis* Vanatta (1915, 83), Cariaquita, Venezuela.

This Cariaquita lot is not distinguishable from typical Trinidad specimens, which, as indicated below, do approach some specimens of the smoothish form of *A. distorta* from the coastal belt of central Venezuela.

Auris (Eudolichotis) distorta distorta (Bruguière)

Bulimus distortus Brug. (1789, Encycl. Meth. I, 344); Martens (1873, 175), Chino, Caracas. *Plecochilus distortus* Jouss. (1889, 244), San Esteban. *A. distorta* Pils. (1896, 109, fig. xl, 24–26, 32), Ejido, Aroa (?).

Twenty-seven adults, mainly dead shells, collected from rich forest on mountain sides and in creek valley (H, I, II, bc, 2, 3, 4, 5) near San Esteban. This species aestivates on the ground under leaves, especially along the roots of trees.

	Shell			Aperture		Whorls
	alt.	maj. diam.	min. diam.	alt.	diam.	
Means (22 shells).....	48.7	41(20.1)	36(17.3)	53(26.1)	54(14.0)	5.8
Minimums (ditto)...	42.5	36(17.8)	33(15.7)	48(23.1)	48(11.6)	5½
Maximums (ditto)...	53.8	45(22.1)	39(18.7)	57(27.9)	58(15.6)	6

Animal (specimens in alcohol from San Esteban, H, I, b, 3) lightly pigmented on exposed surfaces. Foot: holopod, large, bluntly acuminate posteriad, with thin, expanding margins so that it superficially resembles that of Euglandina; sides with vertical rows of fine, but prominent granulations which extend almost to mantle edge.

Pallial complex: similar to that of *Plekocheilus pardalis*, but lung somewhat more elongate and with considerably more prominent venation, especially across gut side. Apparently arboreal species in this family tend to develop heavier tributary veins than do the terrestrial members, as Drymaeus differs from Bulimulus in a similar manner.

Genitalia (fig. xvii–88): very similar to those of *P. pardalis*; only differences will be noted. Ovotestis: with only two major lobes. Ovisperm duct: with close and coarse convolutions imbedded in albumen gland; talon digitiform but coiled, as in *P. pardalis*, so as to appear cauliflower-shaped; portion below talon quite long, imbedded along albumen gland.

Albumen gland: large, solid and lumpy. Spermoviduct: entire length within body cavity; very similar to middle and lower portions of that of *P. pardalis* but more elongate. Spermoviducal glands: oviducal gland coarser in structure and lighter in color than prostate. Oviduct: free portion elongate, very slender, and with less plicate cavity (A). Bursa: stalk long, separate from free oviduct to near internal confluence; terminal enlargement small, almost spherical, caught in loop of aorta, but only slightly imbedded in liver. Vas deferens: closely attached along oviduct, penis and epiphallus, but loosely fastened near cloaca. Epiphallus: with small, slender, thick-walled, apical prolongation (B) above entrance of vas deferens; lower portion slender club-shaped; externally marked off from penis by a constriction; major portion of cavity large, with relatively thin, longitudinally plicate, glandular walls (C) which are greatly thickened near penis (D). Penis: long, quite slender; cavity of upper portion large, with complex series of high, crenulate, glandular, longitudinal plicae (E). Penial retractor: very slender, about 2/3 as long as epiphallus, inserted at apex of latter (i.e., at end of blind appendix and some distance above entrance of vas deferens), and attached high up on diaphragm. The short cloaca (everted in one specimen) receives small bands of muscle from the free retractor system. These genitalia agree with Dryptus in the development of the oviducal gland, but are more like Drymaeus and Bulimulus in the possession of a blind epiphallar appendix and in the restriction of the spermoviduct to the elongate haemocoele.

Auris (Eudolichotis) distorta guairensis (Jousseaume)

Plecochilus guairensis Jouss. (1889, 244, fig. ix–11), La Guaira. *A. distorta guairensis* Pils. (1896, 111, fig. xl, 21–23), Caracas, Puerto Cabello.

Eight dead shells from wooded valley of Rio Macuto (H, I, bc, 1). This appears to be the form of *A. distorta* that inhabits the more barren, semideciduous forest around La Guaira.

	Shell			Aperture		Whorls
	alt.	maj. diam.	min. diam.	alt.	diam.	
Means (5 shells).....	38.5	42(16.0)	37(14.3)	52(20.1)	59(11.8)	5½
Minimums (ditto).....	36.7	40(15.1)	36(13.4)	51(19.3)	56(10.9)	5½
Maximums ditto).....	40.2	44(17.1)	39(15.1)	54(20.7)	60(12.2)	5¾

Auris (Eudolichotis) distorta sublaevis Pilsbry

A. distorta sublaevis Pils. (1896, 111, fig. xl, 28–30), woods near Arva (Aroa, type locality), Puerto Cabello, La Guaira.

Twenty-eight adults, mainly dead shells, from mountain valley near Bejuma (H, I, b, 7; approaching *distorta*), and from lowland and hill forests around Palma Sola (H, II, bcd, 20, 22) and Boquerón (H, II, bcd, 27, 28, 29); dead shells on quebrada near Aroa (H, I, 23). A single dead shell, somewhat approaching *guairensis,* was also obtained at Rio Tuca near Tucacas (H, II, b, 31).

	Shell			Aperture		Whorls
	alt.	maj. diam.	min. diam.	alt.	diam.	
Bejuma:						
one shell.....	39.4	43(16.9)	35(13.8)	56(22.3)	52(11.6)	5½
Palma Sola:						
means (12 shells)	43.6	40(17.6)	34(14.8)	56(24.2)	52(12.5)	5½
minimums (ditto)	42.3	37(16.6)	32(13.9)	53(22.7)	48(11.2)	5¼
maximums (ditto)	45.8	44(19.0)	37(15.5)	58(25.8)	57(14.0)	5¾
Boquerón:						
means (12 shells)	38.1	39(15.0)	35(13.2)	52(19.7)	52(10.3)	5½
minimums (ditto)	35.7	37(14.0)	33(12.3)	48(18.4)	48(9.3)	5
maximums (ditto)	41.0	43(16.1)	37(14.1)	55(20.6)	57(11.5)	6
Tucacas:						
one shell.....	38.1	48(18.1)	39(15.0)	59(22.4)	55(12.2)	5¼

Although smoothish shells occur at San Esteban with typical *distorta* and the A.N.S.P. has specimens of the latter labeled as from Aroa itself, the small subspecies, which I am regarding as true *sublaevis,* is the only form which I found in the Aroa River valley. However, the shells from each place collected have a quite different facies. Those from around Bo-

querón are considerably smaller and smoother than those from near Palma Sola, while those from the Cerritos de Yumarito average smaller than the others from the flood-plain forests near Boquerón itself. The smooth portions of the last whorls of the Palma Sola specimens show very fine, but distinct and quite regular, impressed, spiral lines, which disappear where the peculiar granular sculpture is developed. This last sculpture is much more restricted in the Boquerón shells, while the spiral striations are also almost obsolete. Nevertheless, the specimens from both localities agree quite well in the rather elongate form, the pinched base of the aperture, and the marked tendency to bend the spire slightly to one side.

The single specimen from Tucacas shows the rather smooth shell and pinched aperture of *sublaevis,* but is more globose and has a much shorter spire. In this last character, it agrees with the two specimens from Puerto Cabello figured by Dr. Pilsbry (figs. 28, 29). I believe that these three and some other specimens labeled as from La Guaira come from similar, semi-deciduous, coastal woods and that their resemblance is due to the same ecological factors that are coincident with typical *guairensis* at La Guaira. The original *sublaevis* thus seems to contain two types of variation: (1) *sublaevis* proper, which appears to be a geographical subspecies from the Aroa River valley, and (2) this ecological form (or forms) from the drier, coastal belt. Some of the specimens of this last form distinctly approach *A. aurissciuri,* although I have seen no evidence that the two species actually intergrade.

The coloration of my specimens is exceedingly variable. The majority have a whitish or cream-colored background with more distinct stripes than is usually the case with typical *distorta,* but some are considerably darker than the others and one is bright buff and almost unicolor.

Auris (Eudolichotis) bisuturalis Pilsbry, and approaching var. *gracilis* Pilsbry

A. distorta bisuturalis Pils. (1896, 112, fig. xliv–81, 82), San José de Cucuta, Colombia. *A. distorta gracilis* Pils. (1896, 111, fig. xl–31), Cucuta?

Sixteen adults, mainly dead shells, from hills around Estación Táchira (H, I, bc, 35, 38) and La Fría (H, I, bcd, 39, 42, 43); very rare in adjacent forest of the flood-plains (H, II, bd, 40). I suspect that this species aestivates on the ground like *A. distorta,* but was not able to catch it in the act. Although the spring rains began while at La Fría, I was only able to find two living adults, both in tall arums along the edge of the Cerritos de las Brujas towards Rio Oropito (H, I, d, 43).

	Shell			Aperture		Whorls
	alt.	maj. diam.	min. diam.	alt.	diam.	
La Fría:						
means (4 shells)...	38.2	45(16.9)	38(14.4)	54(20.5)	58(11.9)	5¼
minimums (ditto)	37.1	42(16.2)	35(13.8)	52(20.2)	57(11.7)	5¼
maximums (ditto)	39.2	47(17.6)	40(15.0)	56(20.8)	59(12.1)	5¼
Estación Táchira:						
means (8 shells)...	40.7	40(16.2)	34(13.9)	51(20.8)	56(11.5)	5½
minimums (ditto)	38.6	37(15.2)	33(12.8)	49(19.2)	52(10.9)	5½
maximums (ditto)	42.7	43(17.2)	37(14.7)	53(22.3)	58(12.2)	5¾

The specimens from around La Fría are quite typical of this almost smooth, thin-shelled species with the peristome nearly straight in the palatal region. Fresh shells have a bright buff ground-color, with quite regular, diagonal stripes. Spiral, impressed lines are also present as in *A. distorta sublaevis,* although they are much weaker than in the lot from Palma Sola. The specimens from near Estación Táchira have heavier peristomes and more elongate shells than do those from La Fría and thus approach variety *gracilis.* This last form, of uncertain habitat, certainly does appear close to some specimens of *A. distorta sublaevis.*

Animal (in alcohol): quite similar to that of *A. distorta* (although my specimens of the latter are much more retracted); only differences will be noted. Albumen gland (fig. xvii–89): much smaller and more distinctly lobed (probably in a different phase of sexual activity). Spermoviduct: actually very similar although the greater extension of the

specimen figured produces considerable changes in apparent form. Spermoviducal glands: prostate yellow, oviducal gland almost white. Bursa: stalk fused to free oviduct for some distance so that vagina appears much longer; terminal enlargement ovoid. Epiphallus: relatively stouter and more nearly cylindrical; internally with large cavity and 4 to 5, simple, rather low, longitudinal folds; blind appendix more nearly conical. Penis: relatively much shorter and stouter: internally with coarse, transverse rugae in upper third, with very low, anastamosing, irregularly transverse folds in middle third, and with heavy longitudinal plications crossed by prominent transverse ones in basal third; cavity large, especially in middle region. Epiphallus and penis are demarcated internally by a perforated partition, which forms a low penial papilla. Penial retractor: about 1 1/3 times as long as epiphallus. These differences, especially in the male organs, appear to warrant the specific separation of *A. bisuturalis* and *A. distorta,* although the position of *gracilis* still remains rather doubtful.

The following related forms, cited from Venezuela, probably occur in higher altitudes than those collected.

Auris (Eudolichotis) sinuata (Albers), Venezuela; Cumbres (Martens); Tovar (Jousseaume); Puerto Cabello (Pilsbry).

Auris (Eudolichotis) euryomphala (Jonas), Guacharos Cave, Cumana; Caracas, Galipan (Martens).

Auris (Eudolichotis) perdix (Pfr.), Agua de Obispo, New Granada (L 9.5, 70); Caracas (Martens).

Auris (Eudolichotis) midas (Albers), Venezuela; Puerto Cabello (Pilsbry).

Bulimulus krebsianus Pilsbry

B. krebsianus Pils. (1897, M. C. XI, 62, fig. x–1, 2), Cartagena, Colombia.

Ten bleached shells, from barren rocky hill near Bejuma (H, IV, 8). As will be seen from the measurements, these specimens are somewhat less elongate than the Colombian types; in this, they slightly approach *B. dysoni.*

	Shell			Aperture		Whorls
	alt.	maj. diam	min. diam	alt.	diam.	
Pilsbry (1897).....	26.0	42(11.0)		37(9.8)		7½ to 8
Bejuma:						
means (8 shells)...	22.9	44(10.0)	41(9.4)	41(9.3)	61(5.7)	7.3+
minimums (ditto)	21.4	42(9.4)	39(8.8)	38(8.5)	57(5.4)	7¼
maximums (ditto)	23.9	46(11.0)	43(10.3)	43(9.9)	65(6.0)	7¾

Related forms cited from Venezuela are:

Bulimulus dysoni (Pfr.), Honduras; Ciudad Bolivar (Pilsbry; L 8, 64).

Bulimulus erectus (Reeve), on cacti, Curiana (Cumana!); Cariaquita (Vanatta).

Bulimulus cacticolus (Reeve), same localities as preceding, of which it is probably only a form; also Puerto Cabello, Caracas (Martens); Yaracuy River (Pilsbry).

Bulimulus (Rhinus) constrictus (Pfr.), Angostura (Ciudad Bolivar); La Guaira, Caracas (Martens); Venezuelan Guiana (Guppy).

In lieu of specimens from Venezuela, the type of the genus, *B. guadalupensis* (Brug.), and *B. tenuissimus* (d'Orb.) have been dissected. Specimens of the former, collected at the base of the high wall near the water front of San Juan, Puerto Rico (1922), show a pallial complex very similar to that of Drymaeus but with much weaker lung venation outside of the principal vein. The genitalia agree in main with those figured by Fischer and Crosse (1873, Moll. T. F. Mex. I, fig. xix–16), of specimens from Point-a-Pitre, Guadeloupe, but the terminal enlargement of the bursa is about twice as large and the short talon is finger-shaped and recurved (instead of enlarged) at its tip. Spermoviduct: lower portion deeply and transversely constricted into numerous, narrow, regularly overlapping folds; higher up, these become coarser and more like those in Drymaeus; posterior end expanded into a subspherical, folded mass, which is even larger than the base of the albumen gland. Spermoviducal gland: quite uniformly acinous throughout its length, apparently corresponds to prostate alone. Vagina: practically absent. Vas deferens: coiled around penis and epiphallus, sharply re-

curved to enter at apex of epiphallus proper (at place where figure cited shows a hooked convolution in the "verge"). The penis and epiphallus are not sharply demarcated and the latter is prolonged into a blind appendix, or flagellar portion, above the entrance of the vas deferens. Epiphallus: flagellar portion almost as long as penis and epiphallus proper combined, coiled around penial retractor, which is attached along its side to within a short distance of the apex; epiphallus proper about 1 1/3 times as long as penis, internally with 4 to 5, quite simple, longitudinal folds which become higher (i.e., lumen larger) towards base. Penial retractor: inserted on terminal bend of vas deferens and adjacent walls of epiphallus; fastened along flagellar portion to near its tip; attached to diaphragm a little above middle of spermoviduct. Penis: considerably stouter than epiphallus proper; enclosed basally in a muscular sheath (upper edge labeled by F. and C. as "éstranglement de la verge"), which also surrounds vas deferens; internally with spacious lumen and numerous, longitudinal plications which apically are complicated by numerous, interlocking, transverse buttresses.

Through the generosity of Dr. Pilsbry, I have also been able to examine *B. tenuissimus,* from city square in Pará, Brazil (Dr. Jos. Bequaert, 1924). Animal and pallial complex very similar to *B. guadalupensis.* Genitalia (fig. xviii–90): also similar but with male organs shorter and stouter; part of the difference in form may be due to the excessive retraction of the animals examined. Ovisperm duct: very similar; lower portion passes through tissue of albumen gland; talon digitiform. Spermoviducal gland: prostate only; section just below its base shows only lumina of vas deferens and oviduct. Vagina: much longer. Bursa: stalk similarly stout; ovoid enlargement large, caught in loop of aorta and imbedded in liver near kidney. Epiphallus: flagellar portion much shorter and stouter, tapered towards free apex, about as long as penis: portion below entrance of vas deferens not quite as long as penis, almost cylindrical, internally with longitudinal

folds. Penial retractor: similar. Penis: apical half stout, with very heavy walls, internally with strong, crenulate, longitudinal rugae; basal half much narrower, with thinner, simpler walls, and surrounded by heavy, muscular sheath.

Drymaeus trigonostomus trigonostomus (Jonas)

Bulimus trigonostomus Jonas (1844, Zeit. Mal. I, 36), near Guacharos Cave; immature shell. *B. curianensis* Reeve (1849, fig. lviii–390), Curiana (Cumana!), on leaves of palms. *Otostomus trigonostomus* Martens (1873, 181), mainly describes *knorri*. *D. curianensis* Jouss. (1889, 242), Caracas. *B. curianianus* "Reeve" Pils. (1898, 257), misprint.

The original *trigonostomus* is very evidently an immature shell of what Reeve later figured as *curianensis* from the same region. Lot 25,816 in the A. N. S. P., from Caracas, somewhat approaches the basally constricted aperture of this subspecies, but is about as close to *knorri*. I have not seen any specimens from Cumana.

Drymaeus trigonostomus knorri (Pfr.),
and form *correctus* (Pfr.)

Bulimus knorri Pfr. (1846, Phil. Ab. Beschr. II, 115, fig. iv–3), La Guaira. *B. correctus* Pfr. (1852, Zeit. Mal. IX, 93; Chemn. II, fig. xxxix–3, 5), Venezuela. *Otostomus trigonostomus* Martens (1873, 181, figs. I, 9–13, II–18), Chino, Caracas, Ciudad Bolivar (shells from last two localities probably approach true *trigonostomus*). *Bulimulus knorri* Gibbons (1879, J. of C., 129), Puerto Cabello, on cacti. *Bulimus knorri*, varieties *6–fasciatus, 4–fasciatus, tricolor, 5–fasciatus, guttulatus, percomis, modesta* Schaufuss (1881, Nach. D. M. Ges. XIII, 178, 179), color forms without definite localities. *Bulimulus knorri* Strebel and Pfeffer (1882, Beitr. Kent. Mex. V, 95, fig. xv, 7–9), anatomy and radula. *D. knorri* Jouss. (1889, 242), San Esteban. *D. trigonostomus correctus* (+ *knorri*) Pils. (1898, 257, 258, figs. xxxix, 31–33, 35–40, 44, 45).

Fifty adults, mainly dead shells, from mountain and lowland forest at Rio Macuto, San Esteban, Las Quiguas, Palma Sola, Boquerón and Aroa (H, I, II, 1, 2, 4, 5, 6, 20, 22, 23, 27, 28). One living adult and several immature specimens were collected in trees and palms at Palma Sola and Boquerón during light rains. Although most abundant in the richer forests, this form also occurred in the drier, more open woods.

The form *correctus* appears to be the characteristic one in the rich valleys around San Esteban, while those from the drier places tend to develop less elongate spires (cf. Pilsbry, figs. 44, 45). Typical *knorri,* from around La Guaira, has a somewhat narrower aperture and thus approaches true *trigonostomus.* The specimens from Aroa and Boquerón are

	Shell			Aperture		Whorls
	alt.	maj. diam.	min. diam.	alt.	diam.	
curianensis (1849):						
fig. 390–a	32.7	37(11.9)		51(16.7)	55(9.2)	7–8
fig. 390–c	40.6	37(15.2)		51(20.7)	56(11.5)	7–8
knorri (1846):						
text	40.2	33(13.4)				7
fig. iv–3	37.2	39(14.6)		52(19.4)	55(10.7)	7
correctus (1852):						
text	35.7	44(15.6)				
fig. xxxix–3	36.5	42(15.4)		52(18.8)	58(10.9)	7½
La Guaira:						
means (3 shells)	31.7	44(13.8)	36(11.4)	55(17.5)	60(10.5)	6.4
minimums (ditto)	31.4	42(13.4)	35(11.1)	53(16.7)	57(10.1)	6¼
maximums (ditto)	32.2	45(14.3)	37(11.6)	59(19.0)	62(10.9)	6½
San Esteban:						
means (13 shells)	34.7	45(15.6)	36(12.6)	54(18.7)	63(11.7)	6.6
minimums (ditto)	31.7	38(13.4)	31(11.2)	50(16.4)	58(10.9)	6¼
maximums (ditto)	39.2	48(16.9)	40(14.1)	57(19.6)	66(12.2)	7½
Palma Sola:						
means (13 shells)	32.3	42(13.4)	33(10.8)	56(18.1)	59(10.7)	6.3
minimums (ditto)	27.2	39(11.9)	31(9.5)	54(15.7)	55(9.6)	6
maximums (ditto)	36.0	46(15.5)	36(11.7)	59(20.3)	63(12.0)	6¾
Boquerón:						
means (3 shells)	30.6	43(13.2)	35(10.6)	54(16.6)	62(10.3)	6.4
minimums (ditto)	29.5	42(12.6)	33(10.1)	53(16.4)	61(10.0)	6¼
maximums (ditto)	32.1	44(13.8)	36(11.3)	56(16.9)	63(10.6)	6½
Aroa:						
means (2 shells)	30.8	41(12.7)	33(10.0)	51(15.8)	60(9.6)	6.6
minimums (ditto)	30.5	41(12.7)	31(9.4)	50(15.3)	59(9.4)	6½
maximums (ditto)	31.2	42(12.7)	35(10.7)	53(16.4)	61(9.7)	6¾

considerably smaller for the same number of whorls. However, shells from a single locality vary a great deal in shape, while the striking color-forms appear to have practically no geographic significance, although the individuals from near San Esteban tend to be more variegated than those from the Aroa River valley (mainly form *percomis*).

Animal (specimen in alcohol from near Palma Sola, H, II, d, 20) quite similar to that of *Auris distorta*. Pallial complex: quite like that of *Drymaeus acervatus* (Pilsbry, 1902, fig. liv–40), but with slightly longer lung and considerably broader pericardium, somewhat similar to that of *Bulimulus dealbatus* (Pilsbry, 1902, fig. liii–30).

Genitalia (fig. xviii–91): quite similar to those of Bulimulus, with which they will be compared. Ovotestis: with similar, weak lobes and large, club-shaped alveoli. Ovisperm duct: convoluted portion enormously swollen, imbedded between albumen gland and liver; talon straight, club-shaped; portion below talon incompletely imbedded in albumen gland. Spermoviduct: thick-walled, with coarser transverse folds. On removal from alcohol for dissection in water, the spermoviduct of my specimen became considerably swollen and almost gelatinous in texture. Spermoviducal gland: acinous, yellowish in color, along entire length of spermoviduct; apparently only prostate represented. Bursa: stalk enlarged near base; terminal sac very small, caught in loop of aorta just below base of liver. Vagina: rather long and slender, attached to skin. Vas deferens: very slender, attached closely to other organs. Epiphallus: flagellar portion quite slender, a little more than one third as long as portion below entrance of vas deferens; epiphallus proper very long and slender, club-shaped. Penial retractor: free portion very short, not one half as long as flagellar portion of epiphallus, which it appears to sheathe; continuous with tip of latter, attached to diaphragm near base of albumen gland. Penis: about as long as entire epiphallus; apical portion slender, club-shaped, and slightly convoluted inside of a thin, investing sheath; basal one third considerably enlarged and looped (in my specimen)

across pharynx just behind bases of ocular tentacles. Free retractor system as in family. These genitalia appear to have much in common with those of *Drymaeus lattrei* (Fischer and Crosse, 1875, fig. xxii–4). From the scanty data at hand, Drymaeus appears to agree with Bulimulus s. s. in the absence of the oviducal gland but to differ in the relatively small bursal sac and in the apical attachment of the penial retractor, which appears to be continuous with the flagellum rather than attached along its side. The weaker lung-venation of the terrestrial group has already been mentioned.

Jaw: quite similar to that of *D. acervatus* (Pilsbry, 1902, fig. lviii–69), but composed of narrower and more numerous plaits (about 60). Radular formula (fig. xiv–76): around 149–1–149; transverse rows (199 counted) slope obliquely backward but curve at their outer ends so as to be almost transverse. Central: elongate, usually bicuspid, but may have as many as six cusps, usually asymmetrical but rarely quite symmetrical. Laterals: mainly four-cusped, bases trapezoidal. This radula appears to have much in common with that of Mexican specimens of *D. dominicus* (1923, this series, No. 135, fig. I–2). Mid-gut: longitudinally ridged on its exterior.

The following more or less closely related forms have been cited from Venezuela:

Drymaeus auris (Pfr.), Venezuela.

Drymaeus glaucostomus (Albers), Venezuela; Cumbre de Valencia, 1,400 meters (Jousseaume).

Drymaeus fabrefactus (Reeve), Prov. Merida, New Granada; Bogotá (Pfr.).

Drymaeus decoratus goniobasis Pilsbry, Santa Ana, U. S. of Colombia (?).

Drymaeus studeri studeri (Pfr.), Central America ?; Prov. Merida, New Granada (Reeve).

Drymaeus studeri primula (Reeve), Prov. Merida, New Granada.

Drymaeus pealianus (Lea), near rapids at Ciudad Bolivar.

Drymaeus granadensis (Pfeiffer)

Bulimus granadensis Pfr. (1847, P. Z. S. XV, 231), Prov. Merida, New Granada. *D. granadensis* Pils. (1898, 300, fig. xlv–36, 37). *Bulimulus*

interruptus and var. *pallidus* Preston (1909, 511, fig. 1), Merida; typical coloration and albinistic form.

Two adults and several immature shells, in heavy forest near Estación Táchira (H, I, 38), and La Fría (H, II, d, 40, 42). The original *granadensis* appears to be a rather large, immature shell of what Preston later described. All of my specimens have spiral series of squarish blotches of color.

	Shell			Aperture		Whorls
	alt.	maj. diam.	min. diam.	alt.	diam.	
granadensis:						
Pfr., text	26	42(11)		54(14)		6
Reeve, fig. 234	26.4	50(13.1)		50(13.3)	63(8.4)	6
interruptus:						
text	25.5	41(10.5)		43(11.0)	59(6.5)	5½
La Fría:						
one shell	28.1	43(12.2)	38(10.7)	42(11.7)	65(7.6)	6¾

Although the specimen of which the measurements are given appeared to be mature, the genitalia are still in the immature condition. The flagellar appendix is short as in *D. trigonostomus,* while the bursa is closer to that of *D. virgulatus* (see below); these relative proportions may change with maturity.

Jaw: quite similar to that of *D. trigonostomus knorri.* Radular formula (fig. xiv–77): (83–35)–1(83–85) in two radulae; transverse rows (162 counted) directed obliquely backward for about one third of their length but then curved gradually so that the outer two thirds are slightly oblique in the opposite direction. Central: tricuspid, with rather pronounced mesocone and broad base. In one radula, the lateral cusps are very much reduced so that many of the centrals appear practically unicuspid, but, from their appearance, I suspect that these represent an exceedingly divergent, probably malformed condition. Laterals: inner 33 to 34 mainly tricuspid, most of remainder 4-cusped; quite similar in shape to those of *D. multilineatus* (1923, *op. cit.*, fig. I–5). This radula appears closest to that of this last species, although the shape of the rows slightly approaches that in *D. virgulatus,* which also has a relatively small number of teeth.

Exclusive of the last two species, the following forms, cited from Venezuela, appear to agree with *D. granadensis* in most characters except their color patterns.

Drymaeus meridanus (Pfr.), Merida, Andes of Bolivia (*sic*).

Drymaeus coniformis (Pfr.), Merida, Andes; certainly a young shell, possibly of the next species.

Drymaeus roseatus (Reeve), Venezuela; Tovar (Jousseaume).

Drymaeus depictus (Reeve), New Granada; Caracas, Jali (Martens).

Drymaeus depictus, var. *ictericus* (Martens), Caracas; albinistic form.

Drymaeus demotus (Reeve), Venezuela, same locality as *roseatus.*

Drymaeus lividus (Reeve), Venezuela.

Drymaeus incarnatus (Pfr.), Venezuela; unfigured.

Drymaeus deshayesi (Pfr.); Venezuela (Reeve).

Drymaeus multilineatus (Say), form *menkei* (Gruner), Ciudad Bolivar; Valencia (Jousseaume); Yaracuy (L 10.5, 68.5; Pilsbry); very probably introduced.

None of the species included in the group of *D. virginalis* were obtained by the expedition, but, as *D. virgulatus* from the Dutch Leeward Islands (1924, this series, No. 152, 84, fig. xiv–52) appears to have a similar radula, the anatomy of that species is presented here as exemplar of the group. Animal (specimens in alcohol from Bonaire) : quite similar to that of *D. trigonostomus knorri.* Pallial complex: also similar; cardiac region of lung surface quite sharply divided into two portions, a poorly pigmented strip with heavy cross-veins near the principal vessel, and a wider area with weak venation but darker pigmentation; these two areas are not separated by a longitudinal vein (cf. *D. acervatus, l. c.*). Genitalia (fig. xviii–92) : very similar to those of *knorri*; only differences will be noted. Ovisperm duct: convoluted portion much more slender; talon very short and with jet black pigmentation; portion below talon inside of albumen gland. Albumen gland: greenish yellow, with numerous, angular, white flecks. Spermoviducal gland (prostate) : relatively narrower. Bursa: stalk much shorter; apex scarcely enlarged, imbedded in folds of spermoviduct and not caught in loop of aorta. Vagina: shorter. Epiphallus: appendix extremely slender, fully as long as portion below entrance of vas deferens, looks like the

penial retractor but contains plicate lumen (A); apical two thirds of epiphallus proper with spacious lumen, the walls of which are thrown up into a few, low, longitudinal folds; basal one third slightly enlarged externally but with much reduced lumen and thicker, glandular walls. Penial retractor: free portion even shorter and attached still higher on diaphragm. Penis: relatively shorter, not enlarged basally, looped across straight vas deferens; interior of basal portion with longitudinal plications which become crenulate and finally die out near middle of length; apical portion with almost smooth walls, except for a large, double pilaster which extends about two mm. along one side. The shallow cloaca and the base of the penis are attached to the skin by a heavy sheath.

The following species of this last group have been listed from Venezuela:

Drymaeus virgulatus (Férussac), Puerto Rico; Caracas ? (Martens); possibly introduced.

Drymaeus flavidus flavidus (Menke), Puerto Rico and St. Vincent (*sic*); Caracas (Martens).

Drymaeus flavidus debilis (Beck), Antilles (*sic*); Caracas (Martens); Cariaquita (Vanatta).

Drymaeus electrum (Reeve), Venezuela.

Drymaeus amandus (Pfr.), Venezuela.

Drymaeus virginalis (Pfr.), near Caracas; near mouth Yaracuy River (Pilsbry).

Drymaeus tenuilabris (Pfr.), Venezuela; more probably lower valley of Rio Magdalena, Colombia.

Drymaeus venezuelensis (Martens), Caracas.

Tomigerus cumingi venezuelensis Pfeiffer

Tomigerus venezuelensis Pfr. (1855, Mal. Bl. II, 148), Venezuela. *T. cumingi venezuelensis* Pils. (1901, M. C. XIV, 105), Caracas.

Oxystyla obducta (Shuttleworth)

Orthalicus obductus Shuttl. (1856, Not. Mal., 61, fig. III, 1–3), Barquimeseto (Barquisimeto), Caracas; Martens (1873, 189), shores of Lake Valencia (Tacarigua). *Oxystyla obducta* Pils. (1899, 134), Puerto Cabello, west coast of Venezuela. *Zebra delphinus,* form *vividus* Strebel (1909, Beitr. Jahrb. Hamburg W. Anst. XXVI, 34), Venezuela. ? *Z. zoniferus,* form *naesiotes* Strebel (1909, 53), in logs shipped from Puerto

Cabello. *Z. sphinx,* form *zonata* Strebel (1909, 67), Puerto Cabello. *Z. obductus* Strebel (1909, 77, 78), San Estevan.

Three dead shells, only one adult, from near Palma Sola (H, II, 20).

	Shell			Aperture		Whorls
	alt.	maj. diam.	min. diam.	alt.	diam.	
Palma Sola.....	62.3	60(37.1)	53(33.2)	53(32.9)	74(24.2)	6¾

The following related species have been cited from Venezuela:

Oxystyla pulchella (Spix) and var. *prototypus* Pilsbry, Barcelona (L 10, 65).

Oxystyla maracaibensis (Pfr.), Maracaibo; Caracas, Lake Valencia, Ciudad Bolivar (Martens); Barcelona, Margarita Island (L 11.5, 64; Pilsbry); Puerto Cabello, Caracas (Strebel; 1909, 63, 86–89; under the names of *Zebra gruneri, Z. maracaibensis* and form *ferussaci*).

Oxystyla varia (Martens), Ciudad Bolivar, Caracas; Pedernales (L 10, 62; Vanatta). *Orthalicus varins* Martens (1873, 190) is apparently a misprint.

A University of Michigan Expedition collected the following species of Bulimulidae near Dunoon, British Guiana (see Part III, p. 1):

Auris aurisscIuri (Guppy). Six specimens, quite typical but somewhat thinner and slightly approaching *A. lacerta* (Pfr.) in the regularity of the color bands.

Bulimulus tenuissimus (d'Orb.). Six specimens, mainly immature; smaller and more slender than most southern specimens, but with practically identical sculpture.

Drymaeus demerarensis (Pfr.). Four specimens; one almost unicolor whitish, but with faint indications of broken bands on last whorl, another with five spiral rows of faint, widely-spaced spots, a third with similar but more closely-spaced blotches, and a fourth with almost continuous, rufous bands. The original description of the color reads "strigis IuscIs irregulariter notata," but this easily falls within the color variation indicated by these specimens. The type shell must be smaller, with a lesser number of whorls, but one of my specimens shows that it had formed an expanded peristome at a size that corresponds very closely to the dimensions given by Pfeiffer (see below). I strongly suspect that *Drymaeus semimaculatus* (non Pils.), *D. interruptofasciatus*

and *D. quadrifasciatus* Vernhout (1914, Notes Leyden Mus. XXXVI, pp. 11, 12) are all color forms of this same species. *D. demerarensis* appears quite close to *D. granadensis* (see above), but is a solider shell, with more closely-spaced spiral striations and heavier peristome.

Drymaeus (Leiostracus) ruthveni, new species. Seven specimens, three of which are adult (described below).

Oxystyla bensoni (Reeve). Three specimens; one shell is quite like Drouet's (1859, fig. iv–48) "*Bulimus zebra* (type)," while the other two have shorter spires, much more prominent vertical flammulations and darker ground color so as to resemble that author's "varieté" (*l.c.*, fig. 49) and somewhat approach *O. varia* (Martens). All three specimens have the prominent, impressed, spiral lines that characterize this species.

Liguus (Corona) perversus (Swainson). Seven specimens, all sinistral.

Orthalicus sultana (Dillwyn). Six shells.

	Shell		Aperture		Whorls
	alt.	maj. diam.	min. diam.	alt.	diam.	
Auris aurisciuri:						
means (4 shells)...	38.6	45(17.4)	39(14.9)	58(22.5)	51(11.2)	5¼
minimums (ditto)	36.4	43(16.7)	37(14.4)	58(21.3)	48(10.8)	5
maximums (ditto)	40.9	48(17.7)	41(15.3)	59(23.6)	54(11.7)	5½
B. tenuissimus:						
one shell	14.9	46(6.8)	42(6.3)	41(6.1)	75(4.6)	6
D. demerarensis:						
Pfeiffer (1868).....	20.5	49(10.0)		46(9.5)	60(5.7)	6
means (4 shells)...	26.6	42(11.2)	38(10.1)	43(11.4)	64(7.2)	6¾
minimums (ditto)	25.4	40(11.1)	36(10.0)	41(11.3)	62(7.0)	6½
maximums (ditto)	28.2	44(11.3)	39(10.2)	44(11.6)	66(7.4)	7
Oxystyla bensoni:						
three shells	66.9	48(32.3)	45(30.3)	44(29.4)	65(19.1)	8
	58.1	51(29.7)	47(27.5)	46(26.6)	66(17.4)	7½
	59.8	51(30.4)	46(27.3)	45(26.6)	68(18.2)	7½
Liguus perversus:.....	66.1	46(30.4)	44(29.1)	41(27.3)	66(17.9)	7½
Orthalicus sultana:	67.7	67(45.1)	58(39.2)	60(41.0)	71(29.1)	6½

Drymaeus (Leiostracus) ruthveni, new species

?*Bulimus cinnamomeolineatus* Troschel (1849; Arch. Naturg. I, 231, fig. iv–4; jaw and radula); Drouet (1859, 61), Cayenne; non Moricand.

Shell: perforate, subconical, rather thin; cream, semi-opaque ground-color, with brownish-coreous growth-streaks;

tip of spire lightly tinged with fulvous. Surface: almost smooth, growth lines low, oblique and crossed by scattered, nearly obsolete, spiral striae. Spire: rather short-conic, with nearly straight outline but rather prominent sutures. Whorls: 6¼, the 1 3/5 nepionic ones with delicate, excessively fine spiral striae, the rest distinctly convex, and the last noticeably angulate. Aperture: very oblique (outer edge of peristome at about 45° to long axis of shell), subcircular; peristome well reflected, columellar margin triangularly reflexed above.

Type locality: on trees in forest on sand ridge near Dunoon, British Guiana.

	Shell			Aperture		Whorls
	alt.	maj. diam.	min. diam.	alt.	diam.	
Type	19.2	59(11.3)	51(9.8)	45(8.6)	88(7.6)	6¼
Adult ...	18.1	60(10.9)	50(9.1)	45(8.1)	89(7.2)	6
Adult ...	17.3	60(10.4)	51(8.8)	47(8.1)	90(7.3)	6
Means ...	18.2	60(10.9)	51(9.2)	46(8.3)	89(7.4)	6.1

As indicated above, this is probably the shell listed as *Bulimus cinnamomeolineatus* from French Guiana, and does resemble Moricand's species in coloration, but the spire of the Dunoon shell is shorter and more conical, the last whorl more angular, the aperture more oblique and the peristome more strongly reflected. In the last two characters, this species somewhat resembles the much more elongate, unicolor *D. perlucidus* (Spix). *D. ruthveni* will be figured in the next part of this series.

PLATE XII

Scales of figures 62 and 63 represent lengths of one millimeter, those of 65 and 66, one centimeter.

FIG. 62. *Thysanophora* (*Hojeda*) *vanattai.* Internal view of pallial complex from specimen in alcohol, collected at Seroe Canashito, Aruba, Dutch West Indies.

FIG. 63. *T. vanattai.* Genitalia of same specimen.

FIG. 64. *T. vanattai.* Penis, epiphallus and appendix; slightly flattened under coverglass and viewed by transmitted light so as to show lumen. Semidiagrammatic; magnification can be judged from fig. 63.

FIG. 65. *Pleurodonte* (*Labyrinthus*) *plicata.* Internal view of pallial complex from specimen in alcohol, collected near Palma Sola (H, II, b, 22). The pericardium is represented as more transparent than is actually the case.

FIG. 66. *P. plicata.* Genitalia of same specimen. Only the lower portion of ovotestis is dissected out. The varied magnifications of the transverse sections may be judged by comparison with the main figure.

A. Transverse section through spermoviduct, albumen gland (stippled) and spermoviducal gland (acinous), just below entrance of hermaphroditic duct.

B. Through spermoviduct, its gland and uterine artery, near thickest portion of the first.

C. Through oviduct (lower circle) and base of bursa (top), at point where vas deferens (upper right lumen in oviduct) branches off.

D. Through flagellar portion of epiphallus, to show pilaster.

E. Through epiphallus, at point where vas deferens enters.

F. Through cloacal end of penis.

FIG. 67. *P. plicata.* Penis, epiphallus and flagellum split along side and pinned open. Bases of penial retractor and vas deferens shown at right. Magnification can be judged from fig. 66.

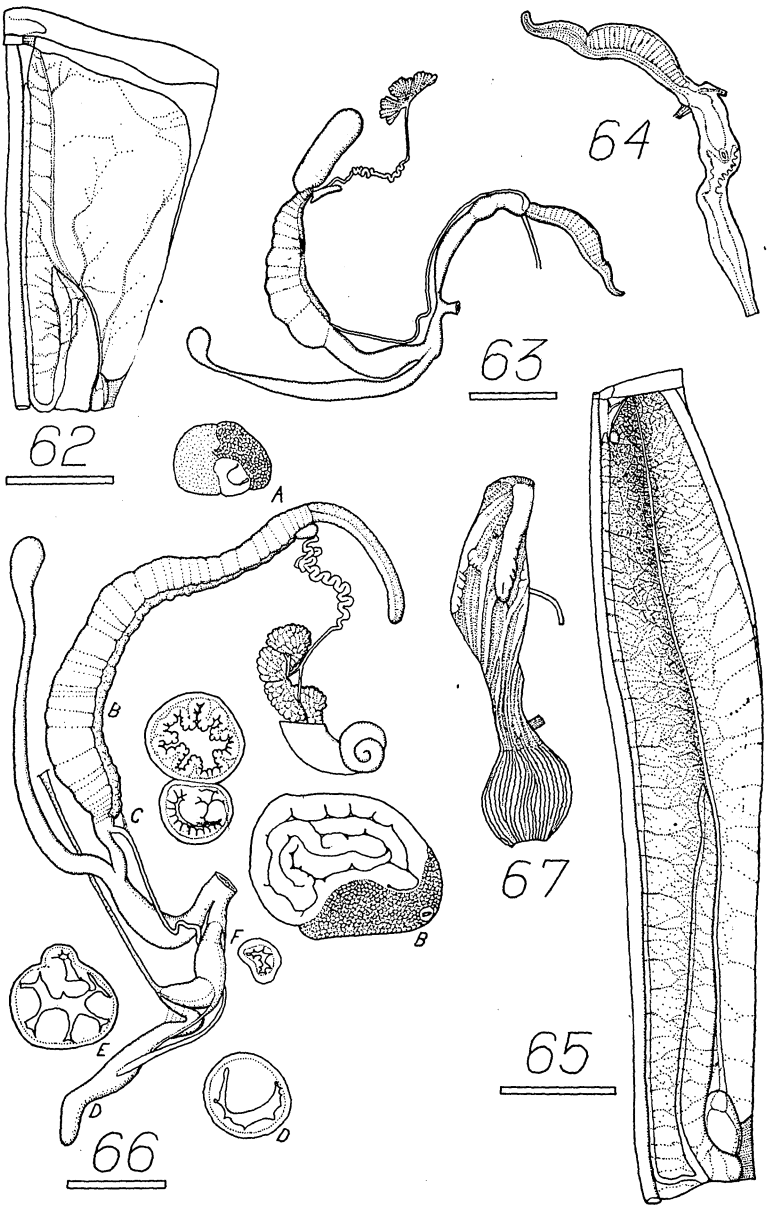

64
63
62
A
B
C
67
B
F
E
D
D
65
66

PLATE XIII

Scales represent lengths of one centimeter.

FIG. 68. *Pleurodonte (Labyrinthus) tamsiana.* Genitalia of specimen in alcohol, collected near Bejuma (H, I, b, 11). Ovotestis, its duct and albumen gland omitted.

FIG. 69. *P. tamsiana.* Tip of epiphallus, split open along one side and pinned out so as to show entrance of vas deferens. Magnification of this and the next figure can be judged from fig. 68.

FIG. 70. *P. tamsiana.* Penis and base of epiphallus; arranged as in fig. 69.

FIG. 71. *Plekocheilus (Dryptus) pardalis.* Internal view of pallial complex from specimen in alcohol, collected at La Fría (H, II, b, 40). In order to represent this on a plane surface, the left side of the lung is incised in two places almost to the principal vein and the hind-gut pinned out in an arc; this makes the left side appear much longer than is actually the case. A piece is removed from the left wall of the pericardium so as to expose that side of the auricle and ventricle.

FIG. 72. *P. pardalis.* Genitalia; same specimen and scale as fig. 71; ovotestis and transverse sections as in fig. 66.

A. Transverse section through anterior region of spermoviduct and attached prostate gland (at right).

B. Through same, just below frilled portion; oviducal gland at right.

C. Through same, at point where vas deferens arises; oviducal gland at right.

D. Through oviduct (at left), vas deferens (upper right) and base of duct of oviducal gland (lower right).

E. Through free oviduct and vas deferens, at place where gland duct enters former.

F. Through free oviduct (right) and stalk of bursa (left), just below their external union.

G. Through same, just above internal confluence; stalk of bursa at left.

H. Through vagina, a short distance below G.

I. Through tip of epiphallus (left) and vas deferens (right).

K. Through upper portion of epiphallus. Glandular tissue stippled in K, L, M and N.

L. Through lower region of epiphallus.

M. Through apex of penis.

N. Through middle region of penis.

O. Through lower region of penis.

P. Near cloacal end of penis.

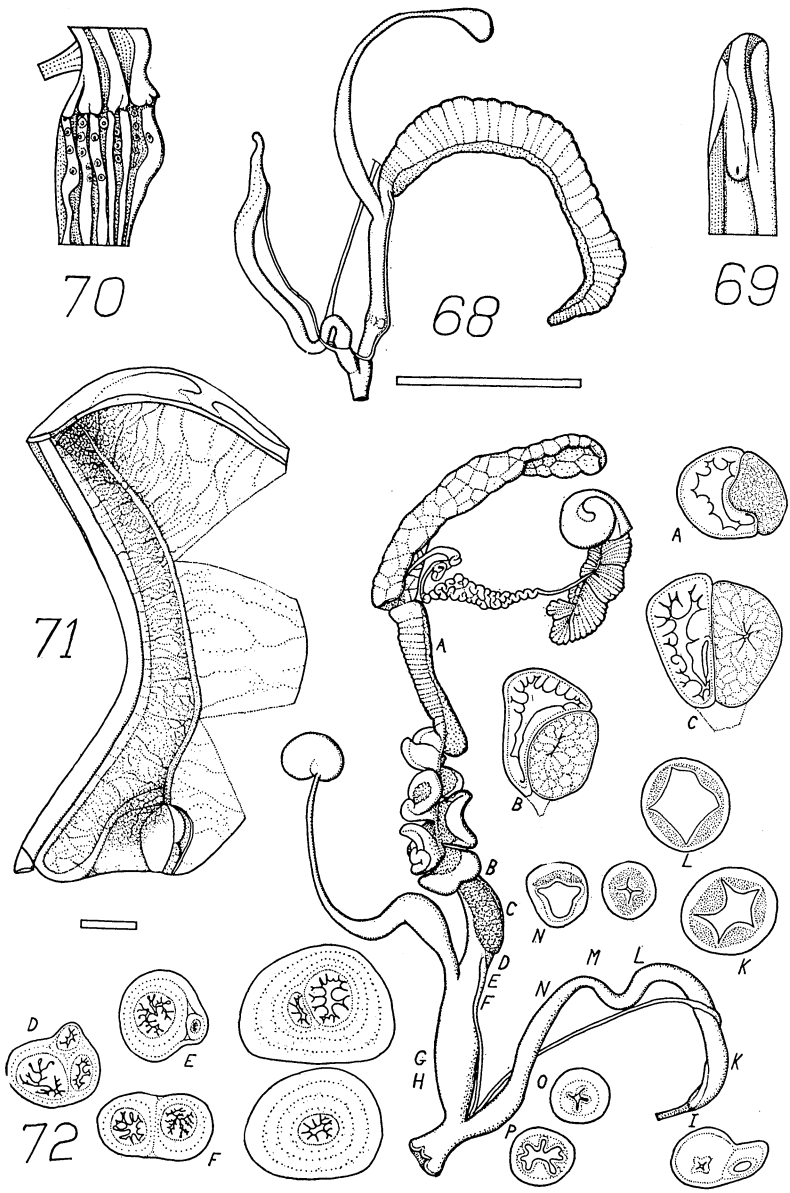

70
68
69
71
72
A
B
C
D
E
F
G
H
K
L
M
N
O
P

PLATE XIV

Scales indicate lengths of fifty microns. Central and first lateral in usual relation to each other; remainder of teeth simply oriented in regard to long axis of radula. Hair-lines represent shape of right half of transverse row, with positions of central (left end), every 7th tooth (every 25th in figs. 76, 77), and lateral edge marked.

FIG. 73. *Pleurodonte (Labyrinthus) plicata.* Radula of specimen in fig. 65. Central, 1st, 7th, 14th, 21st, 28th, 47th and 53rd teeth.

FIG. 74. *P. tamsiana.* Radula of specimen in fig. 68. Central, 1st, 7th, 14th, 21st, 28th and 34th teeth.

FIG. 75. *Plekocheilus (Dryptus) pardalis.* Radula of specimen in fig. 71. Central, 1st, 7th, 14th, 28th, 45th and 55th teeth.

FIG. 76. *Drymaeus trigonostomus knorri.* Radula from specimens in alcohol. Central with tips of 1st laterals to show relations; also 1st, 3rd, 28th, 100th and 149th teeth from Palma Sola specimen (H, II, d, 20); tips of two other centrals from Aroa animal (H, I, a, 23).

FIG. 77. *Drymaeus granadensis.* Radula from specimen in alcohol, collected near La Fría (H, II, d, 40). Central, tip of left 1st lateral, right 1st, 3rd, 28th, 57th and 83rd teeth.

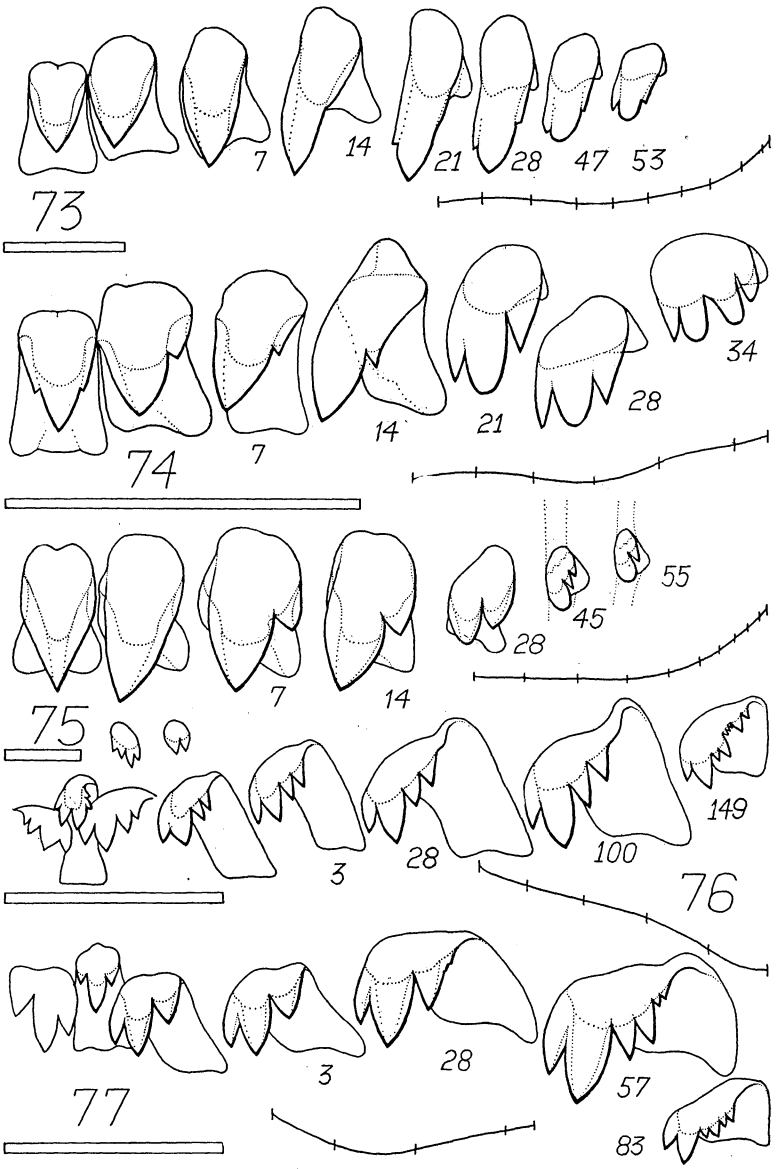

7
14
21
28
47
53
73
34
28
21
14
7
74
55
45
28
14
7
75
149
100
28
3
76
57
28
3
77
83

PLATE XV

Scales represent lengths of one centimeter.

FIG. 78. *Strophocheilus (Borus) oblongus.* Genitalia from specimens in alcohol, collected near La Fría (H, V, b, 44). Top scale is for main figure (from a different specimen than the transverse sections); middle one for sections A to F; bottom one for G to L.

A. Transverse section about 5 mm. above base of albumen gland (on top); also passes through spermoviducal gland (below) and spermoviduct (interstitial).

B. About 12 mm. below base of albumen gland. Thin-walled portion of spermoviduct (above and to left) and thick-walled region (to right) partially enclose prostate. Seminal groove and minute, closed (prostatic?) duct near edge of interstitial column.

C. About 6 mm. above diverticulum of oviduct and just above origin of vas deferens. Thick-walled portion (below and to right) and thin-walled region (above) enclose interstitial column, which contains spermoviducal gland, closed duct and deep seminal groove.

D. About 3 mm. below apex of diverticulum (on left). Vas deferens (on right) enclosed in wall of oviduct, to which stalk of bursa (on left) is also firmly fastened.

E. About 5 mm. below base of diverticulum. Vas deferens (on right) still enclosed in wall of oviduct, to which stalk of bursa (on left) is also firmly fastened.

F. Just below confluence of oviduct and bursa. Vas deferens (on right) attached to side of vagina.

G. Less than 2 mm. below attachment of penial retractor. Apical lumen of penis (on left) partially surrounds base of penial papilla, which includes cavity of very short, descending limb of epiphallus. Ascending limb of latter (on right) closely attached.

H. Just below penial papilla; through penis (on right) and epiphallus (on left).

I. Just anterior to middle of epiphallus (on left). Deep slit in epiphallar pilaster is continuous with vas deferens.

K. About 2 mm. anterior to blind end of epiphallus (on right). Vas deferens just outside of slender, blind prolongation (flagellum?) of epiphallus.

L. About 7 mm. above cloaca. Vas deferens (on right) closely attached to wall of penis.

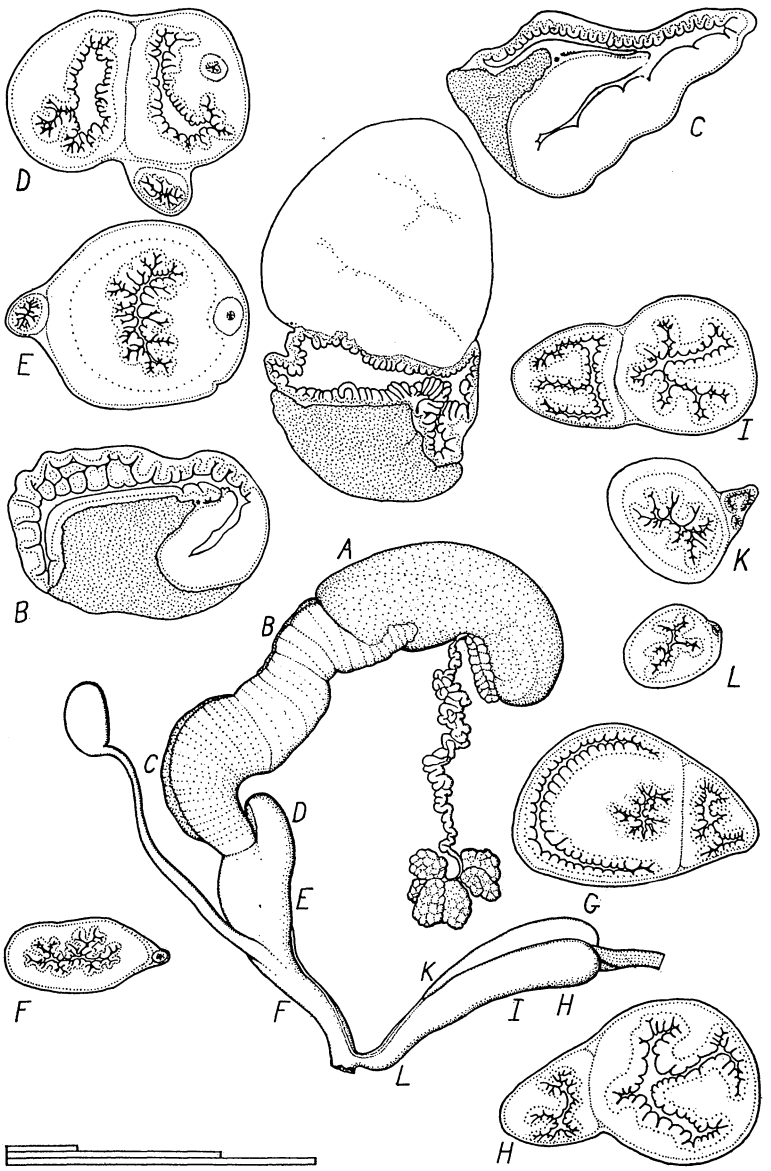

D
C
E
I
B
K
A
B
L
C
D
G
E
F
K
F
I
H
L
H

PLATE XVI

Scales of figs. 79 and 81 indicate lengths of five millimeters, that of fig. 82, fifty microns, that of fig. 83, one millimeter.

FIG. 79. *Omalonyx felina.* Internal view of pallial complex from specimen in alcohol, collected near Bejuma (H, XII, 9). Anterior end above and long axis of body parallel to that of plate. Primary ureter and hind-gut are represented as more transparent than is actually the case.

FIG. 80. *O. felina.* External view of pneumostome and mantle lappets; same specimen as fig. 79.

E. Edge of mantle. H. Hind-gut. U. Secondary ureter.

FIG. 81. *O. felina.* Genitalia from same specimen. Uterus is dissected out of its sheath so as to show its full length, but apical 5/6 of penis is still coiled in place. Lower portion of penial sheath represented as more transparent than is actually the case.

A. Apex of penis with ends of vas deferens, penial retractor and penial sheath; slightly flattened by coverglass and viewed by transmitted light.

B. Portion of penis about 4 mm. below apex; flattened and viewed as in A.

C. Transverse section through penis and penial sheath about 3 mm. above cloaca.

D. Same about 1 mm. above cloaca.

FIG. 82. *O. felina.* Radula of same specimen. Central and 1st lateral in usual relations; also 7th, 14th and 21st teeth. Hair-line shape of right half of transverse row, with positions of central, every 7th tooth and lateral edge marked.

FIG. 83. *O. felina.* Jaw of same specimen.

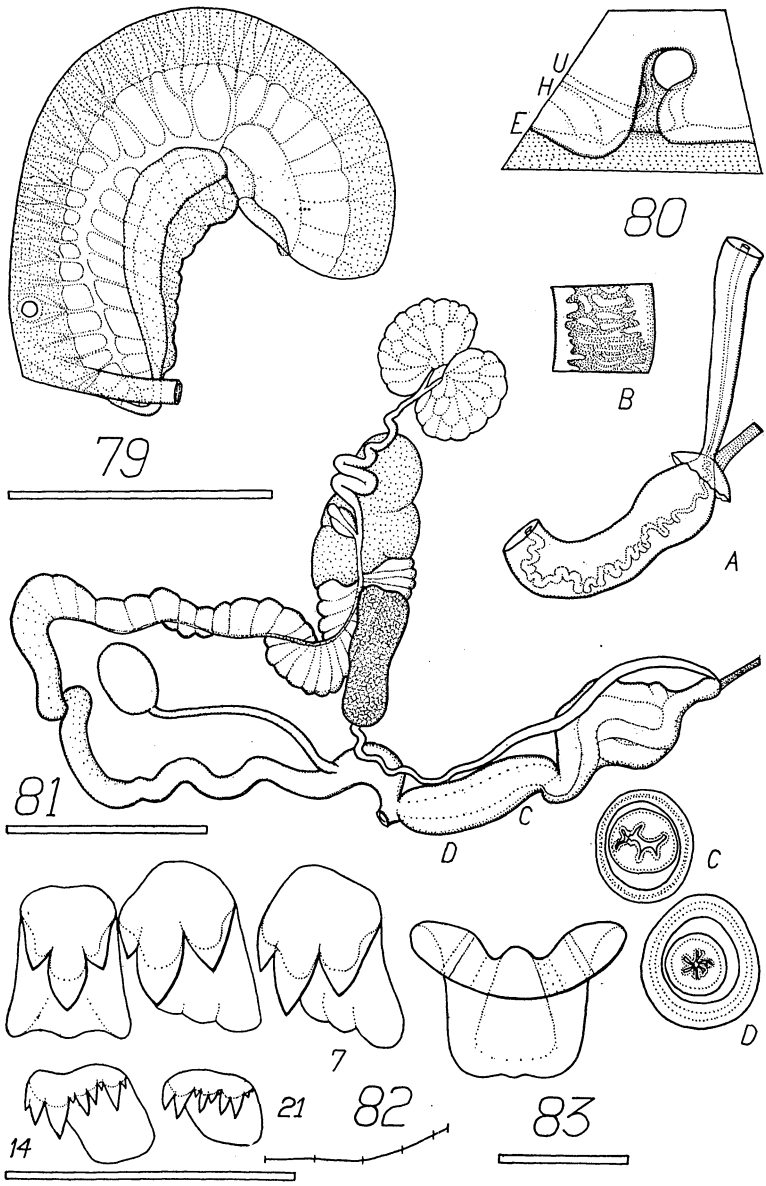

U
H
E
80
B
A
79
81
C
D
C
D
7
14
21
82
83

PLATE XVII

Scale of fig. 84 represents length of one millimeter, those of figs. 88 and 89, five millimeters.

FIG. 84. *Streptaxis (Odontartemon) glaber normalis.* Genitalia of specimen in alcohol, collected near Palma Sola (H, II, b, 22).

FIG. 85. *S. glaber normalis.* Penis of same specimen, slightly flattened by coverglass and viewed by transmitted light. Only those penial hooks which appear in profile are shown.

FIG. 86. *S. glaber normalis.* A single penial hook under greater magnification.

FIG. 87. *Scolodonta (Systrophiella) eudiscus.* Lateral view of posterior end of foot; specimen in alcohol from type locality (H, II, b, 40).

FIG. 88. *Auris (Eudolichotis) distorta distorta.* Genitalia of retracted specimen in alcohol from near San Esteban (H, I, b, 3). Ovisperm duct and talon have been dissected loose from side of albumen gland.

A. Transverse section just below base of oviducal gland. Duct of latter (above and to left) and vas deferens (above on right) are both imbedded in walls of oviduct (below).

B. Through flagellum.

C. Through epiphallus just below entrance of vas deferens (below).

D. Through epiphallus just above its base.

E. Through penis a short distance below its apex; flattened by sectioning knife.

FIG. 89. *A. bisuturalis.* Genitalia of extended specimen in alcohol from near La Fría (H, I, d, 43). Ovotestis omitted.

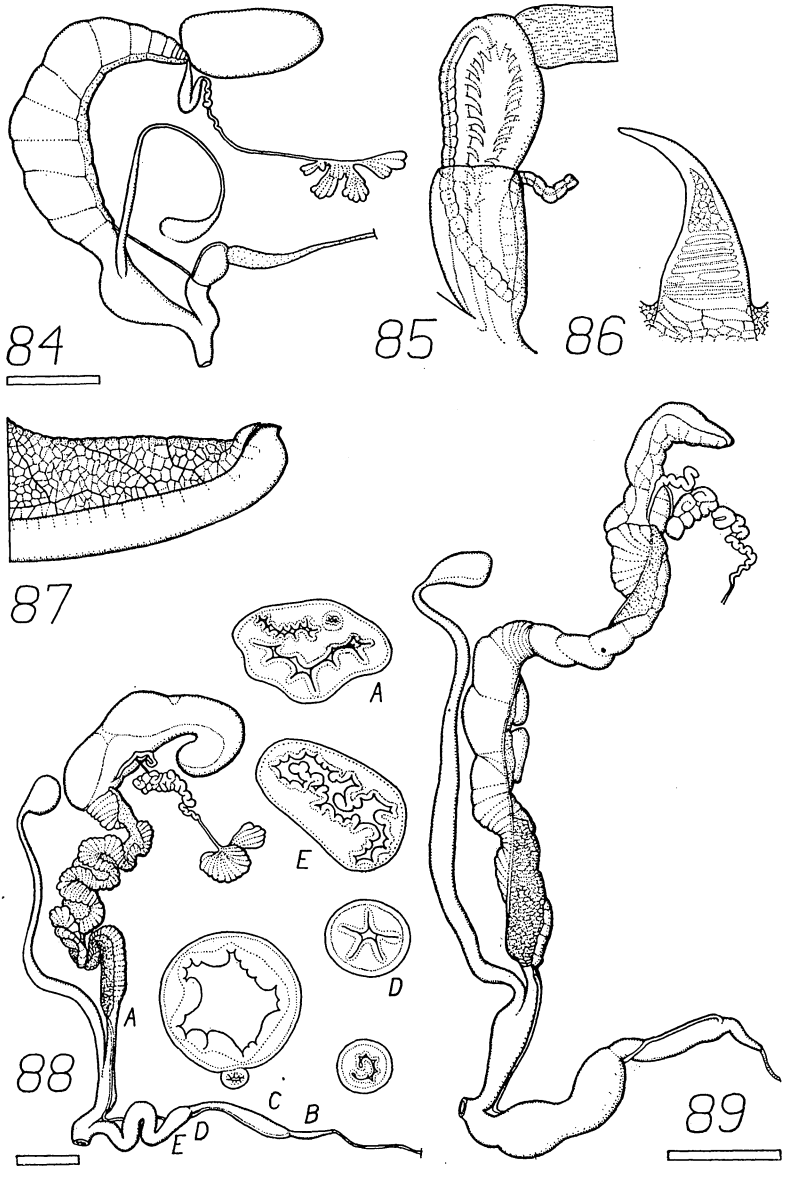

84
85
86
87
A
E
D
A
88
C
B
E
D
89

PLATE XVIII

Scales represent lengths of five millimeters.

FIG. 90. *Bulimulus tenuissimus.* Genitalia of retracted specimen in alcohol from Pará, Brazil. Ovotestis omitted; penial sheath represented as more transparent than is actually the case.

FIG. 91. *Drymaeus trigonostomus knorri.* Terminations of genitalia from specimen in alcohol, collected near Palma Sola (H, II, b, 20). Only base of spermoviduct shown.

A. Transverse section just below base of prostate. Vas deferens (at left) imbedded in wall of oviduct (oviducal gland absent).

FIG. 92. *Drymaeus virgulatus.* Genitalia from specimen in alcohol, collected on Bonaire, Dutch West Indies. Ovotestis only shown in outline.

A. Transverse section through flagellar appendix of epiphallus.

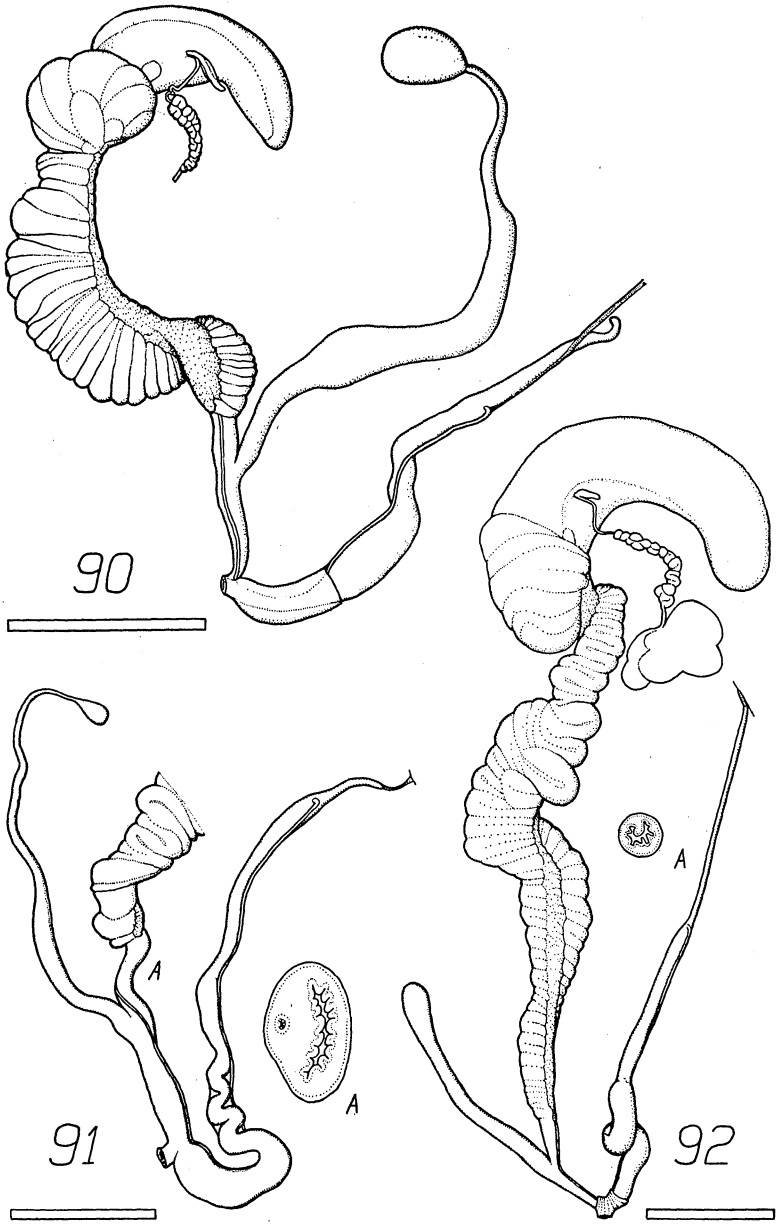

90
A
91
A
A
92

PLATE XIX

Scale of fig. 93 represents one millimeter, those of others, ten microns. Central and 1st lateral of each radula shown in normal relations but slightly separated laterad; most of laterals tilted inwards. Hair-lines give shape of right half of transverse row, with positions of central, outer edge and each 7th tooth marked.

FIG. 93. *Pseudosubulina (Rectaxis) decussata.* Type shell.

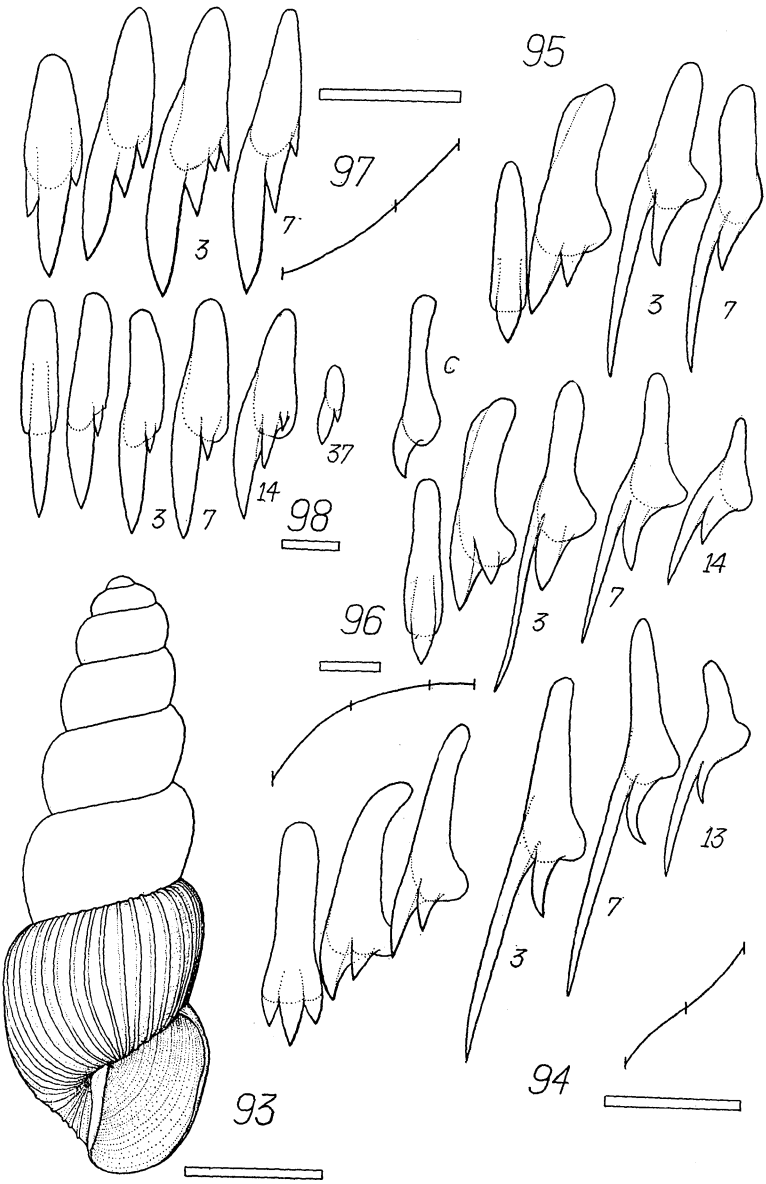
FIG. 94. *P. decussata.* Radula of paratype. Central, 1st and 2nd laterals in usual relations; also 3rd, 7th and 13th teeth.

FIG. 95. *P. berendti occidentalis.* Radula of dried specimen from Uruapam, Mexico. Central, 1st, 3rd and 7th teeth. Same scale as fig. 96.

FIG. 96. *Spiraxis (Volutaxis) sulciferus.* Radula of dried specimen from Misantla, Mexico. Central, 1st, 3rd, 7th and 14th teeth. Above the central in the normal position is another markedly tilted to the left.

FIG. 97. *Varicella (Melaniella) gracillima floridana.* Radula of dried specimen from Sugar Loaf Key, Florida. Central, 1st, 3rd and 7th teeth.

FIG. 98. *Varicella nemorensis.* Radula of dried specimen from Morant Bay, Jamaica. Central, 1st, 3rd, 7th, 14th and 37th teeth.


95
97
3
7
3
7
C
37
3
7
14
98
14
96
3
7
13
7
3
94
93