NOTES ON AND DESCRIPTIONS OF BULIMULIDAE (MOLLUSCA, GASTROPODA), II

by

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and

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With 376 text-figures, 4 tables and 8 plates

ABSTRACT

The following new taxa are described: *Drymaeus* (*Drymaeus*) *cleefi*, *Drymaeus* (*Drymaeus*) *palassus* and *Drymaeus* (*Drymaeus*) *yapacanensis*.

The variation in the size of the sculpture of the protoconch is analyzed and two groups, which roughly correspond to the subgenera *Drymaeus* and *Mesembrinus*, are distinguished. Furthermore the variation in the mandibula and radula of 46 species is analyzed.

Anatomical data are presented for 52 species and four species are redescribed.

INTRODUCTION

This paper is a continuation of the recent publication of Breure (1978) and concerns the genera *Drymaeus* Albers, *Oxychona* Mörch, *Otostomus* Beck and *Cochlorina* Jan. The data given in this paper have been used in the revision of the Bulimulinae, which was recently published by one of us (Breure, 1979).

The following abbreviations are used to refer to the location of the specimens: BMNH — British Museum (Natural History), London; FMNH — Field Museum of Natural History, Chicago; ICNB — Instituto de Ciencias Naturales, Bogotá; IML — Instituto Miguel Lillo, Tucumán; MN — Museu Nacional, Rio de Janeiro; NRS — Naturhistoriska Riksmuseet, Stockholm; RMNH — Rijksmuseum van Natuurlijke Historie, Leiden; SMF — Natur-Museum Senckenberg, Frankfurt am Main; UF — Florida State Museum, Gainesville, U.S.A.

Moreover, the following abbreviations are used to refer to parts of the anatomy: AG — albumen gland; DP — distal part of the penis; EP — epiphallus; FL — flagellum; GA — genital atrium; OD — ovotestis duct; OV — oviduct; P — penis; PA — penis appendix; PP — proximal part of

the penis; PR — prostate; PS — penis sheath; RS — receptaculum seminis; SD — spermathecal duct; SOV — spermoviduct; SP — spermatheca; V — vagina.

The histology was studied at our Division with the following methods: after embedding in paraffin the material was sectioned at 7 μm and stained with 1% alcian blue after kaliumpermanganate oxidation, followed by staining with haemalum and eosin-erythrosin in ethanol 80%. The slides were mounted in malinol and have been deposited in the Rijksmuseum van Natuurlijke Historie, Leiden.

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Without the generous help of the staff of the British Museum (Natural History), Mollusca Section, the task of tracing type specimens in their collection could not have been completed. Furthermore, the following persons deserve our gratitude as they kindly lent us material from the collections in their charge: Dr. Å. Andersson (Stockholm), Dr. A. Solem (Chicago), Dr. F. G. Thompson (Gainesville) and Drs. A. Zilch and R. Janssen (Frankfurt a. M).

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Systematics

Drymaeus (Drymaeus) acervatus (Pfeiffer, 1857)
(pl. 8 fig. 6)

The type material of this species has been traced in the British Museum (Natural History) and the specimen is designated lectotype: shell height 41.5 mm, diameter 25.0 mm (BMNH 1975461). The material is labelled 'Brazils' (ex Cuming ex Strain).

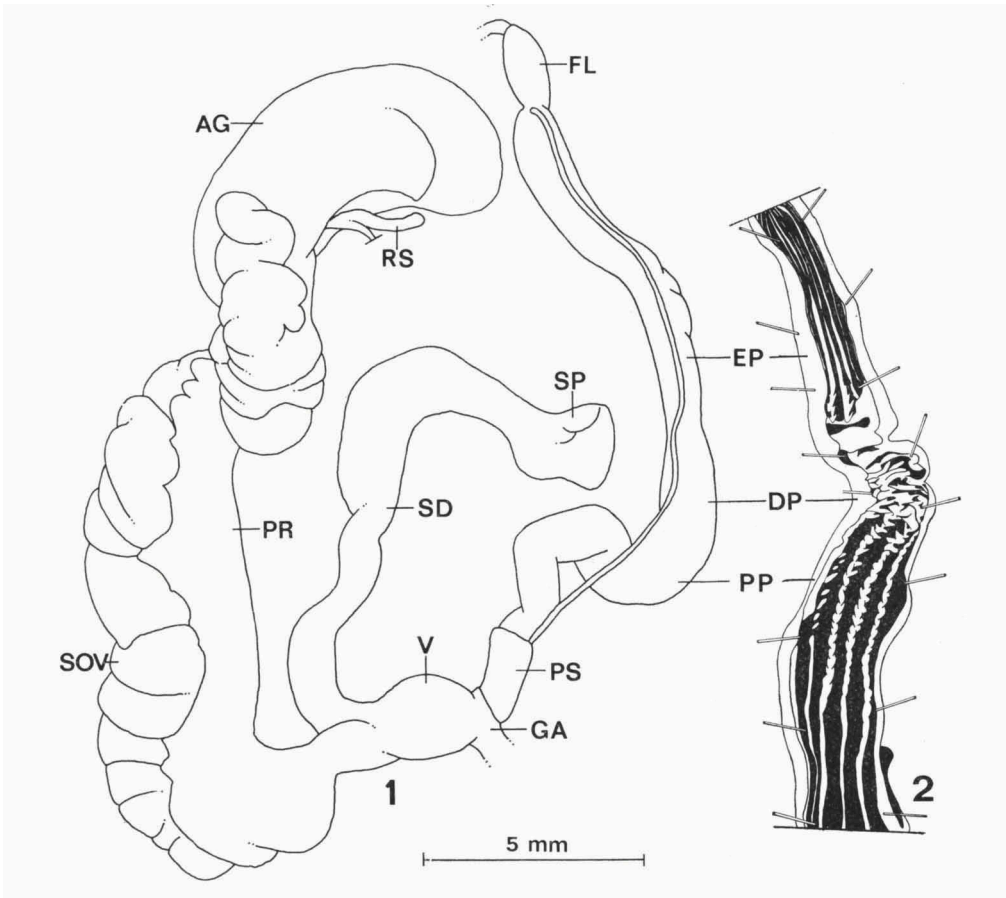
Drymaeus (Drymaeus) aequatorianus (E. A. Smith, 1877)

From among the type specimens in the London museum one is here designated lectotype: shell height 27.0 mm, diameter 13.5 mm (BMNH

1975137). Three paralectotypes are registered BMNH 1975138; the largest one measures: shell height 29.0 mm, diameter 15.5 mm. The specimens are labelled 'Ecuador' (ex Cuming).

Drymaeus (Drymaeus) ambustus (Reeve, 1849)
(figs. 1-2)

The type specimens of this species are in the British Museum (Natural History). The specimen figured by Reeve (1849: pl. 74 fig. 535) is here designated lectotype: shell height 26.5 mm, diameter 13.5 mm (BMNH 1975441). There are two paralectotypes (BMNH 1975442) and the material is labelled 'Between Jacunga and Ambato' (ex Cuming ex Bourcier).



Figs. 1-2. *Drymaeus* (*D.*) *ambustus* (Reeve), genitalia. Ecuador, Pichincha, Pomasqui (UF).

Two type specimens of *Drymaeus* (*D.*) *ambustus chamaeleon* (Pfeiffer, 1855) are also preserved in the London museum (BMNH 1975443). They are considered syntypes and labelled 'near Quito' (ex Cuming ex Bourcier).

Genitalia. — Penis with a short sheath (ca. 1/11 the length of the phallus), sub-cylindrical with the distal part slightly swollen. Internally the proximal part of the penis bears ca. five longitudinal pilasters; in the distal part the folds are broad and short, irregularly shaped and they partially overlap each other. The penis passes without external differentiation into the epiphallus, which is sub-cylindrical. Internally the epiphallus bears ca. six smooth, continuous longitudinal pilasters. The flagellum is relatively short (ca. 1/11 the length of the phallus). The vagina is swollen and about twice as broad as the genital atrium. The spermathecal duct is sub-cylindrical, its distal part about twice as broad as its proximal part, and bearing an elongate-globose spermatheca at the distal end.

Material. — Ecuador, Prov. Pichincha, ca. 16 km N. Quito, Pomasqui (UF).

Drymaeus (Drymaeus) antioquensis (Pfeiffer, 1855)

The type specimen of this species is preserved in the British Museum (Natural History) and is here designated lectotype: shell height 29.5 mm, diameter 16.5 mm (BMNH 1975450). The label reads '[Colombia] Province of Antioquia' (ex Cuming ex Schlim).

Drymaeus (Drymaeus) arcuatostriatus (Pfeiffer, 1855)
(pl. 6 fig. 10)

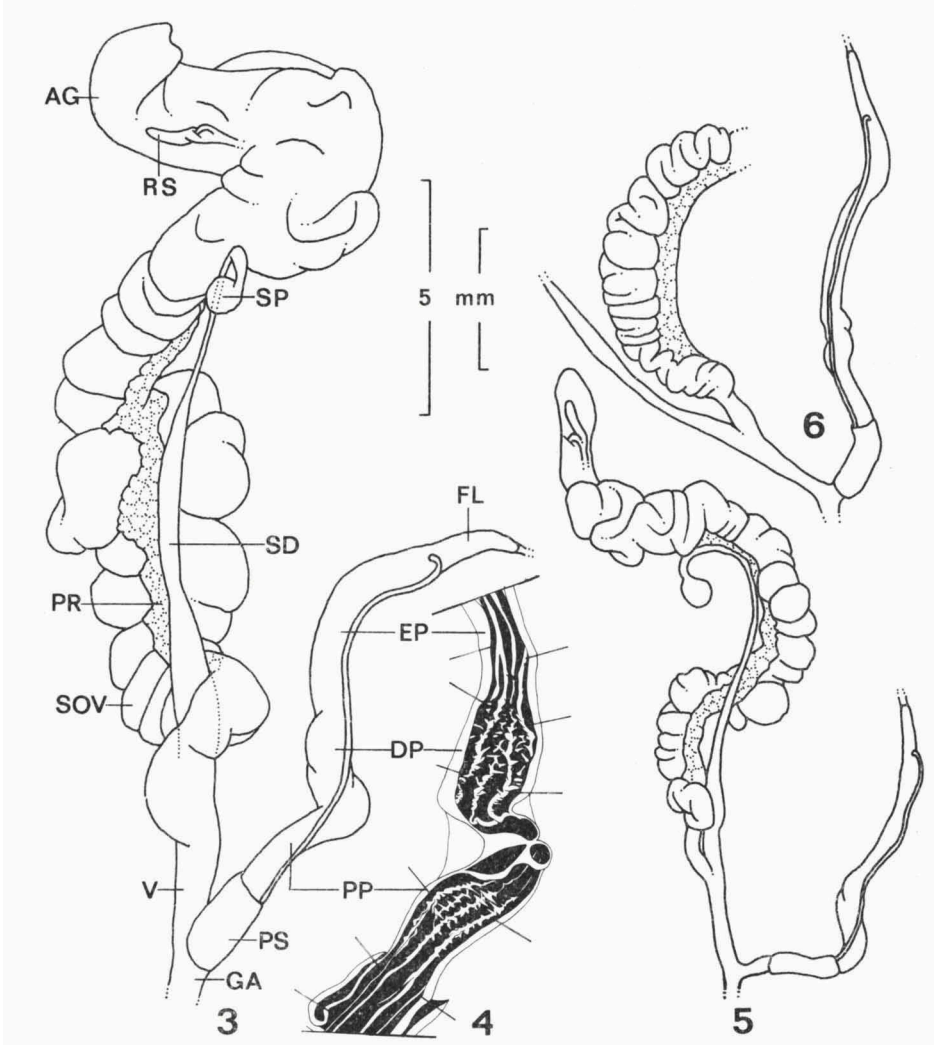
Two type specimens of this species have been located in the London museum and one is here designated lectotype: shell height 30.0 mm, diameter 16.0 mm (BMNH 1975455). The material is labelled 'Peru' (ex Cuming).

Drymaeus (Drymaeus) attenuatus (Pfeiffer, 1853)
(figs. 3-6)

From among the type specimens preserved in the British Museum (Natural History) one is here designated lectotype: shell height 34.0 mm, diameter 14.4 mm (BMNH 1975458). There are two paralectotypes and the material is labelled '[Mexico] Vera Cruz' (ex Cuming).

Until now two publications dealt with the anatomy of this species. Strebel & Pfeffer (1882) described the radula of a specimen collected somewhere in the State of Vera Cruz. Their data agree pretty well with our observations (see page 96). Solem (1955) studied the radulae of specimens originating

from Córdova and Sumidero. Comparing his data with those of Strebel & Pfeffer (1882) he found some differences in the central and first latero-marginal teeth. The genitalia were not figured by Solem (1955), but according to him they resemble those of *Drymaeus aurifluus* (Pfeiffer, 1857).



Figs. 3-6. *Drymaeus* (*D.*) *attenuatus* (Pfeiffer), genitalia. Costa Rica, Cartago (UF).

Genitalia. — Phallus relatively small. Penis with a proximal sheath (ca. 1/7 the length of the phallus), its proximal part sub-cylindrical and the distal part somewhat swollen, passing without external differentiation into the epiphallus, which is sub-cylindrical. The flagellum is short and tapering, with

the retractor muscle distally inserted. The vagina is relatively long (ca. 1/3 the length of the phallus). The spermathecal duct, which is as long as the spermoviduct, tapers and bears a globose spermatheca at the distal end. Internally, both the proximal and distal part of the penis bear ca. five longitudinal pilasters, which give off short transverse folds and thus appear serrate. At the transition between these two parts the lumen is narrowed. The epiphallus bears relatively broad and continuous longitudinal pilasters.

Material. — Costa Rica, Cartago (UF).

Drymaeus (Drymaeus) auris (Pfeiffer, 1866)
(pl. 5 fig. 1)

The type specimen of this species is preserved in the London museum and here designated lectotype: shell height 39.0 mm, diameter 22.0 mm (BMNH 1975499). The specimen is labelled 'Venezuela' (ex Cuming) and is figured here for the first time.

Drymaeus (Drymaeus) baranguillanus (Pfeiffer, 1853)

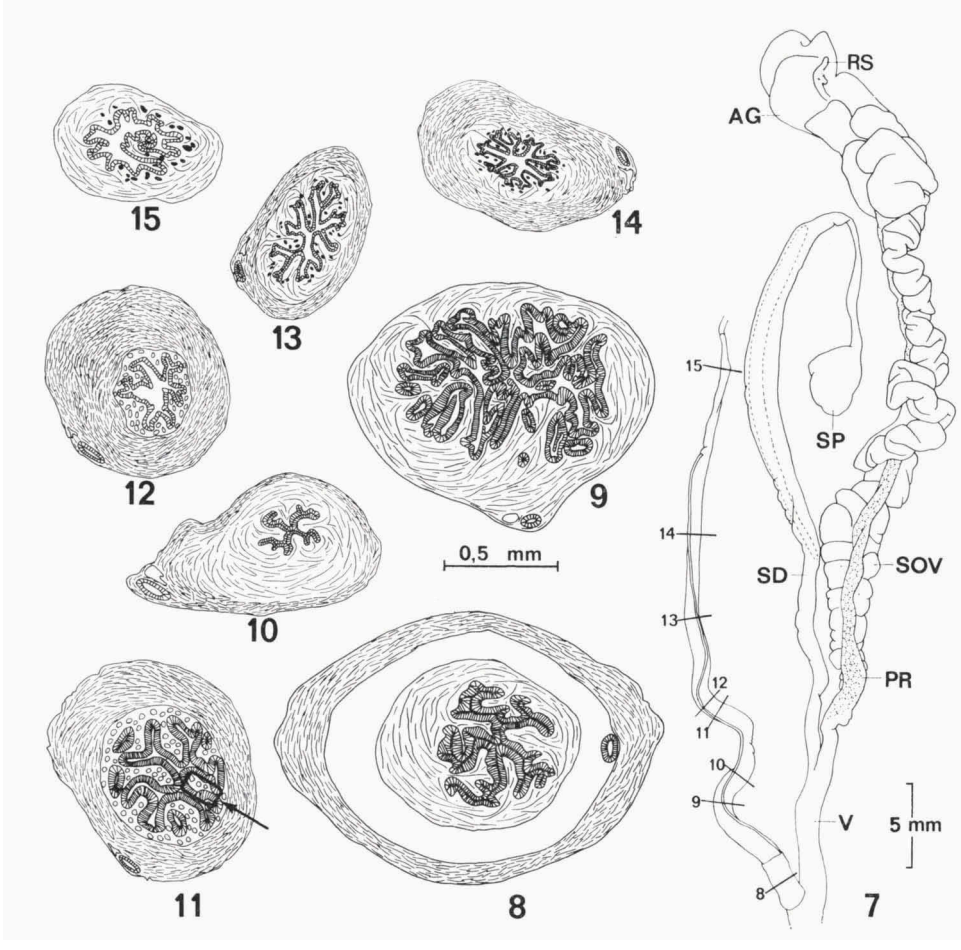
The type specimen of this species has been located in the British Museum (Natural History) and is here designated lectotype: shell height 31.5 mm, diameter 16.0 mm (BMNH 1975452). The material is labelled 'Baranguilla Andes of Colombia' (ex Cuming ex Bland).

Drymaeus (Drymaeus) beyerleanus (Hupé, 1857)
(figs. 7-16, pl. 1 fig. 4)

Genitalia. — Penis with a short proximal sheath (ca. 1/12 the length of the phallus), sub-cylindrical and passing without external differentiation into the epiphallus, which is also sub-cylindrical. At the transition between proximal and distal part the penis is somewhat constricted. The flagellum is about half as broad as the epiphallus and ca. 1/5 the length of the phallus. The vagina is rather long. The spermathecal duct is more or less sub-cylindrical in its proximal part, but is wider in its median part where a spermathophore has been observed; the distal end, which is narrow again, bears an elongate-globose spermatheca. The length of the spermathecal duct is somewhat larger than that of the spermoviduct. The spermathophore resembles that of *Drymaeus canaliculatus* (Pfeiffer, 1845) (see Breure & Eskens, 1978), but differs in the length of the initial part and the relative position of the widest part.

Histology. The lumen of the proximal part of the penis is very narrow and lined by a cylindrical epithelium (ca. 25 μm high), which more distally

becomes low-cylindrical (ca. 17 μm high) and provided with a large nucleus (ca. 10 μm diameter). At the short transition to the distal part of the penis low-cylindrical epithelium (ca. 15 μm high; the nuclei are ca. 5 μm in diameter) was observed, which lines a small and narrow lumen. The epithelium in the distal part of the penis is high-cylindrical (ca. 35 μm high); the slender epitheliumcells have a basal elongate nucleus, while secretion vesicles are observed in the distal part of these cells. The secretion product of these cells stains dark blue with alcian blue. The subepithelial tissue is typical for *Drymaeus* species: large, rounded cells with a cytoplasm that stains light blue



Figs. 7-15. *Drymaeus* (*D.*) *beyerleanus* (Hupé), genitalia and transverse sections of penis (figs. 8-12, slides H 4056, 4065, 4068, 4071), epiphallus (figs. 13-14, slides H 4073, 4076) and flagellum (fig. 15, slide H 4078). Peru, Cuzco, 21.8 km of Quillabamba (RMNH). Arrow in fig. 11 refers to plate 1 fig. 4.

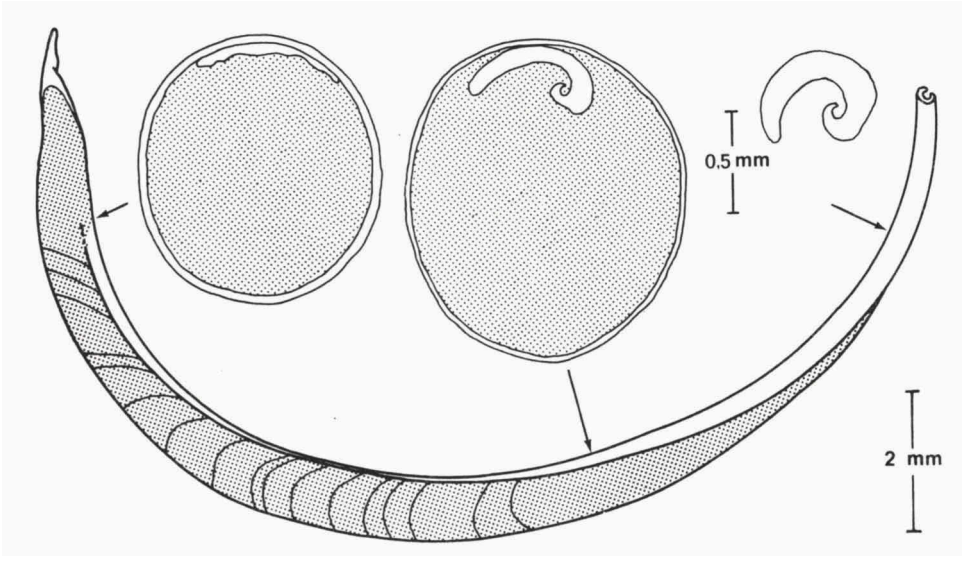


Fig. 16. *Drymaeus* (*D.*) *beyerleanus* (Hupé), spermatophore. Peru, Cuzco, 21.8 km of Quillabamba (RMNH).

with alcian blue. These cells have possibly a secretion function too (see arrow in pl. 1 fig. 4). The epithelium of epiphallus and flagellum is low, cylindrical (ca. 10-15 μm high). In the subepithelial tissue glandular cells were observed that stain dark blue with alcian blue and purple with haemalum-eosin.

Material. — Peru, Dept. Cuzco, 21.8 km of Quillabamba on the road to Ollantaïtambo, 1280 m (RMNH).

Drymaeus (Drymaeus) bivittatus (Sowerby, 1833)
(pl. 8 fig. 3)

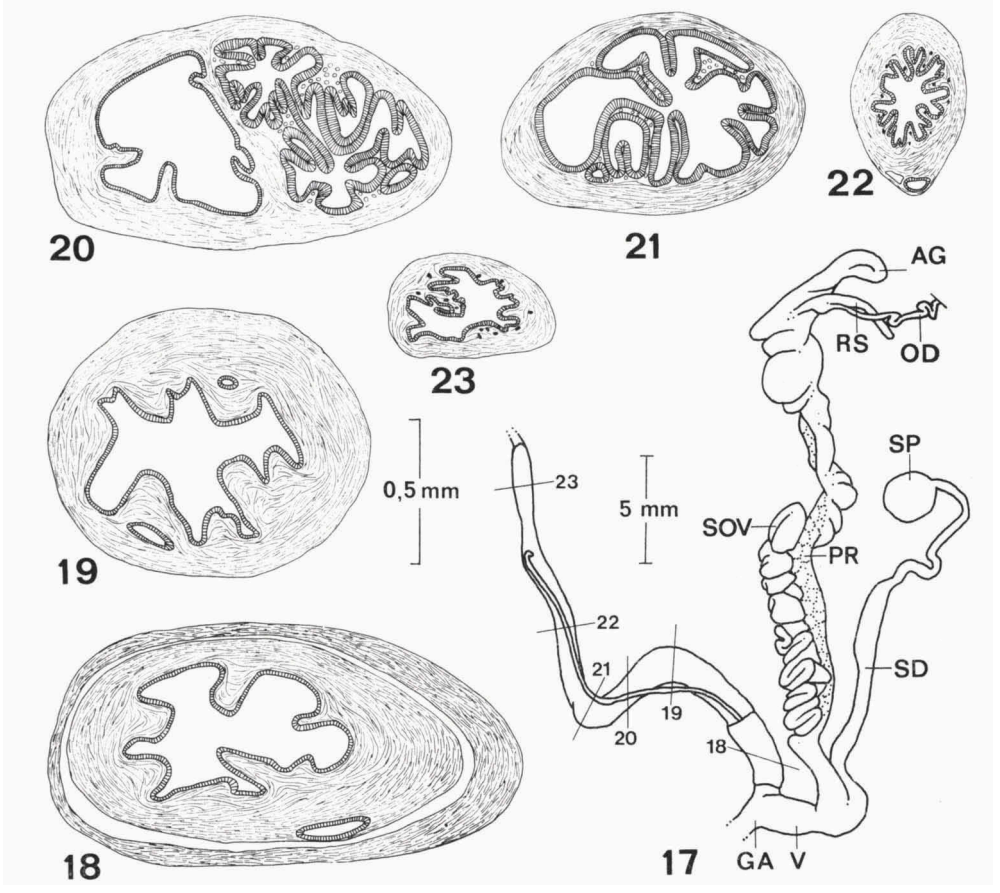
The type specimen of *Bulimus flexilabris* Pfeiffer, 1853 is preserved in the British Museum (Natural History) and is here designated lectotype: shell height 27.0 mm, diameter 14.2 mm (BMNH 1975559). The material is labelled 'Brazils' (ex Cuming).

Drymaeus (Drymaeus) bogotensis (Pfeiffer, 1855)
(figs. 17-23; pl. 8 fig. 8)

The type material of this species has been located in the London museum and a lectotype is here designated: shell height 37.5 mm, diameter 17.5 mm (BMNH 1975191). The specimen is labelled 'Santa Fé de Bogota' (ex Cuming).

Genitalia. — Penis with a rather long sheath (ca. 1/7 the length of the phallus), sub-cylindrical, passing without external differentiation into the epiphallus. The flagellum, which is ca. 1/5 the length of the phallus, is slightly swollen at the distal end, where the retractor muscle is inserted. The spermathecal duct is more or less sub-cylindrical, its distal part narrower than the proximal part; with a globose spermatheca at the distal end.

Histology. The lumen of the proximal part of the penis is lined by a low-cylindrical (cell height 13 μm) epithelium; the nuclei of these epithelium-cells are large (8 μm diameter). In the distal part, which parallels the proximal part over a length of ca. 200 μm, the lumen is narrowed by large folds of the epithelium; the cells of the epithelium are high-cylindrical (ca. 20 μm high), with basal, elongated nuclei and stain dark blue with alcian blue. The



Figs. 17-23. *Drymaeus* (*D.*) *bogotensis* (Pfeiffer), genitalia and transverse sections of penis (figs. 18-21, slides H 4195, 4197, 4198, 4199), epiphallus (fig. 22, slide H 4202) and flagellum (fig. 23, slide H 4205). Colombia, Cundinamarca, Mesitas del Colegio (RMNH).

subepithelial tissue consists of large, rounded cells. Epiphallus and flagellum with low-cylindrical epitheliumcells, which have small nuclei (ca. 3 μm diameter) and bear cilia; the length of these cilia decreases from distal flagellum to proximal epiphallus. In the subepithelial tissue glandular cells are present that stain purple with haemalum-eosin and dark blue with alcian blue.

Material. — Colombia, Cundinamarca, Mesitas del Colegio (RMNH).

Drymaeus (Drymaeus) bolivianus (Pfeiffer, 1846)

Type specimens of this species are in the London museum and one of them is designated lectotype (corresponding to Reeve, 1849: pl. 81 fig. 599): shell height 33.0 mm, diameter 14.1 mm (BMNH 1975444). The material, which includes two paralectotypes, is labelled 'Merida' and 'Bolivia' (ex Cuming).

Drymaeus (Drymaeus) bourcieri (Pfeiffer, 1853)

One specimen from among the type material preserved in the British Museum (Natural History) is designated lectotype: shell height 24.0 mm, diameter 12.8 mm (BMNH 1975446). The specimens, including two paralectotypes, are labelled 'Pichincha, Ecuador' (ex Cuming ex Bourcier).

Drymaeus (Drymaeus) buckleyi (Sowerby, 1895)
(pl. 6 fig. 12)

Two type specimens are preserved in the London museum and one is designated lectotype: shell height 27.5 mm, diameter 11.4 mm (BMNH 1907.11.21.48); the material is labelled 'Ecuador' (ex Da Costa).

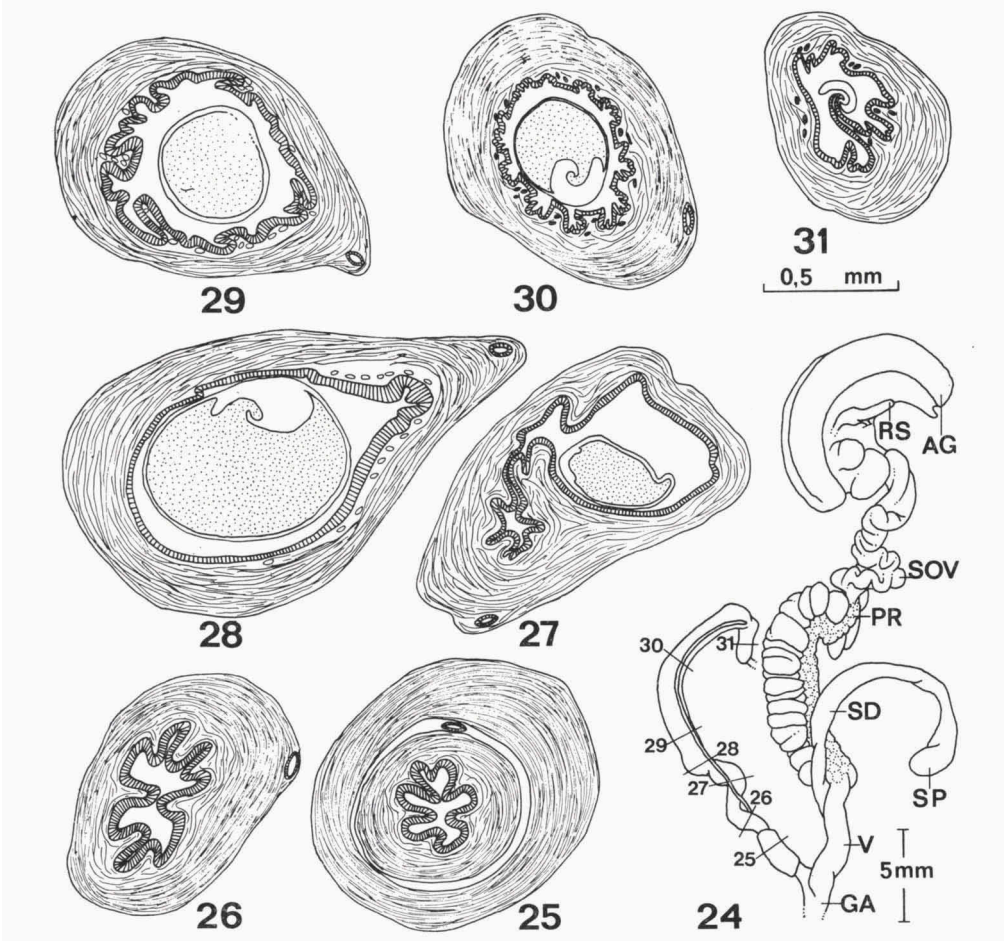
Redescription. — Shell narrowly rimate, with slightly convex sides; elongate; rather solid. Colour whitish with irregular, light to purplish brown axial streaks; on the last whorl these streaks are restricted to the upper part of the whorl, where they leave a white girdle below the suture. Surface shining and smooth. Whorls 5.4, slightly convex; suture hardly impressed. Aperture subovate, slightly oblique; whitish coloured inside. Peristome slightly thickened, expanded at lower part of palatal margin. Columellar margin hardly reflexed and triangularly dilated above. Margins white, converging; parietal callus pink-brown.

Drymaeus (Drymaeus) canaliculatus (Pfeiffer, 1845)
(figs. 24-31; pl. 5 fig. 6)

One of two type specimens, which have been located in the London museum, is here designated lectotype: shell height 36.5 mm, diameter 17.0 mm (BMNH 1975514).

Genitalia. — Penis with a sheath (ca. 1/6 the length of the phallus), sub-cylindrical, its distal part slightly swollen. The distal part of the epiphallus is also somewhat swollen externally. The flagellum is rather slender and relatively short (ca. 1/8 the length of the phallus), with a short retractor muscle at the distal end. The spermathecal duct is more or less sub-cylindrical, with an elongate-globose spermatheca at the distal end.

Histology. The epithelium of the proximal part of the penis is high-cylindrical (25-50 μm high). The lumen of the distal part of the penis is relatively wide and lined by a high-cylindrical epithelium (cell height ca. 40 μm). The cells of this epithelium are filled with secretion granules staining



Figs. 24-31. *Drymaeus* (*D.*) *canaliculatus* (Pfeiffer), genitalia and transverse sections of penis (figs. 25-29, slides H 3967, 3968, 3972, 3974, 3975), epiphallus (fig. 30, slide H 3977) and flagellum (fig. 31, slide H 3981). Peru, Pasco, Oxapampa (SMF).

dark blue with alcian blue. In the subepithelial tissue the large, rounded cells, which are present in other *Drymaeus* species, are nearly totally absent. The epithelium of epiphallus and flagellum is cubic to low cylindrical (cell height up to 15 μm). In the subepithelial tissue glandular cells are dispersed (see Breure & Eskens, 1978: pl. 1 fig. 2).

Material. — Peru, Depto. Pasco, Oxapampa (SMF).

Drymaeus (Drymaeus) championi (Martens, 1893)

A type specimen of this species has been located in the British Museum (Natural History) and is designated lectotype: shell height 27.0 mm, diameter 13.7 mm (BMNH 1901.6.22.451). The specimen, which corresponds to the original figure of Martens (1893), is labelled 'Guatemala' and 'Cerro Zunil' (ex Godman-collection).

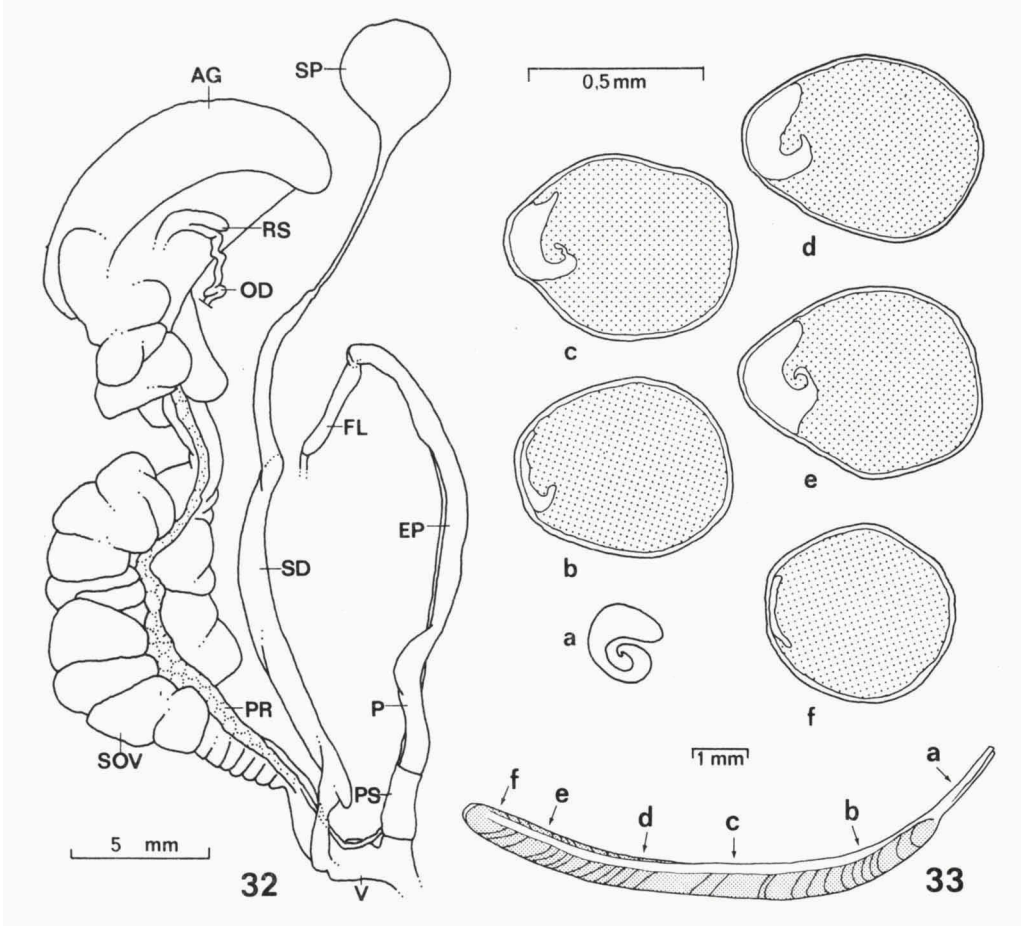
Drymaeus (Drymaeus) clathratus (Pfeiffer, 1858)
(pl. 6 fig. 9)

One specimen, which corresponds to the data given by Pfeiffer, was found in the London museum and is designated lectotype: shell height 30.0 mm, diameter 12.8 mm (BMNH 1975449). The material is labelled 'Province of Patas, Andes of Peru' (ex Cuming ex Farris).

Drymaeus (Drymaeus) cleefi spec. nov.
(figs. 32-33, pl. 5 figs. 7-8)

Description. — Shell up to 33.0 mm, 1.75 times as long as wide, imperforate, with hardly convex sides; rather elongate; moderately solid. Colour whitish yellow with brown, slightly undulating axial streaks; the intervals in between are twice as broad as the streaks. Surface rather shining, with incrassate growth striae that form whitish lines in appearance. Protoconch with a grating sculpture of axial riblets and spiral striae, which are of equal strength. Whorls 5.1, slightly convex; suture well impressed, descending in front. Aperture broadly subovate, skewed, the margins converging; 1.56 times as long as wide, 0.54 times the total length. Peristome thin and simple. Columellar margin thin, receding. Parietal region with a thin callus.

Genitalia. — Penis with a sheath (ca. 1/8 the length of the phallus), subcylindrical, slightly swollen at the transition to the epiphallus, which is relatively long. The flagellum is ca. 1/5 the length of the phallus and is tapering. The vagina is relatively short and broad. The spermathecal duct is more or less sub-cylindrical, its distal part very narrow; the spermatheca is globose. The spermatophore is cylindrical.



Figs. 32-33. *Drymaeus* (*D.*) *cleefi* spec. nov., genitalia and spermatophore. Colombia, Santander, Piedra de Molino (RMNH).

Type material. Colombia, Depto. Santander, Páramo del Almorzadero (06°59'N 72°44'W), Piedra de Molino, 4225 m (A. M. Cleef, J. Aguirre & H. Hooghiemstra leg., 17-XI-1978). Holotype RMNH 55375. Paratypes RMNH 55376/8, ICNB/9.

Remarks. — In the field specimens have been observed at several other localities nearby the type locality, at altitudes of 4175-4350 m. This is the first record of a *Drymaeus* species from altitudes above 4000 m.

Comparisons. — This new species does not closely resemble any other taxon of *Drymaeus*.

Etymology. — Named in honour of Dr. Antoine M. Cleef, eminent specialist of the Colombian páramo flora and fauna.

Measurements (in mm):

shell		aperture		height of	number of	
height	diameter	height	width	last whorl	whorls	
33.0	18.2	17.0	11.8	28.0	5.2	holotype
32.0	17.0	17.5	10.7	26.0	5.2	
27.0	14.5	14.5	8.7	21.5	5.0	(subadult)
25.5	17.0	14.4	9.2	21.0	4.8	(subadult)
26.0	15.5	14.3	9.7	21.0	5.0	(subadult)

Ecology. — The species was found on rocks and in rock-chasms. According to the collectors, who, during the same trip, also visited the páramo of Cocuy, the species is limited to the limestone massif of the Páramo del Almorzadero. The specimens were found in the transitionzone between the grass-páramo and super-páramo, which is the 'upper condensation zone' in this area. The (micro)climatological conditions at the type locality (viz. only occasional occurrence of frost, higher humidity) probably explain why Bulimulidae do not occur in an ecological similar area like the Cocuy.

Drymaeus (Drymaeus) coarctatus (Pfeiffer, 1845)
(pl. 5 fig. 5)

Type specimens of this species are preserved in the British Museum (Natural History) and one specimen is designated lectotype: shell height 34.5 mm, diameter 20.5 mm (BMNH 1975560). The material, which includes one paralectotype, is labelled 'Brazil' (ex Cuming).

Drymaeus (Drymaeus) confluens (Pfeiffer, 1855)
(pl. 8 fig. 1)

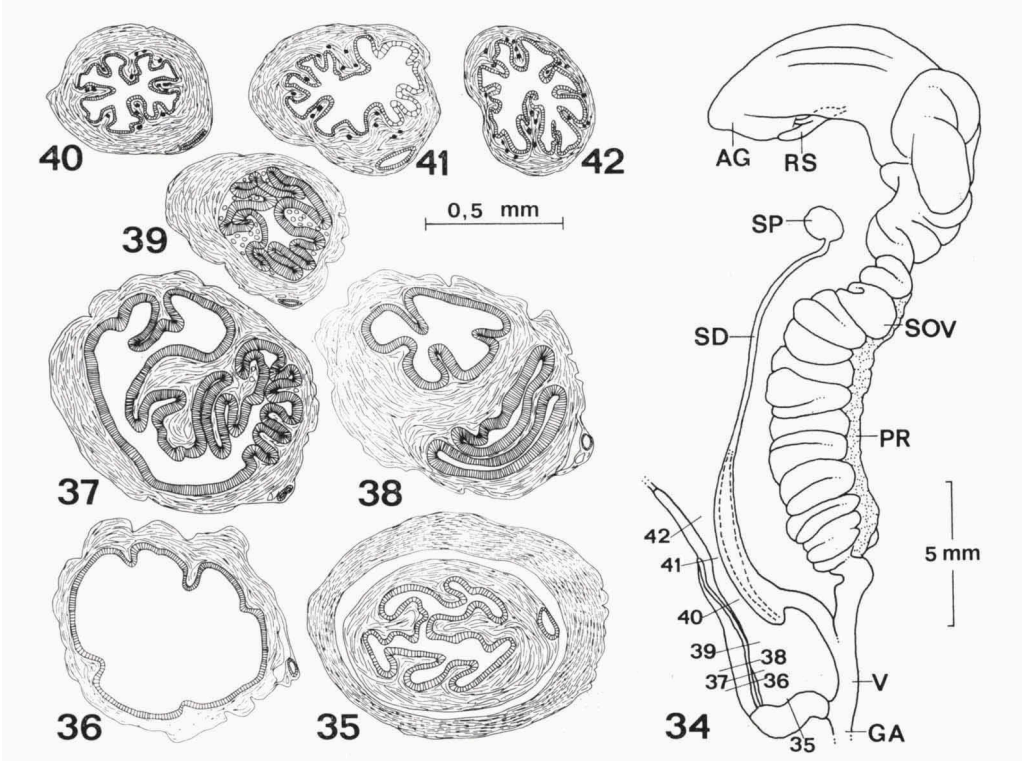
A type specimen of this species is present in the London museum and is designated lectotype: shell height 39.5 mm, diameter 22.0 mm (BMNH 1975196). The specimen is labelled 'New Granada' (ex Cuming).

Drymaeus (Drymaeus) convexus (Pfeiffer, 1855)
(pl. 8 fig. 7)

A lectotype is designated from among the type specimens located in the London museum: shell height 38.5 mm, diameter 16.5 mm (BMNH 1975192). The material is labelled 'Ecuador' (ex Cuming).

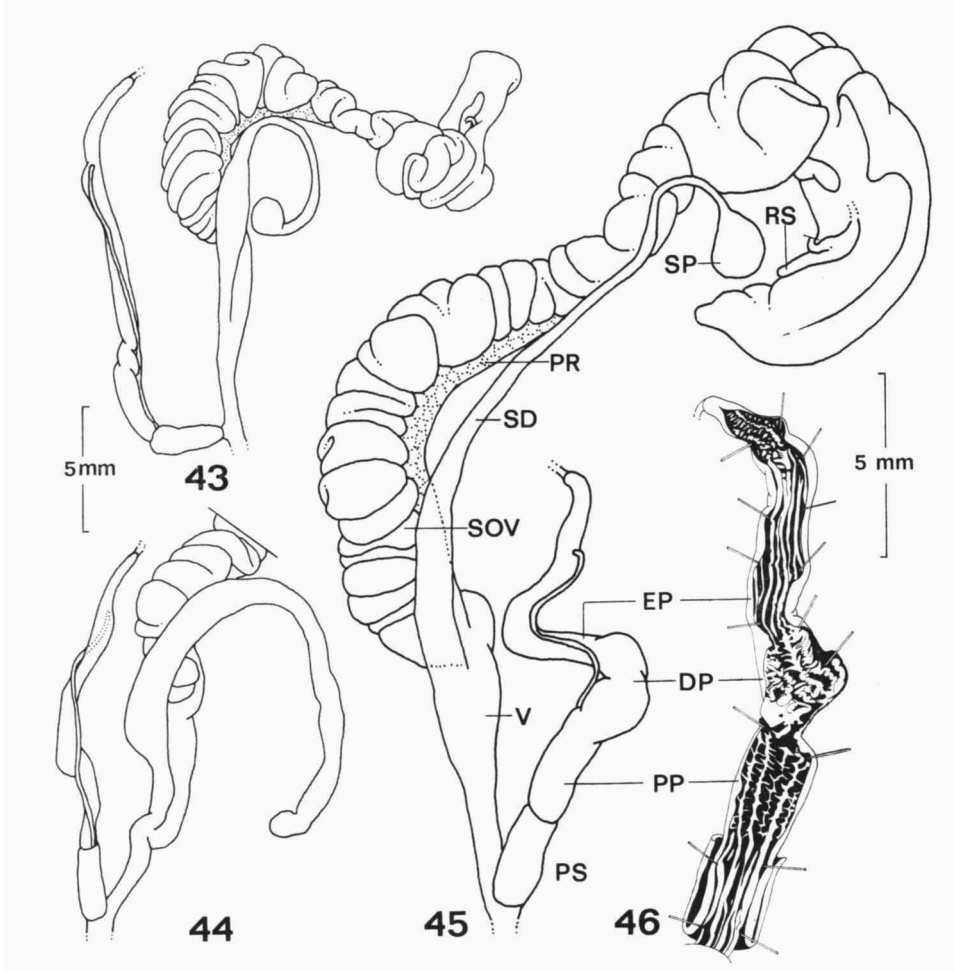
Drymaeus (Drymaeus) costaricensis (Pfeiffer, 1862)
(figs. 34-47)

Genitalia. — Phallus relatively small. Penis with a sheath (ca. 1/5 the length of the phallus), subcylindrical or its distal part slightly swollen. The epiphallus is sub-cylindrical and relatively long. The flagellum is tapering, ca. 1/5 the length of the phallus. Vagina relatively long. The spermathecal duct is rather broad, tapering towards the globose spermatheca. The spermatophore is spool-shaped, its proximal part pointed.



Figs. 34-42. *Drymaeus* (*D.*) *costaricensis* (Pfeiffer), genitalia and transverse sections of penis (figs. 35-39, slides H 4147, 4149, 4150 (2x), 4151), epiphallus (figs. 40-41, slides H 4153, 4154) and flagellum (fig. 42, slide H 4155). Nicaragua, 1.5 mi E. Matagalpa (UF).

Histology. The proximal part of the penis has a relatively wide lumen lined by a low-cylindrical epithelium (cell height 13-17 μm), the cells of which have small, central nuclei of ca. 5 μm diameter. The lumen is constricted at the transition between proximal and distal part of the penis and, again, slightly constricted between distal part of the penis and epiphallus. The epithelium of the distal part of the penis is high-cylindrical (ca. 25-40 μm



Figs. 43-46. *Drymaeus* (*D.*) *costaricensis* (Pfeiffer), genitalia. Nicaragua, 1.5 mi E. Matagalpa (UF).

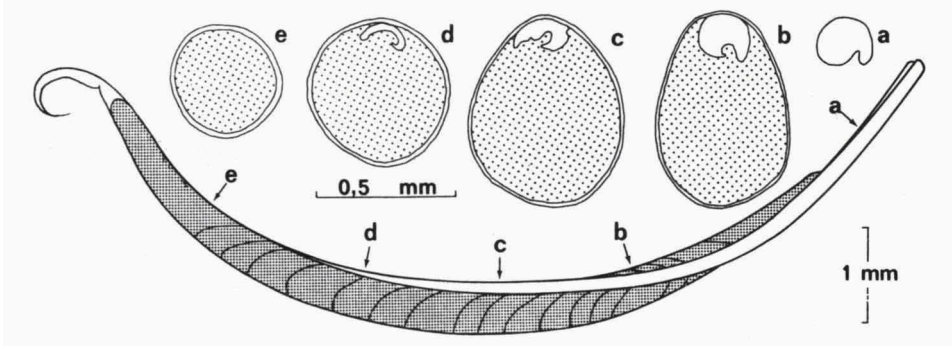
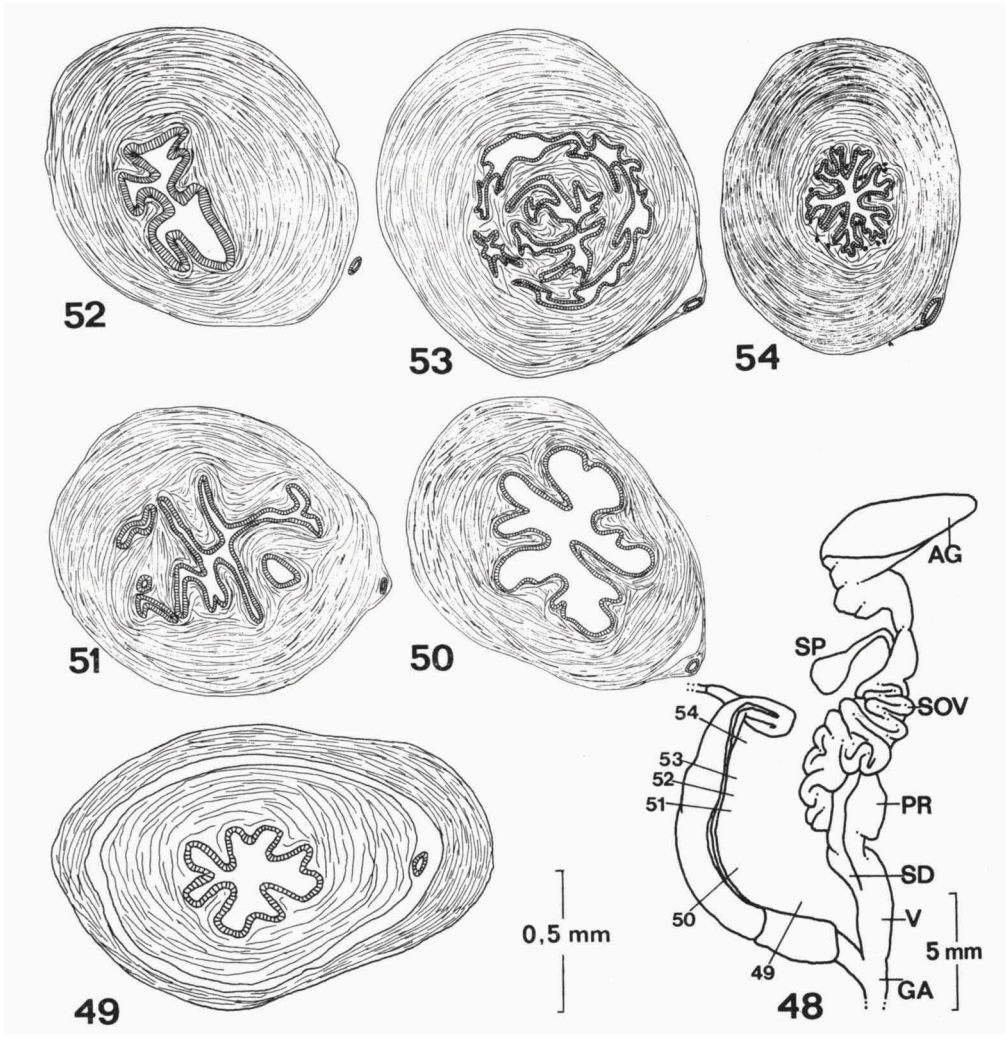


Fig. 47. *Drymaeus* (*D.*) *costaricensis* (Pfeiffer), spermatophore. Nicaragua, 1.5 mi E. Matagalpa (UF).



Figs. 48-54. *Drymaeus* (*D.*) *decoratus* (Lea), genitalia and transverse sections of penis (figs. 49-53, slides H 1637, 1640, 1645, 1646, 1647) and epiphallus (fig. 54, slide H 1649). Ecuador, Llanganate (NRS).

high); the cells contain secretion granules staining dark blue with alcian blue and pink with haemalum-eosin. The subepithelial tissue consists of large, rounded cells. The epiphallus and flagellum have a cubic epithelium of ca. 13 μm high, with cilia of ca. 5 μm in length. Glandular cells are dispersed in the subepithelial tissue of both structures. A longitudinal section through the phallus is shown in fig. 46.

Material. — Nicaragua, 1.5 mi E. of Matagalpa, 2700 feet (UF).

Drymaeus (Drymaeus) cuticulus (Pfeiffer, 1855)

The type specimen (BMNH 1975451), which is preserved in the British Museum (Natural History), proves to be immature; its measurements are: shell height 27.5 mm, diameter 13.4 mm. The material is labelled 'Brazil', 'Rio' (ex Cuming).

Drymaeus (Drymaeus) decoratus (Lea, 1838)
(figs. 48-54)

Genitalia. — Penis with a sheath (ca. 1/6 the length of the phallus), sub-cylindrical, passing without external differentiation into the epiphallus. The flagellum is tapering, ca. 1/5 the length of the phallus. The vagina is rather short. Spermathecal duct sub-cylindrical, its distal part narrow; the spermatheca is elongate-globose.

Histology. The lumen of the proximal part of the penis is narrowed by infoldings and lined by a low-cylindrical epithelium (cell height ca. 18 μm, diameter of nuclei ca. 5 μm). The epithelium of the distal part of the penis is high-cylindrical (ca. 25 μm high) and the cells have a large, basal nucleus (ca. 8 μm diameter); this part of the penis produces a secretory product that stains dark blue with alcian blue. The epithelium of epiphallus and flagellum is cubic and ca. 10 μm high. The subepithelial glandular cells stain dark blue with alcian blue.

Material. — Ecuador, Llanganate, near Río Parcayalu, 300 m (NRS).

Drymaeus (Drymaeus) draparnaudi (Pfeiffer, 1847)

The specimen figured by Reeve, 1848: fig. 116b is here designated lectotype. This taxon corresponds to *Helix torallyi* var. B of d'Orbigny (see Breure, 1976: 1150). Nine syntypes of this variety are in the London museum (catalogue of the d'Orbigny-collection, number 166) and are labelled 'pampa ruiz (Laguna) Bolivia' (see Breure, 1973: 129, fig. 4).

Drymaeus (Drymaeus) dunkeri (Pfeiffer, 1846)
(pl. 6 fig. 2)

A lectotype is designated from among the type material present in the British Museum (Natural History): shell height 35.0 mm, diameter 18.5 mm (BMNH 1975512). The material, including two paralectotypes, is labelled 'Michoacan [Mexico]' (ex Cuming).

Drymaeus (Drymaeus) expansus (Pfeiffer, 1848)
(fig. 55)

Genitalia. — Penis with a sheath (ca. 1/5 the length of the phallus), subcylindrical, passing without external differentiation into the epiphallus. The flagellum is slightly tapering, ca. 2/9 the length of the phallus. The spermathecal duct is more or less tapering; the spermatheca is elongate-globose.

Material. — Peru, Dept. Amazonas, Río Ceupa, San Antonio (UF).

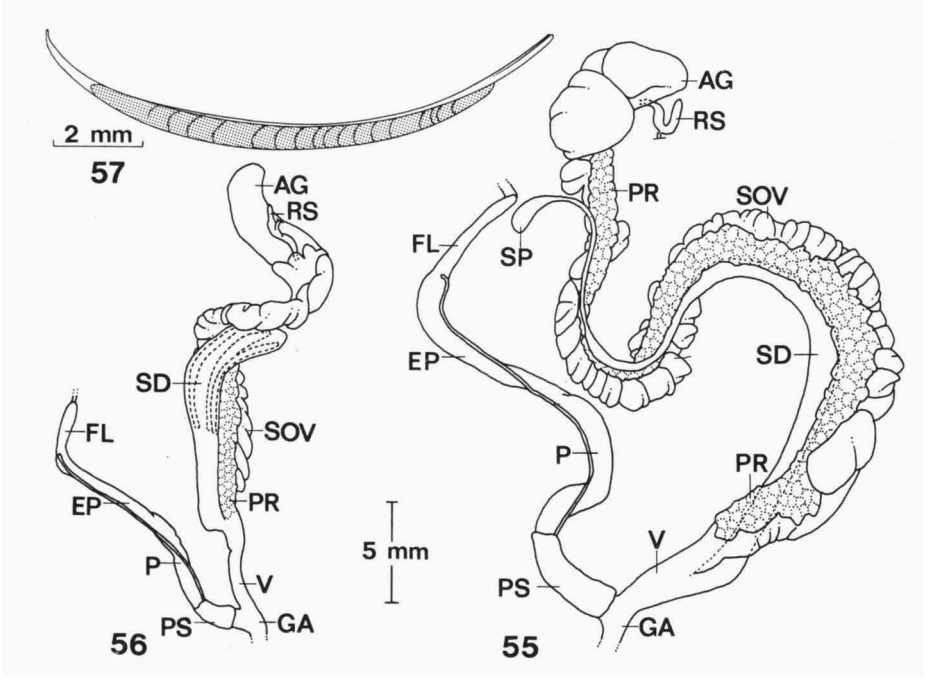


Fig. 55. *Drymaeus* (*D.*) *expansus* (Pfeiffer), genitalia. Peru, Amazonas, San Antonio (UF).
Figs. 56-57. *Drymaeus* (*D.*) *fenestrellus* (Martens), genitalia and spermatophore. Mexico, Michoacán, El Tigre (UF).

Drymaeus (Drymaeus) expatriatus (Preston, 1909)

Two type specimens of this species are preserved in the London museum and one is designated lectotype: shell height 28.5 mm, diameter 11.7 mm (BMNH 1975201). The material is labelled 'E. Bolivia' (ex Preston).

Drymaeus (Drymaeus) fabrefactus (Reeve, 1848)
(pl. 5 fig. 4)

The specimen corresponding to Reeve, 1848: fig. 319, is designated lectotype: shell height 38.5 mm, diameter 17.0 mm (BMNH 1975531). The material is labelled 'New Granada' (ex Cuming).

Drymaeus (Drymaeus) farrisi (Pfeiffer, 1858)
(figs. 58-66)

The specimen originally figured by Pfeiffer (1858: pl. 42 fig. 8) has been located in the London museum and is designated lectotype: shell height 47.0 mm, diameter 19.0 mm (BMNH 1975506). The material, which include four paralectotypes, is labelled 'Province of Patas, Andes of Peru' (ex Cuming ex Farris).

Genitalia. — Penis without a sheath, more or less sub-cylindrical and passing without external differentiation into the epiphallus. The flagellum is sub-cylindrical, ca. 1/5 the length of the phallus. Vagina and spermathecal duct are sub-cylindrical; the distal part of the spermathecal duct is narrow and bears a globose spermatheca.

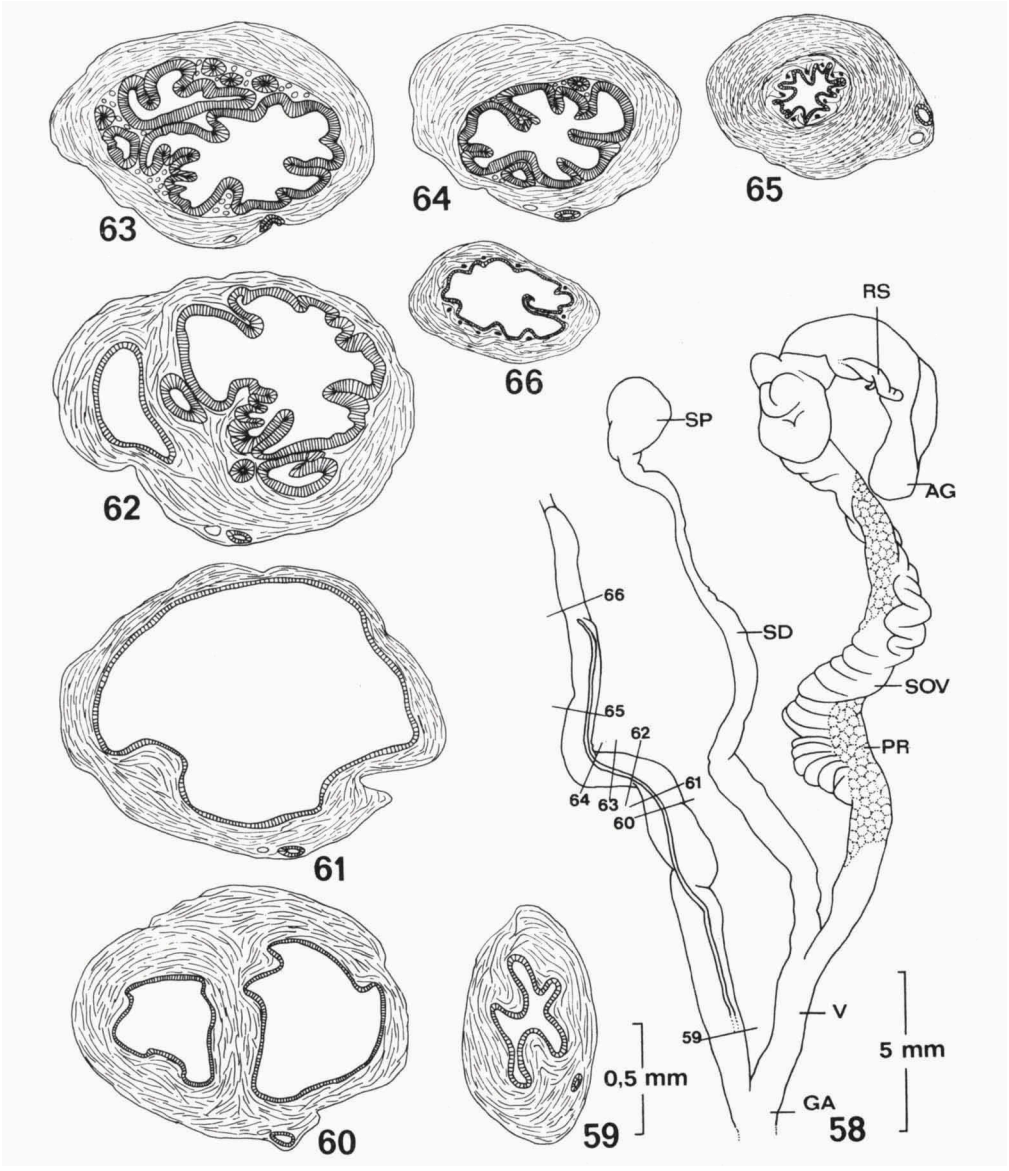
Histology. Proximal part of the penis with a narrow lumen, lined by high-cylindrical, pseudostratified epithelium (25 μm high). More distally the infoldings disappear and the epithelium is cubic (cell height 12 μm). The distal part of the penis is characterized by a complex lumen, with several blind-ending branches, and a high-cylindrical epithelium, (30 μm high), which contains secretion granules staining dark blue with alcian blue. The epithelium of both epiphallus and flagellum is cubic (cell height 10 μm); the cilia decrease in length from 10 μm (distal flagellum) to 6 μm (proximal epiphallus). Glandular cells, which stain dark blue with alcian blue, are dispersed in the subepithelial tissue of epiphallus and flagellum.

Material. — Peru, Dept. La Libertad, Río Chusgon, Santa Rosa, 1800 m (SMF).

Drymaeus (Drymaeus) fenestratus (Pfeiffer, 1846)
(figs. 67-76; pl. 5 fig. 12)

A label in Pfeiffer's handwriting accompanies a type specimen in the British Museum (Natural History) that is designated lectotype: shell height 44.0 mm, diameter 20.5 mm (BMNH 1975525). The specimen, which is labelled 'Mexico' (ex Cuming), corresponds to Reeve's figure (1848: fig. 214).

Genitalia. — Penis with a proximal sheath, sub-cylindrical, passing with-

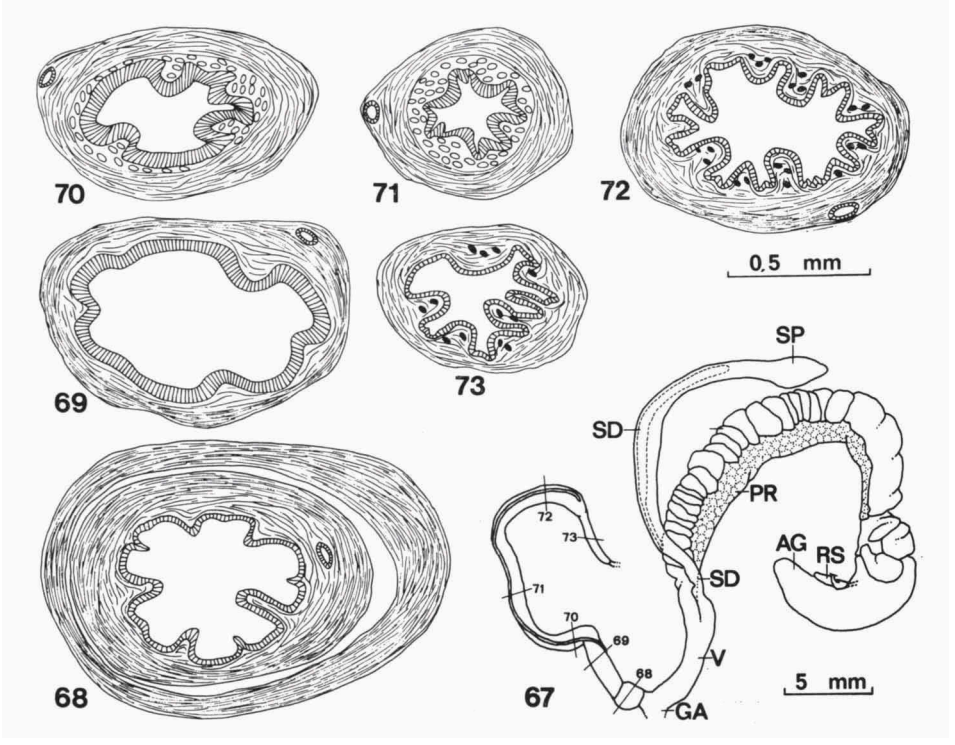


Figs. 58-66. *Drymaeus* (*D.*) *farrisi* (Pfeiffer), genitalia and transverse sections of penis (figs. 59-64, slides H 3992, 3996, 3997, 3998, 3999, 4000), epiphallus (fig. 65, slide H 4003) and flagellum (fig. 66, slide H 4005). Peru, La Libertad, Santa Rosa (SMF).

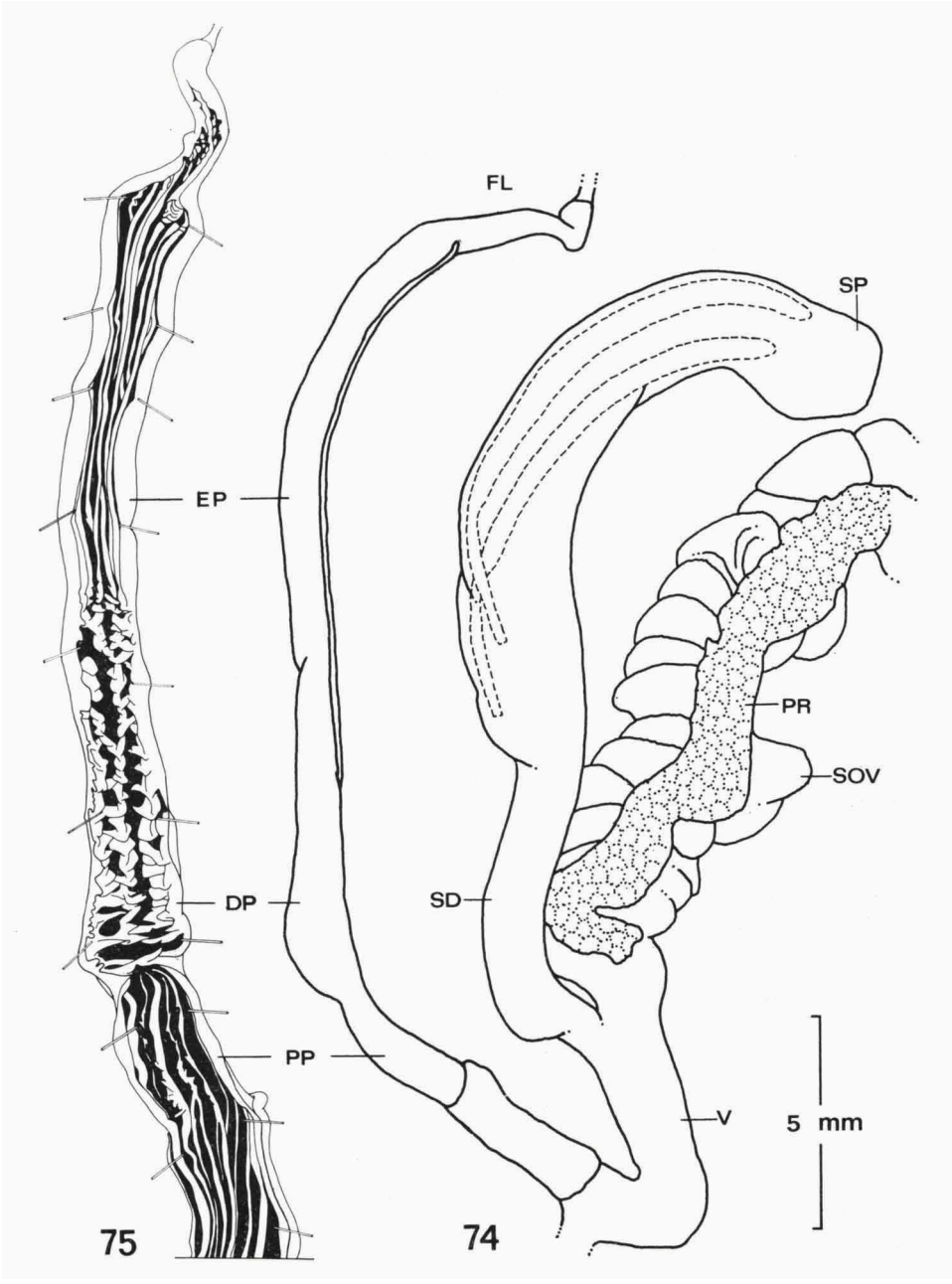
out external differentiation into the epiphallus. The flagellum is sub-cylindrical, ca. 1/6 the length of the phallus. The vagina is rather long, sub-cylindrical. The spermathecal duct is sub-cylindrical, its distal part rather wide; the spermatheca is more or less undifferentiated; spermatheca and duct are shorter than the spermoviduct. The spermatophore is spool-shaped, with the distal part broadest; the proximal part is hardly pointed.

Histology. Proximal part of the penis with a rather wide lumen, which is lined by low-cylindrical epithelium (ca. 15 μm high). The epithelium of the distal part of the penis is high-cylindrical (30-50 μm high), while the subepithelial tissue consists of rounded cells. The epiphallus has a low-cylindrical, ciliated epithelium of ca. 15 μm high. Glandular cells are dispersed in the subepithelial tissue of the epiphallus and flagellum.

Material. — Mexico, Jalisco, 9.1 mi SE San Vicente (UF) [fig. 67]; Mexico, Michoacán, 4.4 mi S Capacuano (UF) [fig. 74].



Figs. 67-73. *Drymaeus* (*D.*) *fenestratus* (Pfeiffer), genitalia and transverse sections of penis (figs. 68-71, slides H 5463, 5467, 5468, 5471), epiphallus (fig. 72, slide H 5476) and flagellum (fig. 73, slide H 5479). Mexico, Jalisco, 9.1 mi SE. San Vicente (UF).



Figs. 74-75. *Drymaeus* (*D.*) *fenestratus* (Pfeiffer), genitalia. Mexico, Michoacán, 4.4 mi S. Capacuano (UF).

Drymaeus (Drymaeus) fenestrellus (Martens, 1864)
(figs. 56-57)

Genitalia. — Penis with a sheath (ca. 1/7 the length of the phallus), sub-cylindrical, passing without external differentiation into the epiphallus. The flagellum is sub-cylindrical and ca. 1/6 the length of the phallus. Vagina relatively long. Spermathecal duct and spermatheca undifferentiated, club-shaped and shorter than spermoviduct. The spermatophores are spool-shaped, with the proximal part pointed.

Material. — Mexico, Michoacán, near El Tigre (UF).

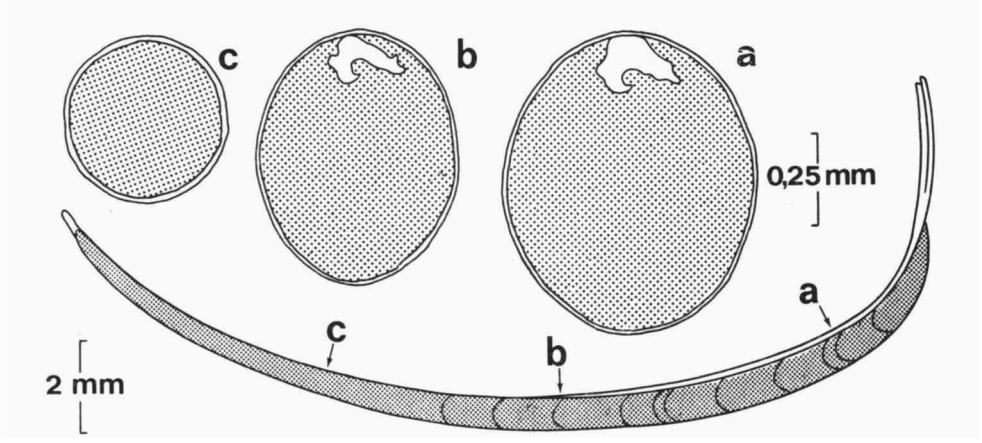


Fig. 76. *Drymaeus* (*D.*) *fenestratus* (Pfeiffer), spermatophore. Mexico, Michoacán, 4.4 mi S. Capacuano (UF).

Drymaeus (Drymaeus) feriatus (Reeve, 1848)

Type specimens of this species have been located in the London museum and one is designated lectotype: shell height 29.5 mm, diameter 11.9 mm (BMNH 1975204). The material, which includes two paralectotypes, is without locality label and originates from the Cuming-collection.

Drymaeus (Drymaeus) flexuosus (Pfeiffer, 1853)
(pl. 5 fig. 3)

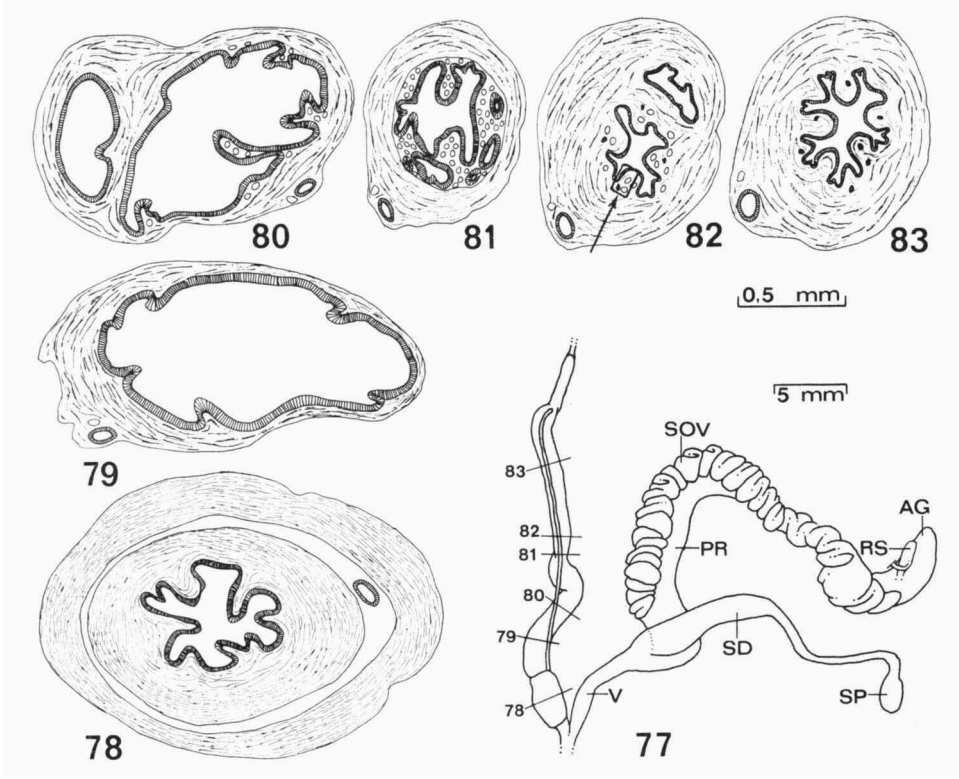
A lectotype is designated from among the specimens preserved in the British Museum (Natural History): shell height 39.5 mm, diameter 20.0 mm (BMNH 1975202). The material, which includes two paralectotypes, is labelled 'Marinata, New Granada' (ex Cuming). Pilsbry (1898: 209) mentions Marmato as type locality. The redescription given by him is not entirely correct, as the columella is without a strong fold in the London specimens.

Drymaeus (Drymaeus) geometricus (Pfeiffer, 1846)
(pl. 8 fig. 2)

Three type specimens of this species are present in the London museum and one of them is designated lectotype: shell height 35.0 mm, diameter 17.5 mm (BMNH 1975564). The material originates from the Cuming-collection and is labelled 'Valley of the Madeleine, New Granada'.

Drymaeus (Drymaeus) gueinzii (Pfeiffer, 1857)
(pl. 6 fig. 8)

A type specimen of this species has been located in the British Museum (Natural History) and is designated lectotype: shell height 23.0 mm, diameter 10.8 mm (BMNH 1975539). The material is labelled '[Peru] Meobamba' (ex Cuming ex Gueinzius). The species is here figured for the first time.



Figs. 77-83. *Drymaeus* (*D.*) *hygrohylaeus* (d'Orbigny), genitalia and transverse sections of penis (figs. 78-82, slides H 4209, 4215, 4219, 4222, 4223) and epiphallus (fig. 83, slide H 4227). Bolivia, 65 km from Santa Cruz (UF). Arrow in fig. 82 refers to plate 1 fig. 3.

Drymaeus (Drymaeus) hepatostomus (Pfeiffer, 1861)
(pl. 8 fig. 10)

Type material of this taxon has been found in the London museum and one specimen is designated lectotype: shell height 30.5 mm, diameter 15.5 mm (BMNH 1975571). The material includes one paralectotype and is labelled 'Tepenistlahuaca, Mexico' (ex Cuming ex Boucard).

Drymaeus (Drymaeus) hygrohylaeus (d'Orbigny, 1835)
(figs. 77-83)

Genitalia. — Penis with a sheath (ca. 1/6 the length of the phallus), sub-cylindrical, passing without external differentiation into the epiphallus. The flagellum is sub-cylindrical, half as broad as the epiphallus and ca. 1/6 the length of the phallus. The vagina is rather long. The spermathecal duct is more or less tapering, with an elongate-globose spermatheca at the distal end.

Histology. Penis with high-cylindrical epithelium (cell height 25-30 μm); the lumen is wide in the proximal part and narrow and complex in the distal part. Epiphallus and flagellum with a cubic to low-cylindrical epithelium and subepithelial glandular cells.

Material. — Bolivia, 65 km from Santa Cruz de la Sierra (UF).

Drymaeus (Drymaeus) inclinatus (Pfeiffer, 1862)
(pl. 8 fig. 9)

Three type specimens of this species are in the British Museum (Natural History) and the one that corresponds to Pfeiffer's original figure is designated lectotype: shell height 33.5 mm, diameter 17.0 mm (BMNH 1975532). The material is labelled 'New Granada' (ex Cuming).

Drymaeus (Drymaeus) lattrei (Pfeiffer, 1846)

The specimen corresponding to the most lefthand figure of Pfeiffer's original publication (Pfeiffer in Philippi, 1846: pl. 4 fig. 11) is designated lectotype: shell height 42.5 mm, diameter 23.0 mm (BMNH 1975555). The material includes two paralectotypes and is labelled 'Vera Cruz' (ex Cuming).

Drymaeus (Drymaeus) lilacinus (Reeve, 1849)

A type specimen of the junior subjective synonym *Otostomus lilacinus jansoni* Martens, 1893, is designated lectotype: shell height 46.0 mm, diameter 22.0 mm (BMNH 1901.6.22.951). The specimen is labelled 'Nicaragua' (ex Godman-collection ex Janson).

Another synonym is *Bulimus patricius* Reeve, 1849, of which a lectotype is present in the London museum: shell height 52.5 mm, diameter 24.5 mm (BMNH 1874.12.11.220).

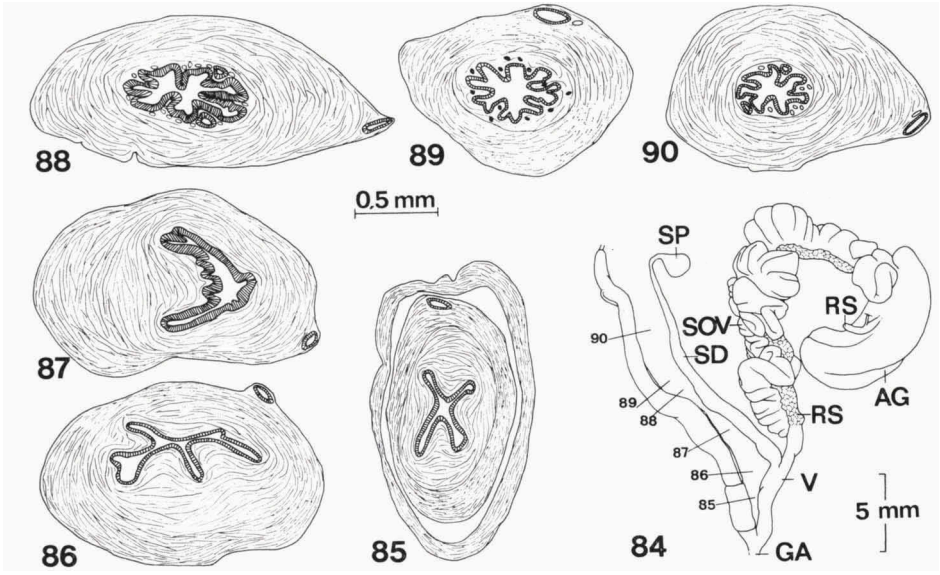
Drymaeus (Drymaeus) malleatus (Da Costa, 1898)

The holotype is preserved in the London museum (BMNH 1907.11.21.130) and is here redescribed.

Shell rimate, with nearly straight sides; rather thin. Colour whitish, with irregular longitudinal streaks of light yellowish-brown. Surface rather shining, with irregular longitudinal malleation. Whorls nearly flat; suture hardly impressed. Aperture subovate, hardly oblique. Peristome thickened, expanded and reflexed. Columellar margin broadly dilated, reflexed. Shell height 34.5 mm, diameter 16.0 mm.

Drymaeus (Drymaeus) morbidus (Philippi, 1867)
(figs. 84-90)

Genitalia. — Penis with a sheath (ca. 1/6 the length of the phallus), sub-cylindrical, passing without external differentiation into the epiphallus. The flagellum is sub-cylindrical and about as long as the penis sheath. The vagina is rather long. The spermathecal duct is more or less tapering; the spermatheca is globose.



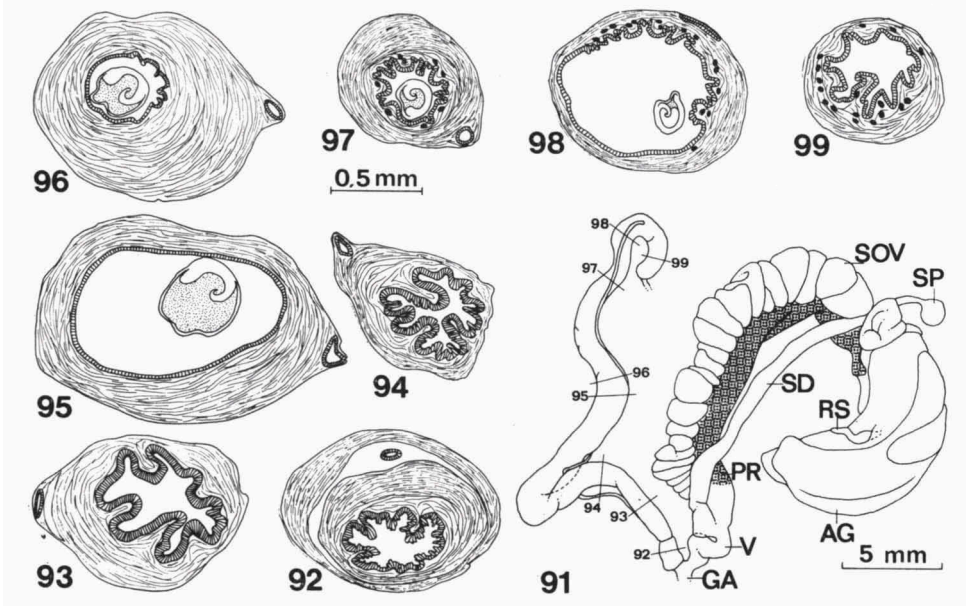
Figs. 84-90. *Drymaeus* (*D.*) *morbidus* (Philippi), genitalia and transverse sections of penis (figs. 85-88, slides H 4012, 4013, 4016, 4022) and epiphallus (figs. 89-90, slides H 4023, 4026). Peru, Chorobamba (SMF).

Histology. Proximal part of the penis with a high-cylindrical, pseudo-stratified epithelium (ca. 50 μm high), but towards the genital atrium the epithelium is low-cylindrical and ca. 15 μm high. The lumen of the distal part is complex and lined by a high-cylindrical epithelium of ca. 25 μm high; the nuclei of these cells are ca. 9 μm in diameter. Subepithelial tissue with relatively few, rounded cells. The epithelium of the epiphallus is cubic (cell height 10 μm); in the subepithelial tissue glandular cells staining dark blue with alcian blue are present.

Material. — Peru, Chorobamba, 1500 m (SMF).

Drymaeus (Drymaeus) nystianus (Pfeiffer, 1853)
(figs. 91-99)

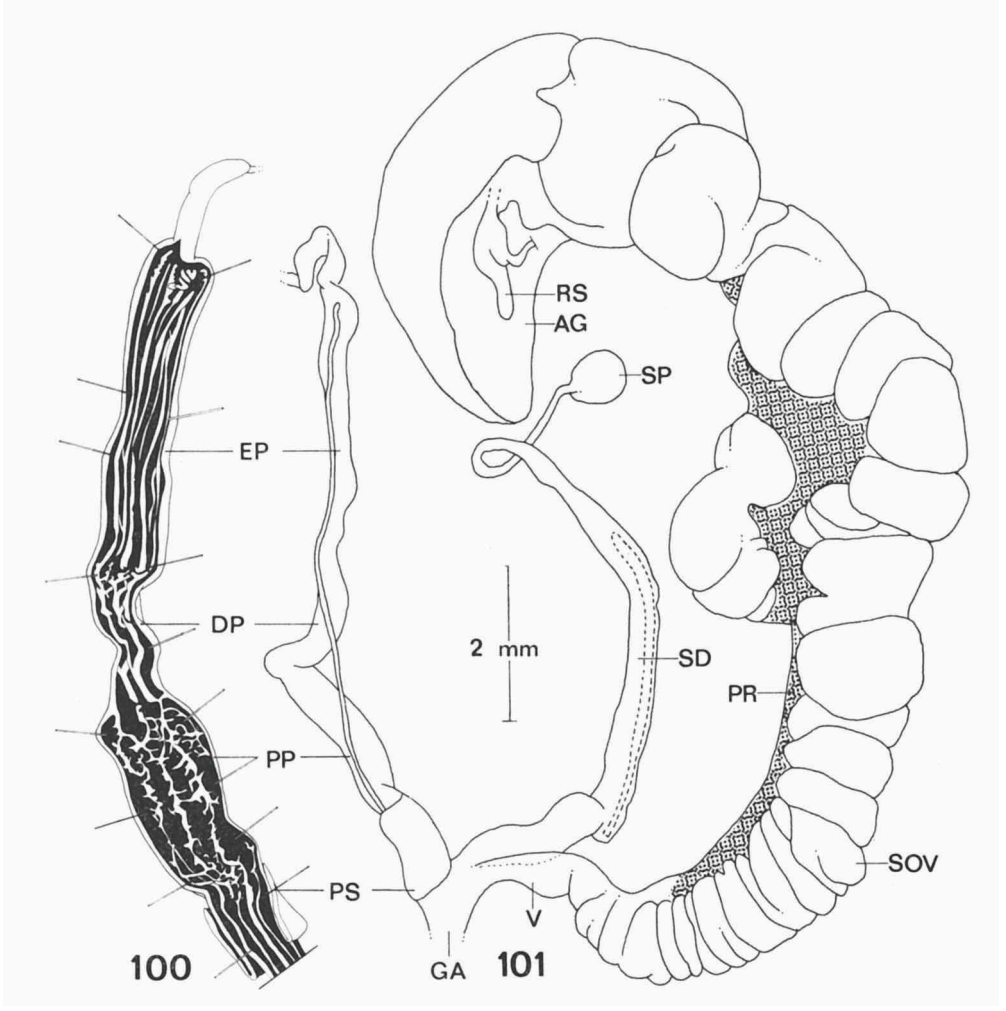
Genitalia. — Penis with a very short sheath (ca. 1/20 the length of the phallus), more or less sub-cylindrical, its proximal half nearly half as broad as the distal part and passing without external differentiation into the epiphallus. The flagellum is as broad as the epiphallus, sub-cylindrical and ca. 1/10 the length of the phallus. Vagina rather short. The spermathecal duct is more or less sub-cylindrical, with a relatively small, globose spermatheca at the distal end.



Figs. 91-99. *Drymaeus* (*D.*) *nystianus* (Pfeiffer), genitalia and transverse sections of penis (figs. 92-96, slides H 5420, 5426, 5431, 5441, 5444), epiphallus (figs. 97-98, slides H 5445, 5446) and flagellum (fig. 99, slide H 5445). Ecuador, Pichincha, Pomasqui (UF).

Histology. Proximal part of the penis with high-cylindrical epithelium-cells (ca. 45 μm high), which have basal, elongated nuclei. The structure of the epithelium of the distal part of the penis could not exactly be ascertained, due to the presence of a spermatophore. Epiphallus and flagellum with a ciliated, low-cylindrical epithelium (15 μm high) and subepithelial glandular cells.

Material. — Ecuador, Prov. Pichincha, ca. 16 km N. Quito, Pomasqui (UF).



Figs. 100-101. *Drymaeus* (*D.*) *papyraceus* (Mawe), genitalia. Brazil, Espírito Santo, Linhares (RMNH).

Drymaeus (Drymaeus) palassus spec. nov.

Drymaeus hygrohylaeus, Weyrauch, 1960: 40, pl. 4 figs. 18-19.

Specimens from Peru, Dept. Cajamarca, 30 km NE. of Cutervo, were identified by Weyrauch (1960: 40) as *Drymaeus hygrohylaeus* (d'Orbigny), which, however, is confined to southern Bolivia and northern Argentina.

The specimens from Peru differ in (1) being more slender; (2) having the aperture inversed ear-shaped; (3) having a rather strong columellar fold; (4) having a different colour pattern. The new species somewhat resembles *Drymaeus orthostomus* (E. A. Smith), from which it may be distinguished by (1) being stouter; (2) the different sculpture of the whorls; (3) the colour pattern. Finally, this novelty may be compared to *Drymaeus confluens* (Pfeiffer), from which it is differing in (1) the more strongly developed columellar fold; (2) being stouter; (3) the relatively larger height of the aperture.

Type material. — Peru, Dept. Cajamarca, 30 km NE Cutervo, 2650 m (W. Weyrauch & O. Velarde leg., 22-I-1959). Holotype SMF 156377a [= Weyrauch, 1960: fig. 18], paratypes SMF 156377b/1, IML 3198/4.

Etymology. — (Gr.) palasso, spot; referring to the colour pattern.

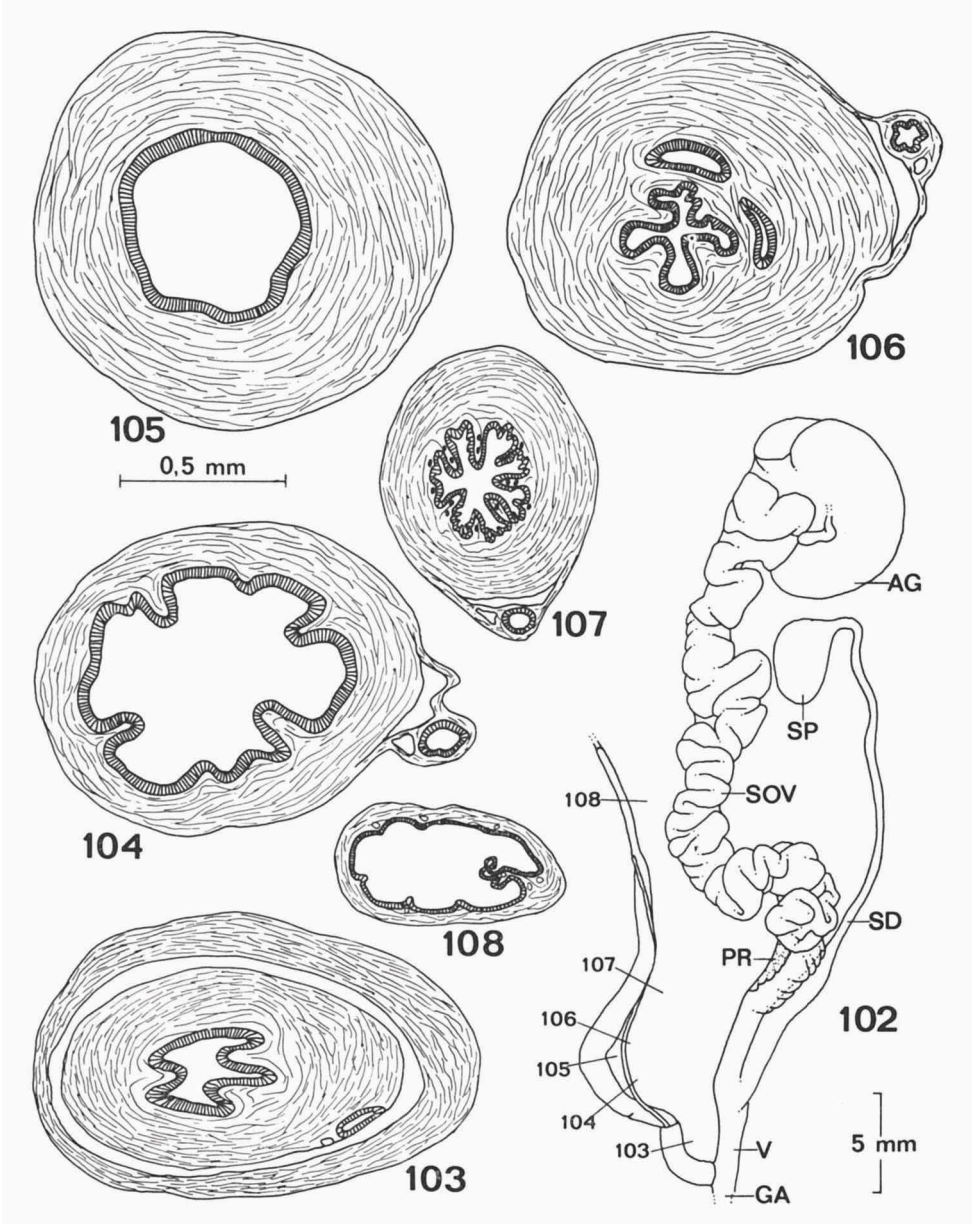
Drymaeus (Drymaeus) papyraceus (Mawe, 1823)
(figs. 100-101)

The anatomy of this species has been described by Rezende (1975). Fig. 100 presents a longitudinal section through the phallus of a specimen from Brazil, Espírito Santo, Linhares (RMNH, MN). See also Van Mol (1971).

Drymaeus (Drymaeus) poecilus (d'Orbigny, 1835)
(figs. 102-108)

Genitalia. — Penis with a sheath (ca. 1/6 the length of the phallus), more or less sub-cylindrical with the distal part relatively broad, passing without external differentiation into the epiphallus. The flagellum is sub-cylindrical, half as broad as the epiphallus and ca. 1/4 the length of the phallus. The vagina is rather short. The proximal part of the spermathecal duct is tapering, but this duct is otherwise narrow and sub-cylindrical, with an elongate-globose spermatheca at the distal end.

Histology. The lumen of the proximal part of the penis is narrowed by four relatively small infoldings and lined by high-cylindrical epithelium (30 μm high), while in the distal part the epitheliumcells reach a height of about 45 μm. No rounded cells have been observed in the subepithelial tissue



Figs. 102-108. *Drymaeus* (*D.*) *poecilus* (d'Orbigny), genitalia and transverse sections of penis (figs. 103-106, slides H 5583, 5586, 5585, 5586), epiphallus (fig. 107, slide H 5591) and flagellum (fig. 108, slide H 5598). Argentina, Salta (SMF).

of the distal penis. The epiphallus and flagellum both have a cubic, ciliated epithelium of ca. 10 μm high and subepithelial glandular cells.

Material. — Argentina, Prov. Salta (SMF).

Drymaeus (Drymaeus) protractus (Pfeiffer, 1855)
(pl. 8 fig. 5)

Three type specimens of this species have been located in the British Museum (Natural History) and one is designated lectotype: shell height 29.5 mm, diameter 13.2 mm (BMNH 1975494). The material is labelled 'Meobamba, Eastern Peru' (ex Cuming ex Yates).

Drymaeus (Drymaeus) punctatus Da Costa, 1907
(figs. 109-111; pl. 8 fig. 4)

The holotype of this species is preserved in the British Museum (Natural History); the specimen is here refigured, because the original figure lacks conclusive details.

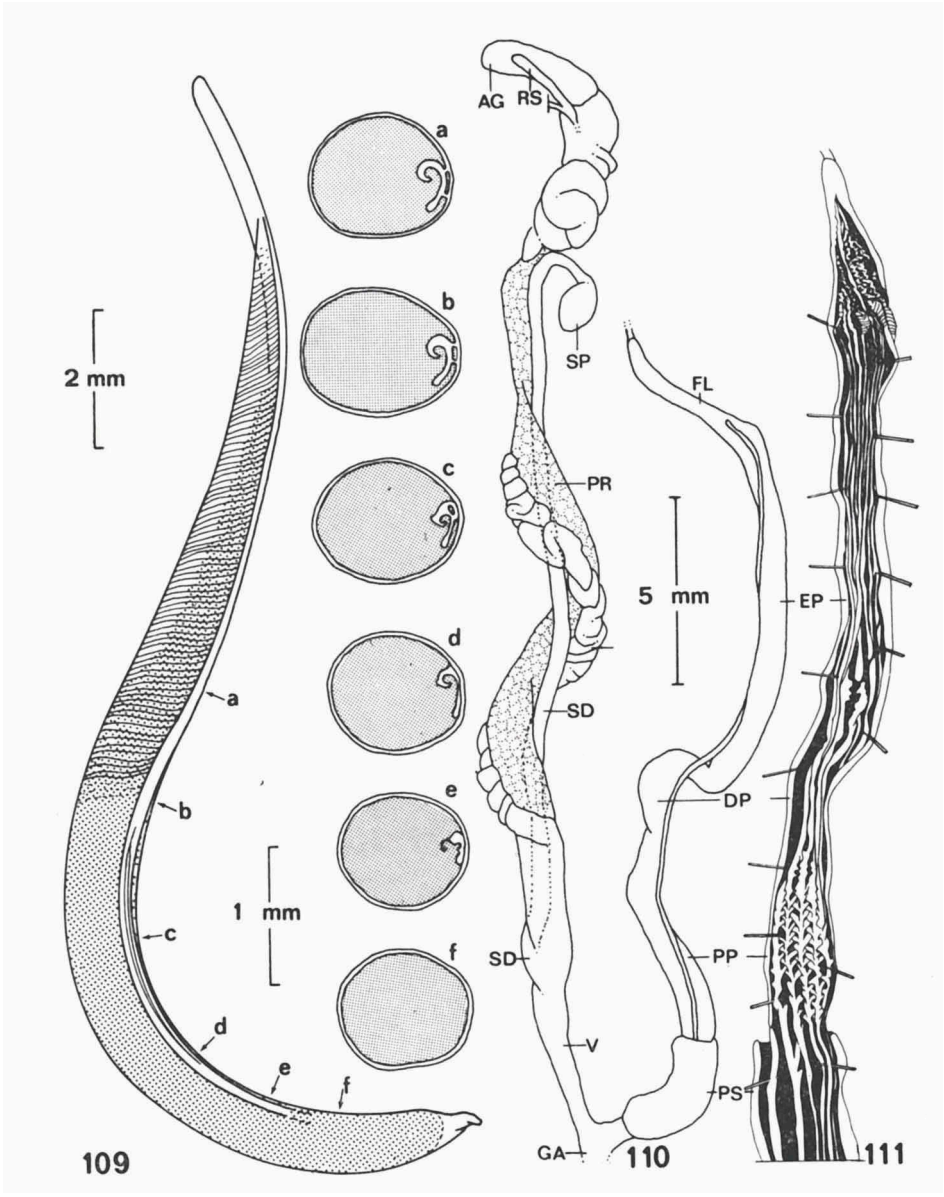
Genitalia. — Penis with a sheath (ca. 1/9 the length of the phallus), sub-cylindrical, passing without external differentiation into the epiphallus. The flagellum is sub-cylindrical, half as broad as the epiphallus and ca. 1/6 the length of the phallus. The spermathecal duct is sub-cylindrical; the spermatheca is elongate-globose. The greatest width of the spermatophore is in the median part; the proximal part is hardly pointed.

Internally the proximal part of the penis has five longitudinal pilasters that split off short transverse folds, which partially overlap each other. In the distal part of the penis this pattern of pilasters is more simple; the transition to the epiphallus is gradual. At the transition to the flagellum two pilasters are thickened and segmented perpendicular to the longitudinal axis, thus forming pillow-shaped organs. It is now hypothesized that these organs play a role at the formation of spermatophores, of which they probably produce the transverse lamellae that are present in all observed spermatophores of *Drymaeus* species.

Material. — Peru, Dept. Huánuco, Boquerón del Padre Abad, 78-80 km ENE. Tingo Maria, 470-520 m (RMNH).

Drymaeus (Drymaeus) quadrifasciatus (Angas, 1878)

A type specimen of this species is present in the London museum; it corresponds to the figures of Angas (1878) and is designated lectotype: shell height 29.0 mm, diameter 15.5 mm (BMNH 1879.1.21.3). The material is labelled 'Ecuador' (ex Angas).



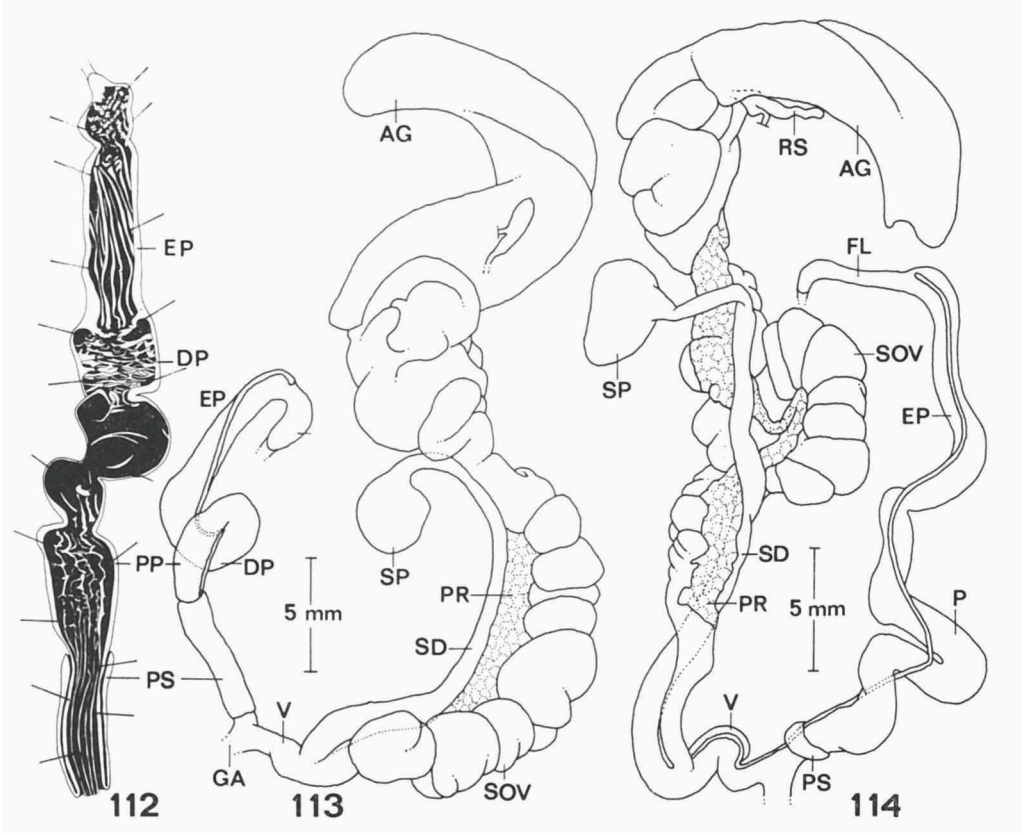
Figs. 109-111. *Drymaeus* (*D.*) *punctatus* Da Costa, genitalia and spermatophore. Peru, Huánuco, Boquerón del Padre Abad (RMNH).

Drymaeus (Drymaeus) recedens (Pfeiffer, 1864)
(pl. 6 fig. 1)

Type material of this hitherto unfigured species has been located in the British Museum (Natural History) and a specimen is designated lectotype: shell height 27.5 mm, diameter 13.6 mm (BMNH 1975477). The specimen is labelled 'Meobamba [Peru]' (ex Cuming).

Drymaeus (Drymaeus) rudis (Anton, 1839)
(figs. 112-113)

Genitalia. — Penis with a sheath (ca. 2/7 the length of the phallus), slightly swollen above the distal end of the sheath. The epiphallus is subcylindrical and slightly less broad than the distal penis. The flagellum is sub-



Figs. 112-113. *Drymaeus* (*D.*) *rudis* (Anton), genitalia. Mexico, Oaxaca (UF).
Fig. 114. *Drymaeus* (*D.*) *scitulus* (Reeve), genitalia. Peru, Cajamarca, Cochambul (RMNH).

cylindrical, about 1/7 the length of the phallus. The vagina is relatively short. The spermathecal duct is proximally tapering, but otherwise sub-cylindrical; the spermatheca is globose.

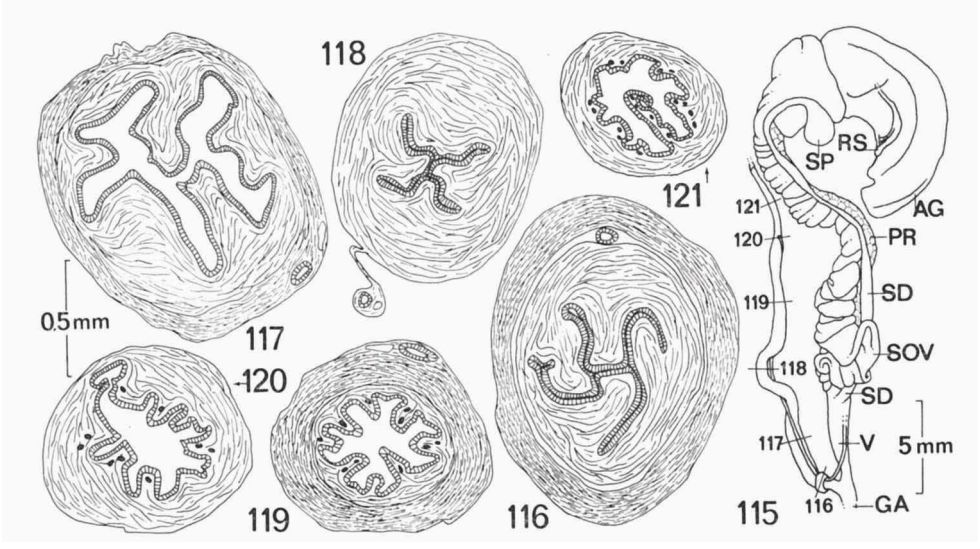
Internally the proximal part of the penis has longitudinal pilasters, whereas in the distal part the folds are transversally directed. The epiphallus has longitudinal pilasters; those in the flagellum are short and of irregular shape.

Material. — Mexico, Oaxaca, Oaxaca (UF).

Drymaeus (Drymaeus) schunkei Haas, 1949
(figs. 115-121)

Genitalia. — Penis with a very short sheath, sub-cylindrical, passing without external differentiation into the epiphallus. The flagellum is sub-cylindrical, half as broad as the epiphallus and about 1/5 the length of the phallus. The vagina is rather long, tapering towards the genital atrium. The spermathecal duct is more or less sub-cylindrical; the spermatheca is elongate-globose.

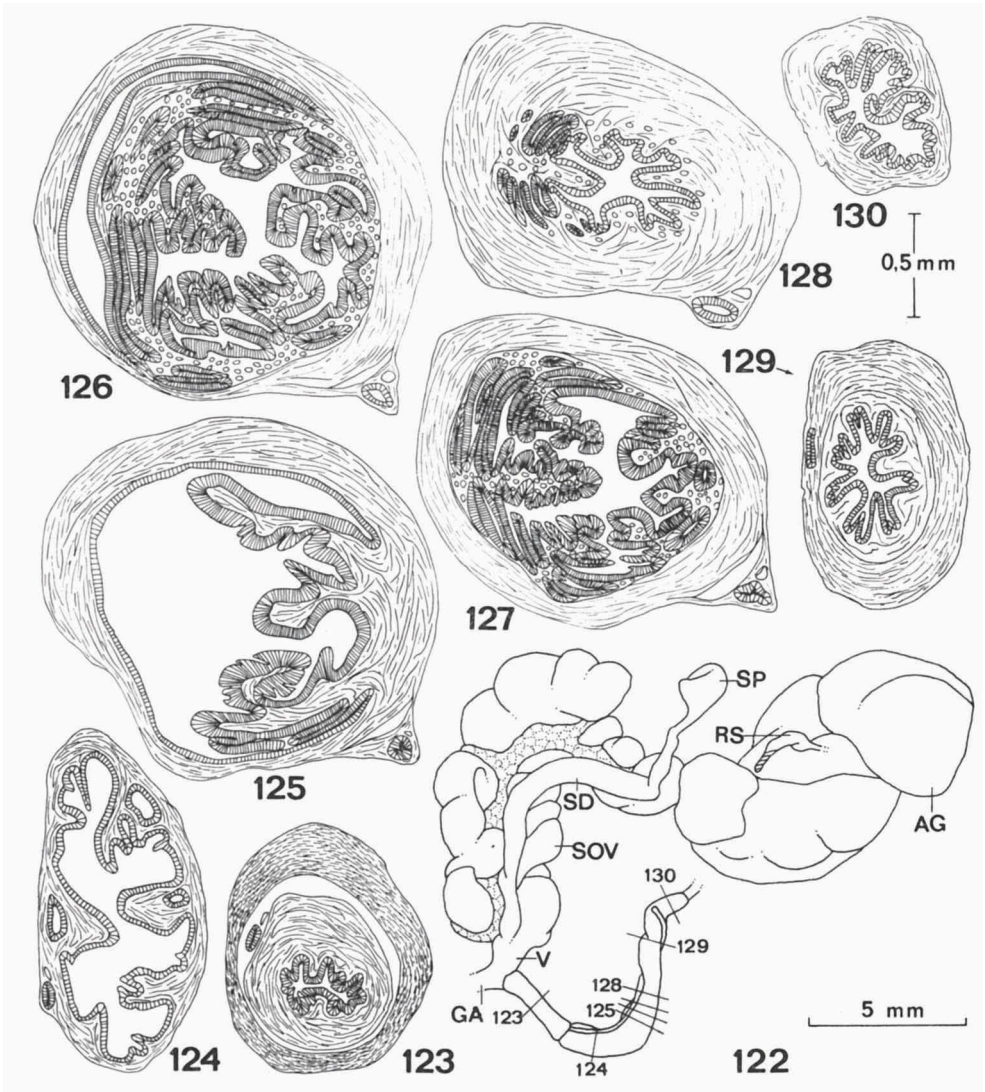
Histology. The lumen of the proximal part of the penis is very narrow and lined by a cubic to low-cylindrical epithelium (cell height 10 μm), of which the cells have basal nuclei of 5 μm diameter (due to technical problems the distal part of the penis could not be studied). The star-shaped lumen of



Figs. 115-121. *Drymaeus* (*D.*) *schunkei* Haas, genitalia and transverse sections of penis (figs. 116-118, slides H 4091, 4092, 4093), epiphallus (figs. 119-120, slides H 4094, 4096) and flagellum (fig. 121, slide H 4098). Peru, Huánuco, Boquerón del Padre Abad (RMNH).

the epiphallus is lined by a ciliated, cubic epithelium of 6 μm high that is also present in the flagellum. Glandular cells have been observed in the subepithelial tissue of both the epiphallus and flagellum; these cells stain green-blue with alcian blue.

Material. — Peru, Dept. Huánuco, 78-80 km ENE. Tingo Maria, Boquerón del Padre Abad, 470-520 m (RMNH).



Figs. 122-130. *Drymaeus* (*D.*) *serratus* (Pfeiffer), genitalia and transverse sections of penis (figs. 123-128, slides 4100, 4102, 4103 (4x)), epiphallus (fig. 129, slide H 4104) and flagellum (fig. 130, slide H 4105). Peru, Huánuco, Cueva de las Pavas (RMNH).

Drymaeus (Drymaeus) scitulus (Reeve, 1849)
(fig. 114)

A lectotype is designated from among the three type specimens that are preserved in the London museum: shell height 29.5 mm, diameter 11.9 mm (BMNH 1975217). The material, which originates from the Cuming-collection, is labelled 'Chachapoyas, Peru'.

Genitalia. — Penis with a very short sheath, its proximal part slightly swollen but otherwise sub-cylindrical and passing without external differentiation into the epiphallus. The flagellum is sub-cylindrical, about half as broad as the epiphallus and ca. 1/6 the length of the phallus. The vagina is rather short. The spermathecal duct is sub-cylindrical, with an elongate-globose spermatheca at the distal end.

Material. — Peru, Dept. Cajamarca, Cochambul, 2900 m (RMNH).

Drymaeus (Drymaeus) serratus (Pfeiffer, 1855)
(figs. 122-130)

Type specimens of this species are preserved in the British Museum (Natural History) and one is designated lectotype: shell height 26.5 mm, diameter 12.6 mm (BMNH 1975475). The material includes two paralectotypes and is labelled 'Meobamba, Eastern Peru' (ex Cuming ex Yates).

Genitalia. — The phallus-complex is relatively short. Penis with a sheath (ca. 2/7 the length of the phallus), more or less sub-cylindrical and passing without external differentiation into the epihallus. The flagellum is sub-cylindrical, as broad as the epiphallus and about 1/8 the length of the phallus. The vagina is relatively short. The spermathecal duct is sub-cylindrical, with a globose spermatheca at the distal end.

Histology. The epithelium of the proximal part of the penis is low-cylindrical (cell height ca. 15 μm). In the distal part of the penis, which intrudes the proximal part of the penis, the epithelium is high-cylindrical (cell height ca. 25 μm). The subepithelial tissue consists of rounded cells. The ciliated epithelium of both the epiphallus and flagellum is cubic and ca. 10 μm high.

Material. — Peru, Dept. Huánuco, Cueva de las Pavas, 9.0 km S. of Tingo Maria, 660 m (RMNH).

Drymaeus (Drymaeus) similaris (J. Moricand, 1856)
(fig. 131)

Genitalia. — Penis with a short sheath (ca. 1/10 the length of the phallus), sub-cylindrical. The epiphallus is swollen and tapering towards the flagellum,

which is sub-cylindrical, about half as broad as the epiphallus and ca. 1/8 the length of the phallus. The vagina is short. The spermathecal duct is sub-cylindrical, with a relatively small, elongate-globose spermatheca at the distal end.

Material. — Peru, Dept. Amazonas, Río Cenepa, San Antonio (UF).

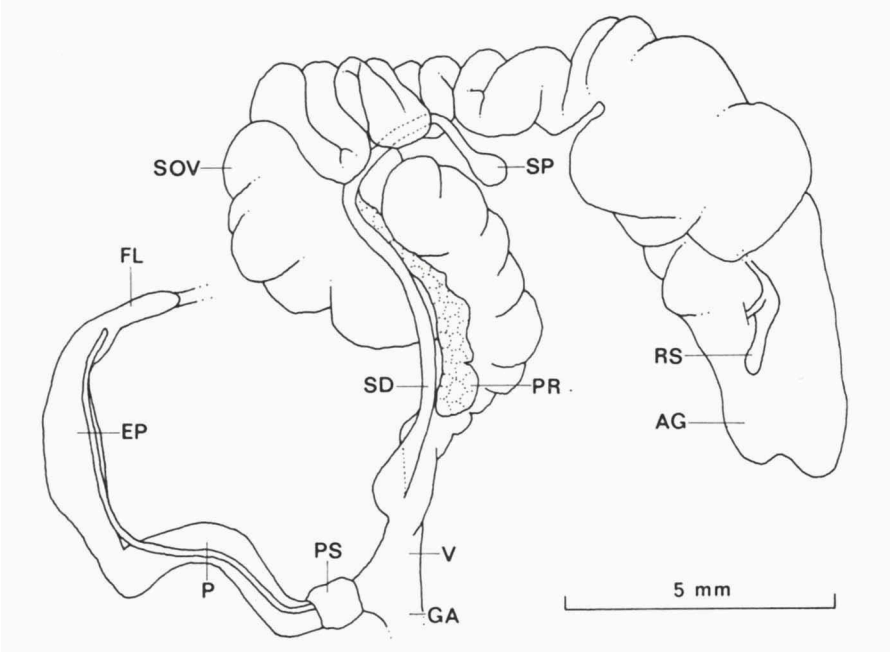


Fig. 131. *Drymaeus* (*D.*) *similaris* (Moricand), genitalia. Peru, Amazonas, San Antonio (UF).

Drymaeus (Drymaeus) steyermarki (Haas, 1955)
(fig. 132)

The holotype (FMNH 49735) was received on loan and has been studied anatomically.

Genitalia. — Proximal part of the penis with a sheath (ca. 1/4 the length of the phallus), its distal part slightly swollen and passing without external differentiation into the epiphallus. The flagellum is tapering, relatively thick, ca. 1/8 the length of the phallus. The retractor muscle is distally inserted and relatively short and thin. The spermathecal duct is somewhat swollen in its proximal part, sub-cylindrical in its median part and long and narrow towards the elongate-truncate spermatheca.

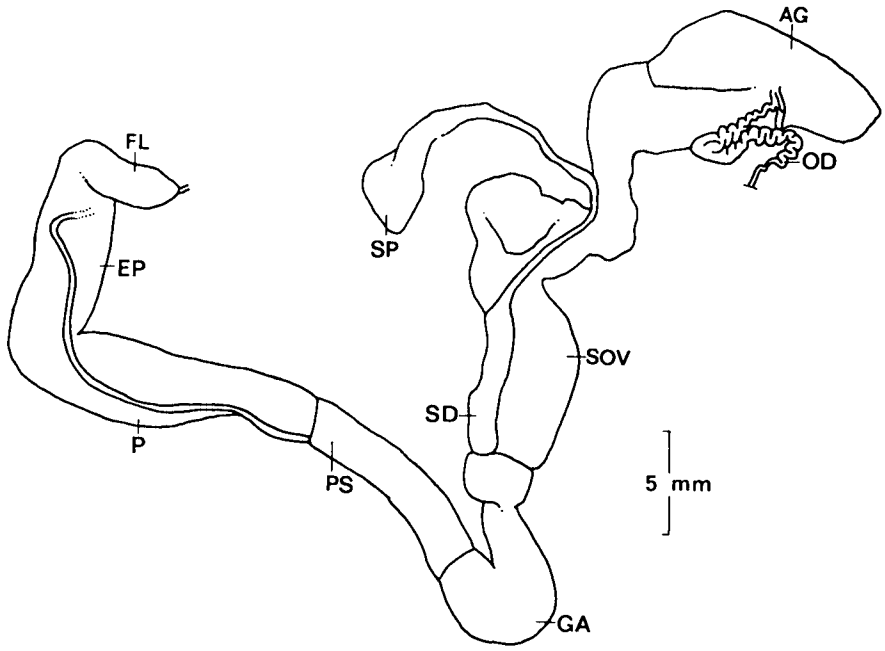


Fig. 132. *Drymaeus* (*D.*) *steyermarki* (Haas), genitalia. Venezuela, Bolívar, Apacará-tepui (FMNH).

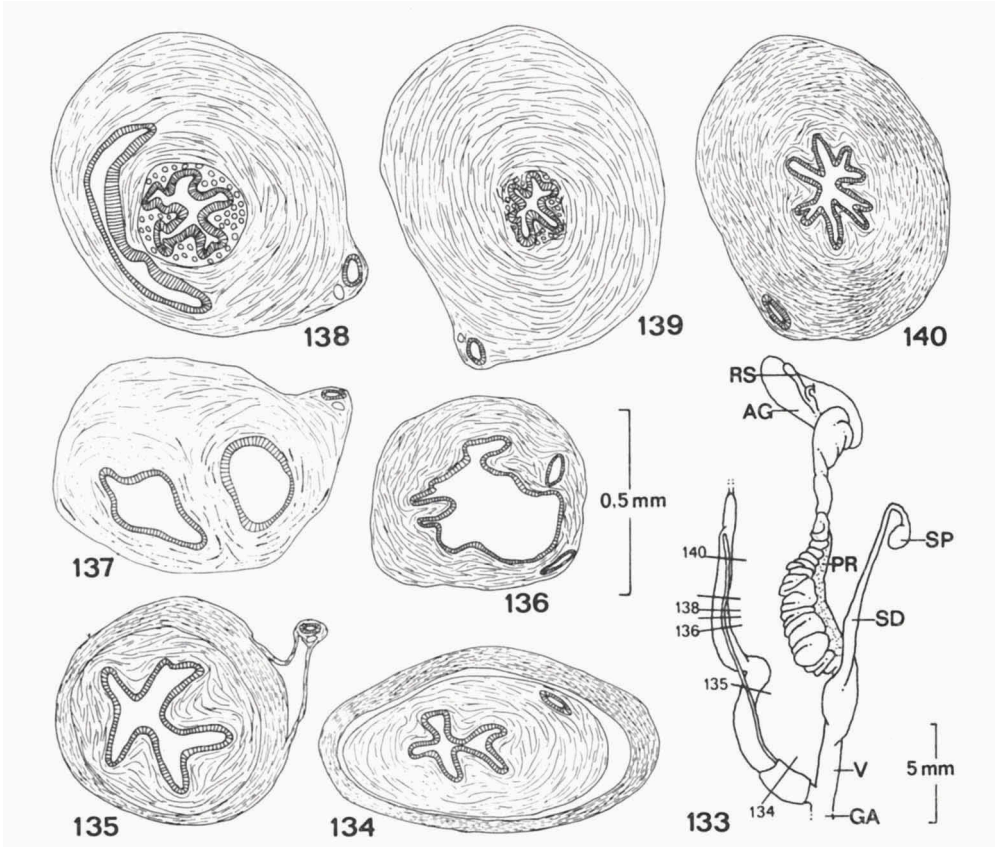
Drymaeus (Drymaeus) strigatus (Sowerby, 1833)
(figs. 133-140)

Type material of the junior synonym *Bulimus musivus* Pfeiffer, 1855 is preserved in the London museum. A lectotype is designated: shell height 21.5 mm, diameter 11.9 mm (BMNH 1975292). All specimens are labelled 'Meobamba Eastern Peru' (ex Cuming ex Yates).

Genitalia. — Penis with a sheath (ca. 1/7 the length of the phallus), sub-cylindrical, passing without external differentiation into the epiphallus. The flagellum is sub-cylindrical, nearly as broad as the epiphallus and ca. 1/8 the length of the phallus. The vagina is relatively long. The spermathecal duct is rather short, somewhat tapering and with an elongate-globose spermatheca at the distal end.

Histology. The lumen of the proximal part of the penis is narrowed by infoldings and lined by a low-cylindrical epithelium of 15 μm high. The epithelium of the distal part of the penis, which intrudes the proximal part, is high-cylindrical (cell height 25 μm). The subepithelial tissue consists of large, rounded cells. The epithelium of both the epiphallus and flagellum is ciliated and cubic (10 μm high).

Material. — Peru, Dept. Amazonas, Roque (NRS).



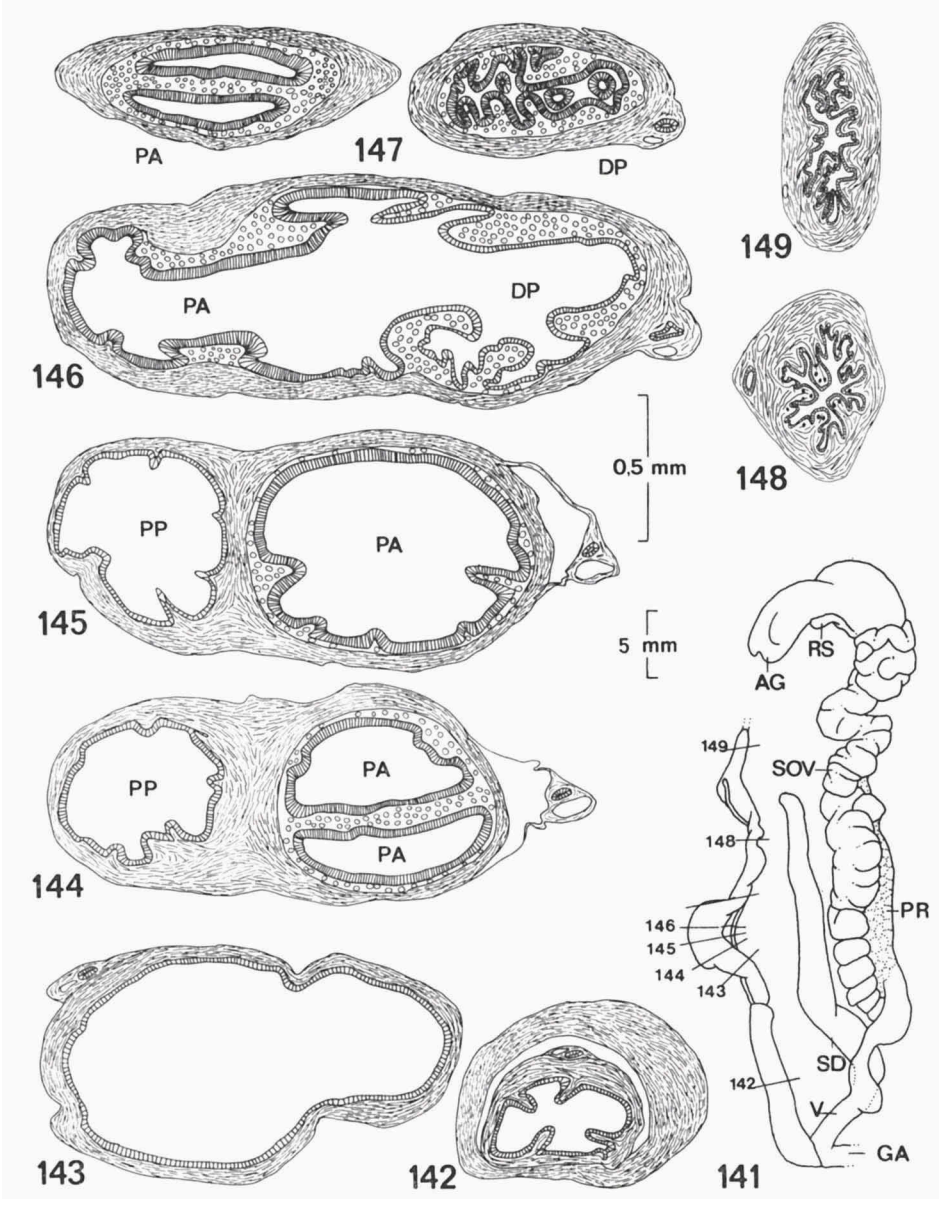
Figs. 133-140. *Drymaeus* (*D.*) *strigatus* (Sowerby), genitalia and transverse sections of penis (figs. 134-139, slides H 4240, 4238, 4236 (3x), 4235) and epiphallus (fig. 140, slide H 4235). Peru, Amazonas, Roque (NRS).

Drymaeus (Drymaeus) subsemiclausus (Petit, 1843)

A syntype of this species was found in the Paris museum. The specimen, which is labelled 'Montagne de Quindiu' (ex Goudot), measures: shell height 22.5 mm, diameter 13.8 mm, height of aperture 9.6 mm, width 6.2 mm, height of last whorl 17.5 mm; 4.9 whorls.

Drymaeus (Drymaeus) sulcosus (Pfeiffer, 1841)
(figs. 141-149)

The genitalia of this species have been figured without further description by Solem (1955). He divided Mexican *Drymaeus* species into four groups, based on the length of the penis sheath. In our opinion, however, the length of the sheath is too variable to be used above the species level (compare our figure 141 with Solem's pl. 4 fig. 1).



Figs. 141-149. *Drymaeus* (*D.*) *sulcosus* (Pfeiffer), genitalia and transverse sections of penis (figs. 142-147, slides H 4116, 4119, 4125, 4127, 4128, 4130), epiphallus (fig. 148, slide H 4136) and flagellum (fig. 149, slide H 4140). Mexico, Guerrero, Cerro Muerte (UF).

Genitalia. — Penis with a long sheath (ca. 2/5 the length of the phallus), more or less sub-cylindrical but strongly swollen at the transition between proximal and distal part. The epiphallus is more or less sub-cylindrical and swollen at the transition to the flagellum, which is slightly tapering and ca. 1/8 the length of the phallus. The vagina is short. The spermathecal duct and spermatheca are undifferentiated, slightly tapering and much shorter than the spermoviduct. Solem (1955: 7) suggested that the shape of spermathecal duct and spermatheca would be affected by the presence of spermatophores: 'when containing spermatophores it is swollen, and the apical sac is not distinguishable'. In our opinion the shape of this structure is specifically different in *Drymaeus sulcosus* and not affected by the presence of spermatophores. Compare also figures 7, 67 and 101.

Histology. The relatively wide lumen of the proximal part of the penis is lined by a cylindrical epithelium of ca. 25 μm high. The lumen of the distal part of the penis is rather complex (see also Solem, 1955: pl. 5 fig. 2) and the epithelium is 40 μm high. The subepithelial tissue consists of large, rounded cells (ca. 25 μm diameter), of which the cytoplasm stains light blue with alcian blue. At the transition between the proximal and distal part of the penis an "internal appendix" is present, which causes the external swelling of the penis (fig. 141). Histologically this "appendix" is identical to the distal part of the penis. The lumen of the "appendix" runs parallel to the main lumen and is divided into two smaller lumina at both extremities (figs. 144 and 147 respectively); the lumen is connected via a small opening with that of the distal part of the penis. The epithelium of epiphallus and flagellum is ciliated and cubic (cell height ca. 12 μm). Especially in the epiphallus glandular cells, which stain blue with alcian blue, are dispersed in the subepithelial tissue.

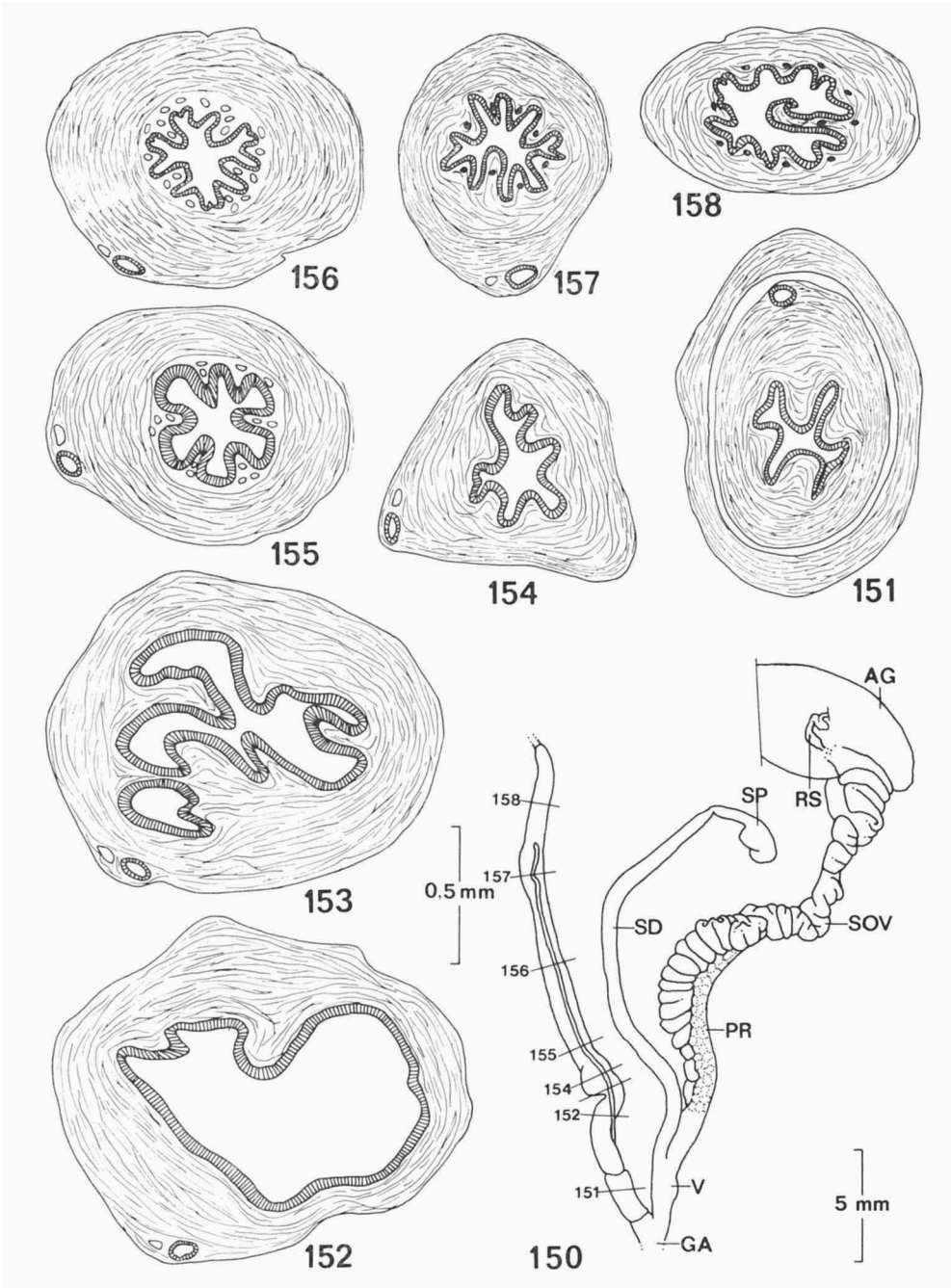
Material. — Mexico, Guerrero, Cerro Muerto, 2600 feet (UF).

Drymaeus (Drymaeus) vespertinus (Pfeiffer, 1858)
(pl. 6 fig. 6)

Three type specimens of this species are in the London museum and one is designated lectotype: shell height 35.0 mm, diameter 14.6 mm (BMNH 1975471). The specimens are labelled 'Province of Patas, Andes of Peru' and originate from the Cuming-collection.

Drymaeus (Drymaeus) vexillum (Wood, 1828)
(figs. 150-158)

Genitalia. — Penis with a sheath (ca. 1/10 the length of the phallus), subcylindrical, its distal part slightly swollen. Epiphallus and flagellum sub-



Figs. 150-158. *Drymaeus* (*D.*) *vexillum* (Wood), genitalia and transverse sections of penis (figs. 151-156, slides H 5553, 5558, 5559, 5560, 5563, 5568), epiphallus (fig. 157, slide H 5572) and flagellum (fig. 158, slide H 5577). Peru, Ancash, Colia (SMF).

cylindrical; the flagellum is as broad as the epiphallus and ca. 1/5 the length of the phallus. The vagina is short. Spermathecal duct sub-cylindrical, with an elongate-globose spermatheca at the distal end.

Histology. The epithelium of the proximal part of the penis is cylindrical and pseudostratified, varying in height from 25 to 50 μm. In the distal part of the penis the epitheliumcells are high-cylindrical (40 μm high) and filled with secretion granules staining dark blue with alcian blue. The subepithelial tissue consists of rounded cells of ca. 15 μm diameter, of which the cytoplasm stains faintly blue with alcian blue. The epithelium of epiphallus and flagellum is cubic and ciliated (cell height ca. 10 μm).

Material. — Peru, Dept. Ancash, (Rio Fortaleza), Colia, 2150 m (SMF).

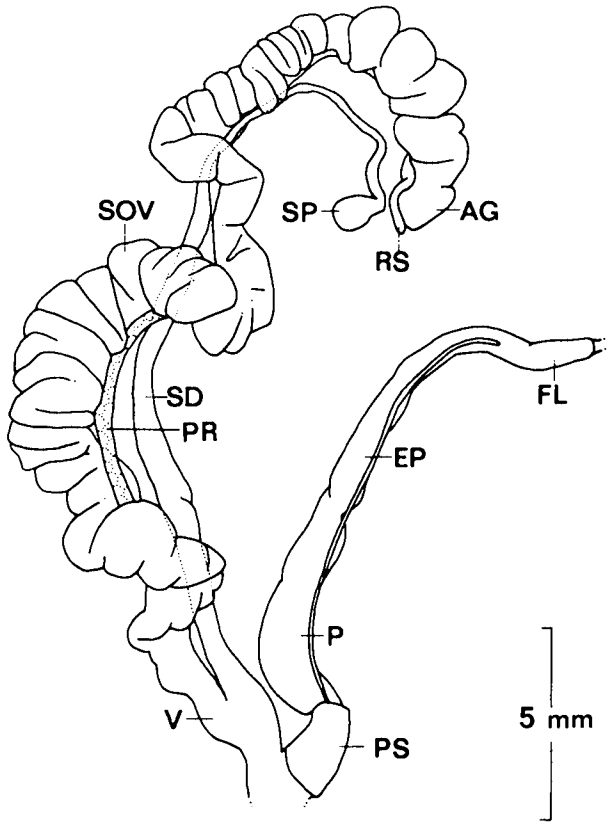


Fig. 159. *Drymaeus* (*D.*) *yapacanensis* spec. nov., genitalia. Venezuela, Amazonas, Cerro Yapacana (RMNH).

Drymaeus (Drymaeus) yapacanensis spec. nov.
(fig. 159; pl. 5 fig. 9)

Description. — Shell up to 31.2 mm, 2.18 times as long as wide, narrowly perforate, with slightly convex sides; thin. Colour pink to yellowish, with axial (reddish-)brown streaks. Surface rather shining, smooth. Whorls 5.9, hardly convex; suture well impressed. Aperture elongate-ovate, 1.66 times as long as wide, 0.5 times the total length; pink coloured inside. Peristome thin, slightly expanded; pink coloured. Columellar margin reflexed, dilated above and receding.

Measurements (in mm):

shell		aperture		height of	number of	
height	diameter	height	width	last whorl	whorls	
31.2	14.4	15.9	9.8	22.8	5.8	holotype
29.5	13.4	14.2	8.4	21.0	5.9	paratype

Type material. — Venezuela, Territoria Amazonas, Cerro Yapacaná (03°42'N 66°46'W), ca. 700 m (J. Cerda leg., 19-II-1978). Holotype RMNH 55331, paratype RMNH 55332.

Comparisons. — This species does not closely resemble any other Venezuelan *Drymaeus* (*Drymaeus*) species. It differs from *Drymaeus* (*Mesembrinus*) *extraneus* (Haas, 1955) in (1) the colour pattern, (2) the more impressed suture, (3) the more expanded peristome, (4) the less inflated last whorl and (5) the less convex sides.

Genitalia. — Penis with a sheath (ca. 1/7 the length of the phallus), somewhat swollen above the distal end of the sheath, but otherwise sub-cylindrical and passing without external differentiation into the epiphallus and as long as the penis sheath. The vagina is relatively short. The spermathecal duct is tapering, with an elongate-globose spermatheca at the distal end.

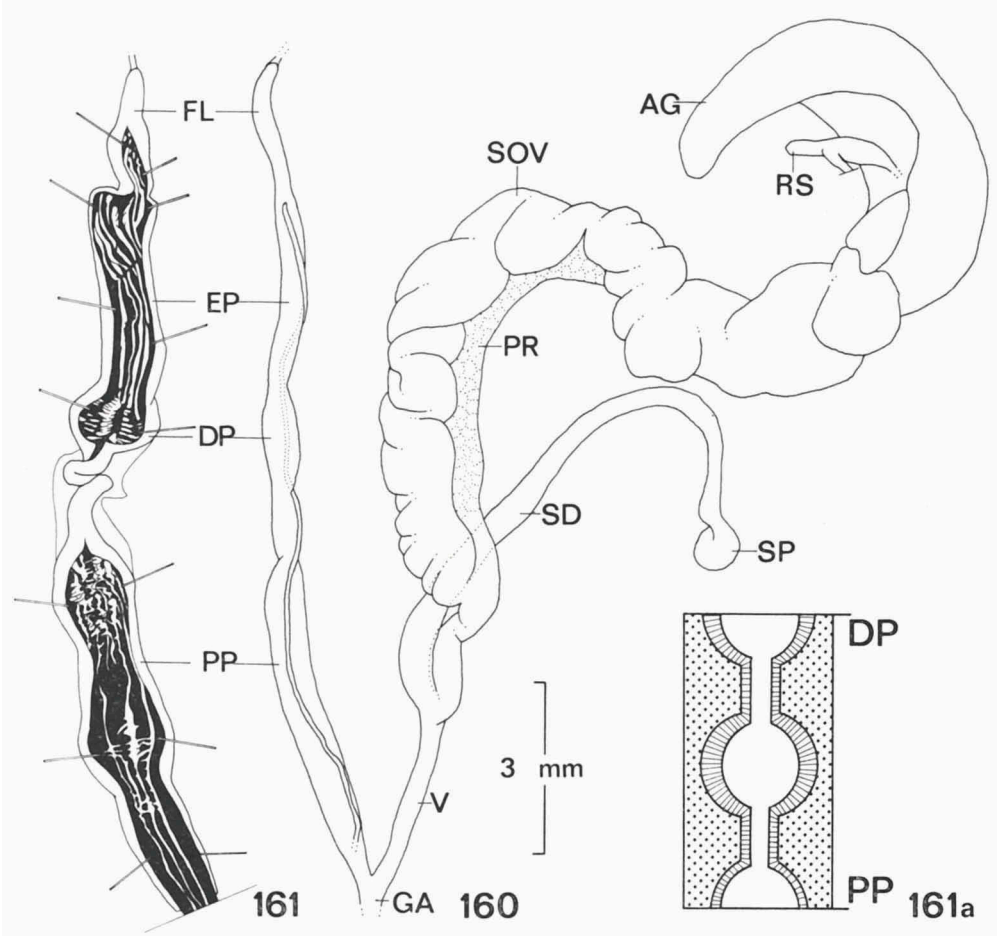
Drymaeus (Mesembrinus) alternans (Beck, 1837)
(figs. 160-173)

At one locality both dextral and sinistral specimens of this species were collected. Figs. 160-161 correspond to a dextral specimen, the other figures to a sinistral one.

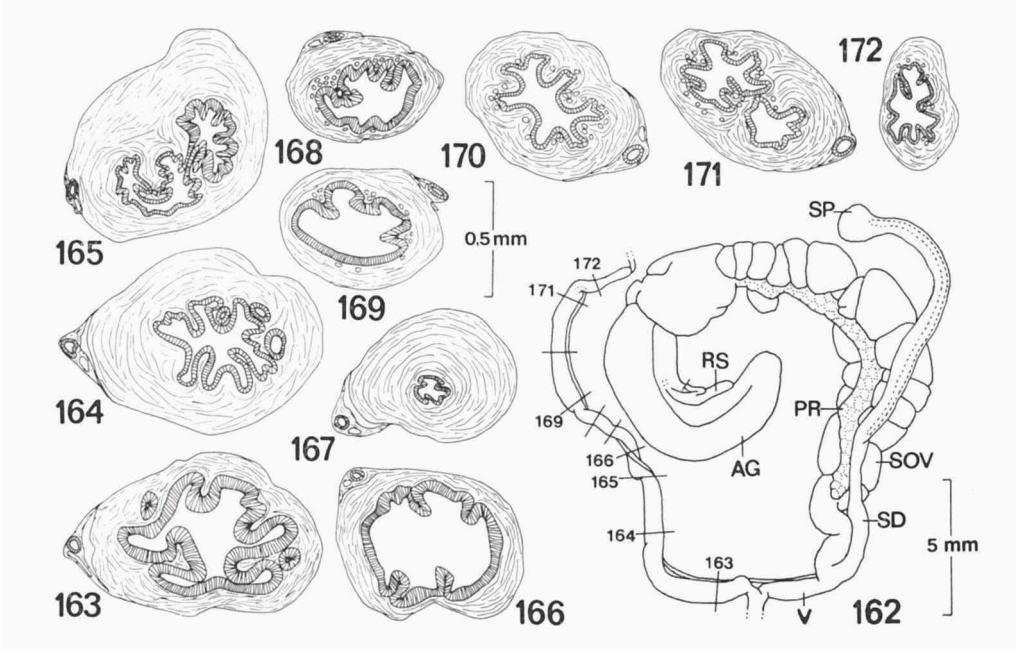
Genitalia. — Penis without a sheath, more or less sub-cylindrical, slightly constricted at the transition to the epiphallus. The epiphallus is sub-cylindrical and about half as long as the penis. The flagellum is short (ca. 1/7 the length of the phallus). The vagina is rather long. Spermathecal duct sub-cylindrical; the spermatheca is globose. The broadest part of the spermatophore is near

the distal end; the proximal part (2/3 of the total length) is sub-cylindrical, with rounded tip.

Histology. Most proximal part of the penis with a high-cylindrical epithelium (cell height 40 μm), of which the cells have large, basal nuclei of 8 μm diameter. More distally the epithelium is low-cylindrical and ca. 15 μm high. This type of epithelium continues in the narrow part of the transition to the distal part of the penis, while in the middle of this transition the lumen is widened and lined by high-cylindrical epithelium; this is schematically shown in fig. 161a. In the distal part of the penis the epitheliumcells are high-cylindrical and ca. 25 μm high. The subepithelial tissue consists of rounded cells of ca. 15 μm diameter. The cubic to low-cylindrical epithelium of epi-



Figs. 160-161a. *Drymaeus* (*Mesembrinus*) *alternans* (Beck), genitalia. Nicaragua, 1 mi E. Matagalpa (UF).



Figs. 162-172. *Drymaeus* (*Mesembrinus*) *alternans* (Beck), genitalia and transverse sections of penis (figs. 163-169, slides H 4082, 4083, 4084 (2x), 4085, 4086 (2x)), epiphallus (figs. 170-171, slides H 4087, 4088) and flagellum (fig. 172, slide H 4088). Nicaragua, 1 mi E. Matagalpa (UF).

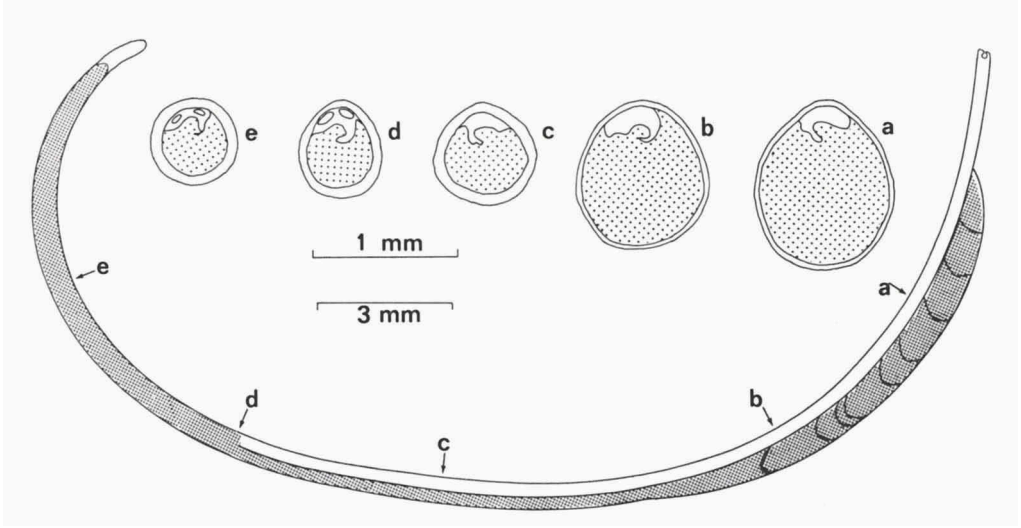


Fig. 173. *Drymaeus* (*Mesembrinus*) *alternans* (Beck), spermatophore. Nicaragua, 1 mi E. Matagalpa (UF).

phallus and flagellum is ca. 10 μm high and ciliated. Glandular cells are dispersed in the subepithelial tissue of both epiphallus and flagellum.

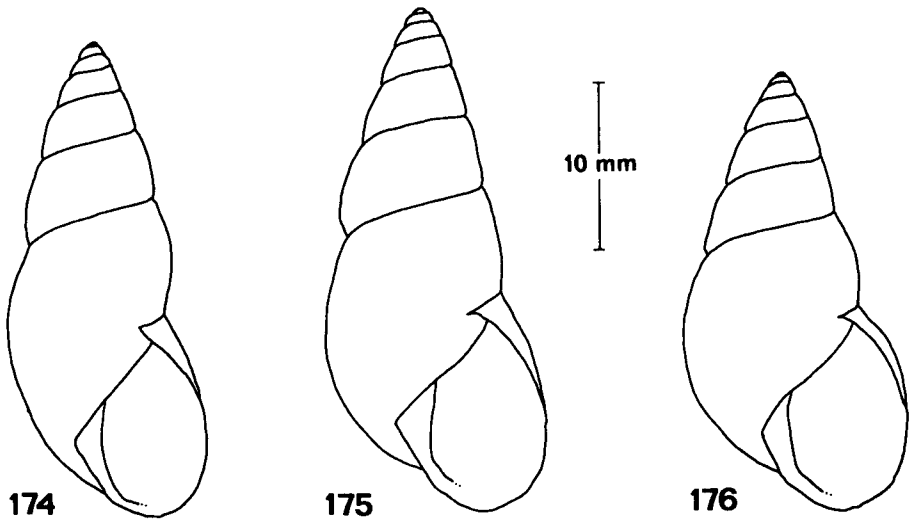
Material. — Nicaragua, 1 mi E. of Matagalpa, 1500 feet (UF).

Drymaeus (Mesembrinus) amandus (Pfeiffer, 1855)

The specimen corresponding to the original figure of Pfeiffer (1855: pl. 31 fig. 4) has been located in the London museum and is designated lectotype: shell height 29.0 mm, diameter 13.1 mm. The material is without locality label and originates from the Cuming-collection.

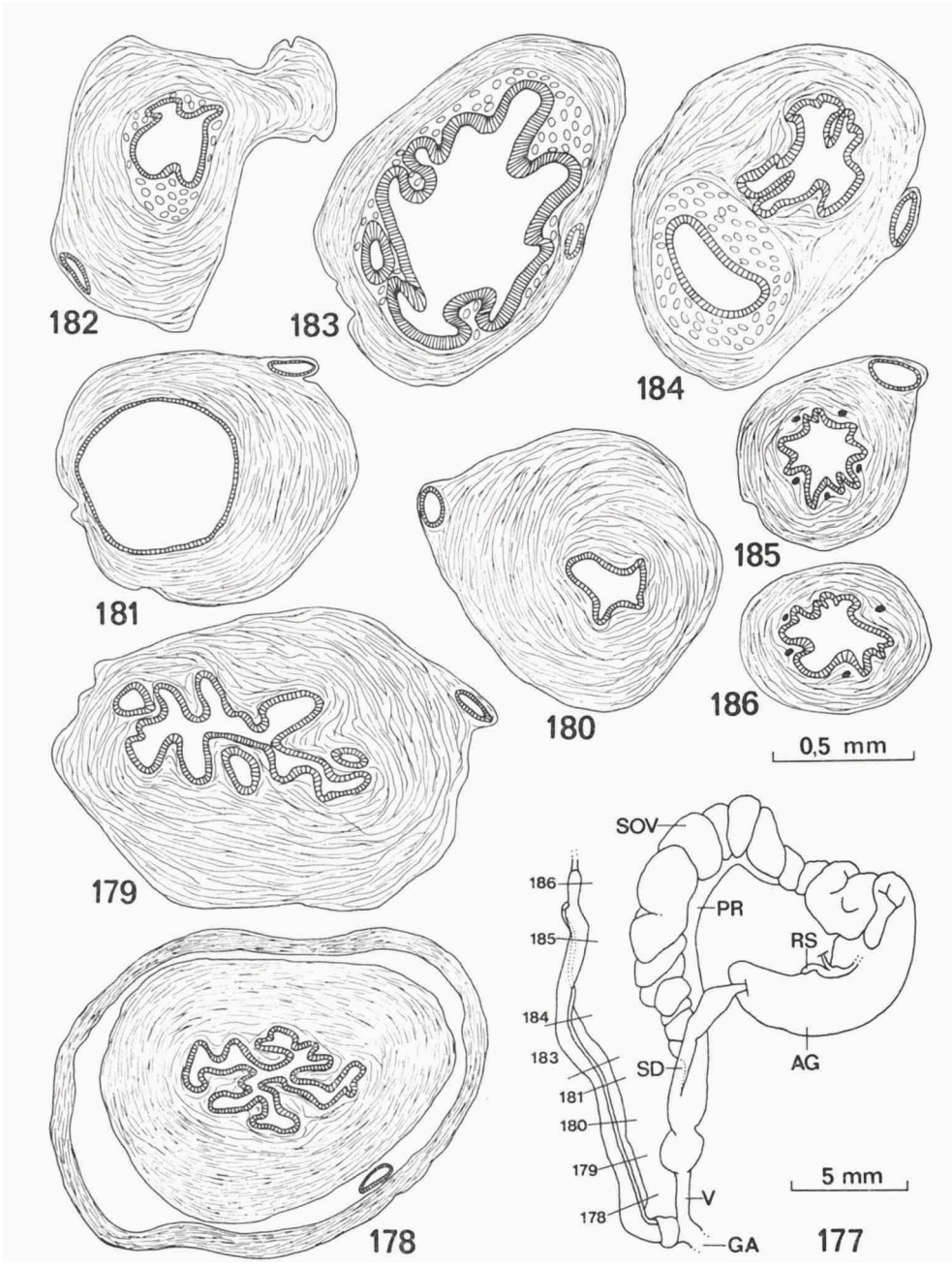
Drymaeus (Mesembrinus) amoenus (Pfeiffer, 1847) (figs. 174-186)

This species was collected by C. Beets in Venezuela, Estado Mérida, (1) between Timotes and Chachopo, 2400 m (RMNH/many); (2) Río Motatán valley, 2 km SW. Chachopo, 3100 m (RMNH/1); (3) mountain SE. Timotes, 3350-3400 m (RMNH/2). These are the first exact localities for this species and it is here figured for the first time.



Figs. 174-176. *Drymaeus* (*Mesembrinus*) *amoenus* (Pfeiffer). Venezuela, Mérida, between Timotes and Chachopo (RMNH).

Redescription. — Shell narrowly perforate to rimate, with slightly convex sides; elongate; solid. Colour yellowish with four pink bands, of which the one just above the periphery of the last whorl is broadest; one specimen



Figs. 177-186. *Drymaeus* (*Mesembrinus*) *amoenus* (Pfeiffer), genitalia and transverse sections of penis (figs. 178-183, slides H 4039, 4040, 4042, 4043, 4044 (2x)), epiphallus (figs. 184-185, slides H 4044, 4045) and flagellum (fig. 186, slide H 4046). Venezuela, Mérida, between Timotes and Chachopo (RMNH).

whitish with only two narrow bands above the periphery of the last whorl. Surface shining, with fine spiral lines. Whorls slightly convex; suture hardly to well impressed. Aperture subovate. Peristome thin and hardly expanded. Columellar margin reflexed and broadly dilated above.

Measurements (in mm) and statistics of characters and ratios (N = 9):

	shell		aperture		height of		HA/		
	height (H)	diameter (D)	height (HA)	width (WA)	last whorl (LW)	H/D	WA	HA/H	LW/H
mean	28.28	12.02	11.66	6.73	18.56	2.35	1.73	0.41	0.66
s. dev.	1.68	0.61	0.78	0.29	1.18	0.08	0.08	0.02	0.03
max.	30.5	12.8	12.9	7.0	20.5	2.46	1.84	0.43	0.70
min.	25.5	11.0	10.7	6.3	17.0	2.23	1.59	0.38	0.62

Remarks. — This species may be compared with *Drymaeus meridanus* (Pfeiffer, 1846) and *D. flavidus* (Menke, 1829), which differ markedly in their colour pattern, viz., having chestnut spiral bands and streaks (*meridanus*) or being uniformly yellowish (*flavidus*).

Genitalia. — Penis with a very short sheath (ca. 1/16 the length of the phallus), sub-cylindrical and passing without external differentiation into the epiphallus. The flagellum is sub-cylindrical, half as broad as the epiphallus and very short. The vagina is rather long, its distal part swollen.

Histology. The epithelium of the proximal part of the penis and the transition to the distal part of the penis is cubic to low-cylindrical; the cells, which are ca. 10 μm high, have a nucleus of ca. 5 μm diameter. The median part of the transition-zone is relatively wide (cf. fig. 161a). The epithelium of the distal part is high-cylindrical (cell height ca. 30 μm); in the cytoplasm of these cells secretion granules are dispersed, which stain deep blue with alcian blue. The large, rounded cells in the subepithelial tissue are ca. 20 μm in diameter. The ciliated epithelium of both epiphallus and flagellum is ca. 10 μm high.

Material. — Venezuela, Edo. Mérida, between Timotes and Chachopo (RMNH).

Drymaeus (Mesembrinus) apicepunctatus (Preston, 1914)

The holotype of this species is preserved in the British Museum (Natural History) (BMNH 1915.1.6.23). This taxon was erroneously assigned by Preston to the genus *Bulimulus* Leach.

Drymaeus (Mesembrinus) aurifluus (Pfeiffer, 1857)
(fig. 187)

Genitalia. — Penis with a long sheath (ca. 1/3 the length of the phallus), more or less sub-cylindrical and relatively thick; the penis is passing without external differentiation into the epiphallus. The flagellum is as broad as the epiphallus and ca. 1/8 the length of the phallus. The vagina is short and relatively broad. Spermathecal duct and spermatheca are undifferentiated, tapering.

Material. — Mexico, Veracruz, 4.7 mi S. of Huatusco (UF).

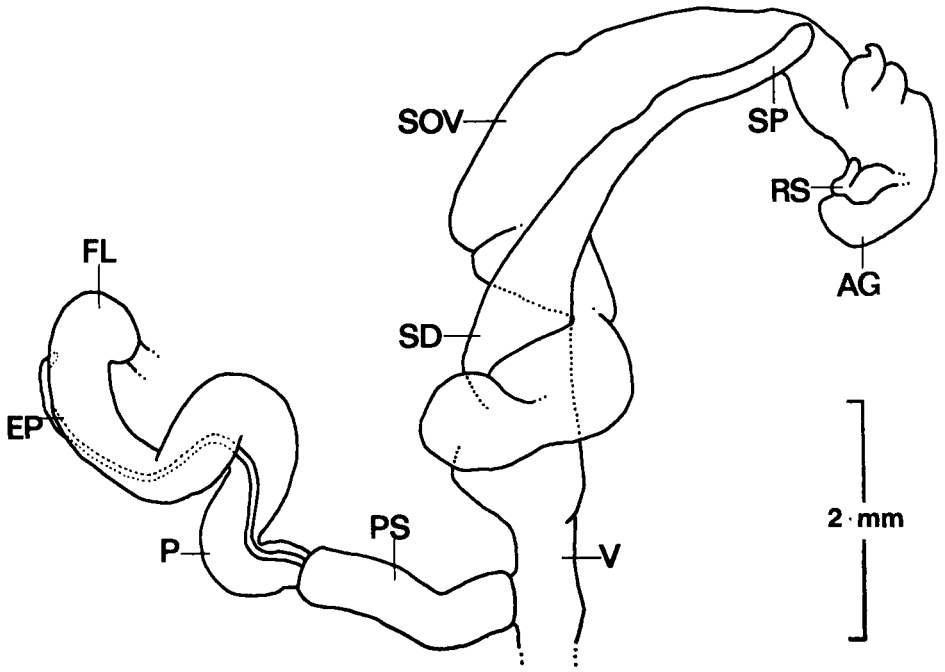
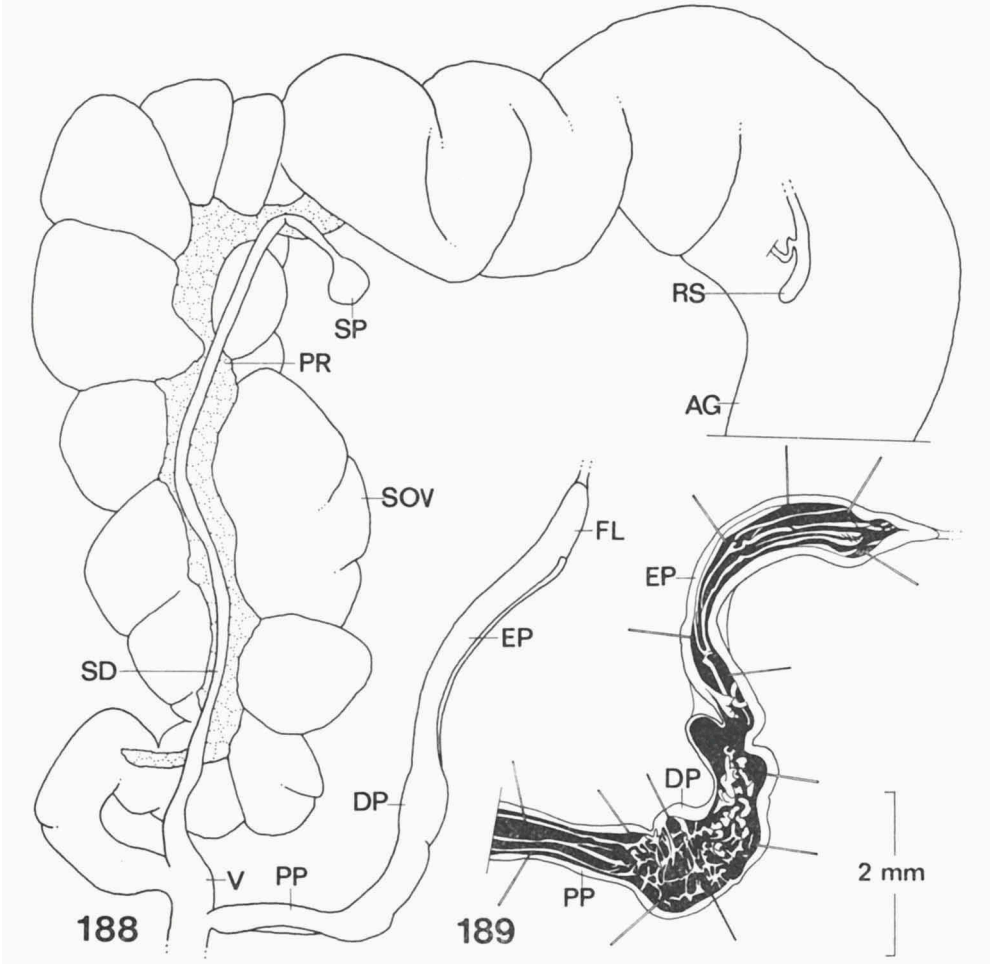


Fig. 187. *Drymaeus* (*Mesembrinus*) *aurifluus* (Pfeiffer), genitalia. Mexico, Veracruz, 4.7 mi S. Huatusco (UF).

Drymaeus (Mesembrinus) bequaerti Weyrauch, 1956

This species was described from Peru, Dept. Huánuco, right margin of Río Monzón near its confluence with Río Huallaga. This locality is a few kilometers SSW. of Tingo Maria. Two new localities for this species are: (1) Cueva de las Pavas, 9.0 km S. Tingo Maria, 660 m (RMNH) [specimens with two spiral bands on the last whorl, but otherwise typical]; (2) 4.0 km

NE. Tingo Maria, 750 m (UF) [the specimen is whitish, with two reddish-brown bands on the upper whorls and three bands on the last whorl; shell height 21.5 mm, diameter 8.6 mm, height of aperture 7.5 mm, width 4.1 mm; eight whorls].



Figs. 188-189. *Drymaeus* (*Mesembrinus*) *dominicus* (Reeve), genitalia. Florida, 2.5 mi W. Dania (UF).

Drymaeus (Mesembrinus) bugabensis (Martens, 1893)
(pl. 6 fig. 4)

The specimen that corresponds to the original figure of Martens (1893) is designated lectotype: shell height 26.5 mm, diameter 11.0 mm (BMNH 1901.6.22.958). The material includes one paralectotype and is labelled 'Bugaba, Panama' (ex Godman-collection ex Champion).

Drymaeus (Mesembrinus) colmeiroi (Hidalgo, 1872)

This taxon was hitherto placed in the genus *Stenostylus* Pilsbry, 1898 (see Breure, 1979). One specimen, which was compared to the holotype in the Paris museum (see Breure, 1976), was collected by prof. Jaime Cantera of the University of Cali at the road to Campo Alegro, Lago Calima, Valle del Cauca, depto. Cali, Colombia (1600 m). This is the first record of this species for Colombia; until now this species was only known from the type locality Beaza in Ecuador.

Comparison of the specimen with specimens of *Stenostylus* species has brought us to the conviction that this taxon belongs to *Drymaeus* (*Mesembrinus*) Albers, 1850, which however need to be confirmed by anatomical data. It may be noted that the ecology (humid forest) and the altitude (1600 m) support our view that this species belongs to *Drymaeus* (*Mesembrinus*) instead of to *Stenostylus* (of which the species live under stones and in rock-chasms at altitudes above 3000 m).

Drymaeus (Mesembrinus) depictus (Reeve, 1849)
(pl. 6 fig. 5)

A lectotype is designated from among the type specimens preserved in the London museum: shell height 28.0 mm, diameter 12.2 mm (BMNH 1975529). The three specimens originate from the Cuming-collection and are labelled 'Venezuela'.

Drymaeus (Mesembrinus) deshayesi (Pfeiffer, 1845)
(pl. 7 fig. 1)

Type specimens of this species are preserved in the British Museum (Natural History) and one is designated lectotype: shell height 44.5 mm, diameter 17.5 mm (BMNH 1975526). The material is labelled 'New Granada' (ex Cuming).

Drymaeus (Mesembrinus) dominicus (Reeve, 1850)
(figs. 188-189)

Two type specimens of the junior synonym *Bulimus floridanus* Pfeiffer, 1857, have been located in the British Museum (Natural History). A lectotype is here designated: shell height 17.0 mm, diameter 8.3 mm (BMNH 1975199). The specimens are labelled 'Florida' and originate from the Cuming-collection.

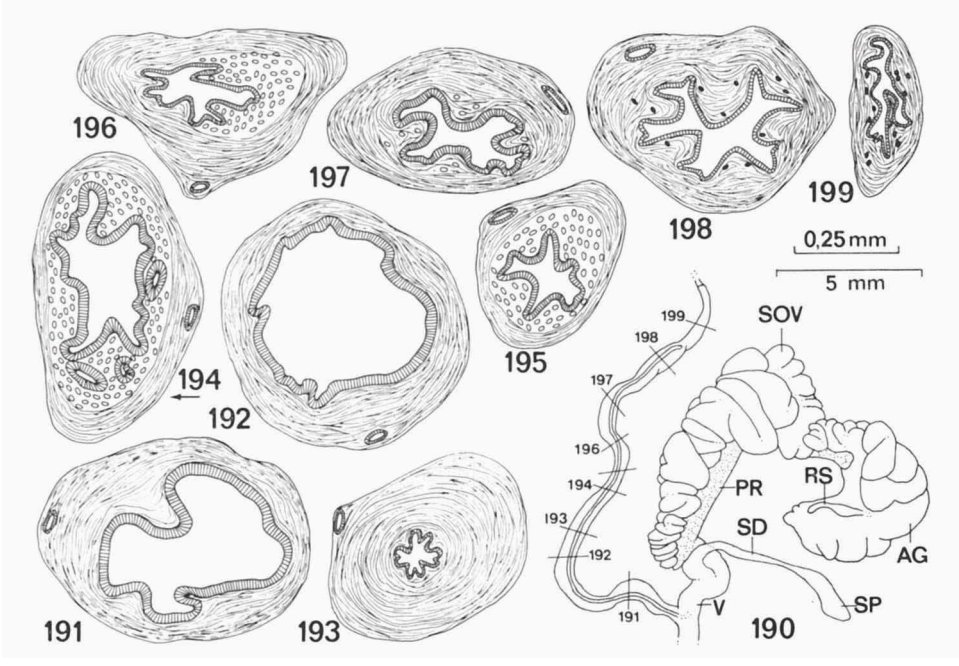
Genitalia. — The phallus-complex is relatively short. The penis is without a proximal sheath, sub-cylindrical, its distal part swollen. The epiphallus is sub-cylindrical, about as long as the penis. The flagellum is tapering and ca. 1/7 the length of the phallus. The vagina is very short. The spermathecal duct is sub-cylindrical, with a small, globose spermtheca.

Material. — U.S.A., Florida, Broward County, 2.5 mi W. of Dania (UF) [figs. 188-189]; Florida, Dade County, 8 mi W. of Gould (UF).

Drymaeus (Mesembrinus) dormani (W. G. Binney, 1857) (figs. 190-199)

The radula of a specimen from Florida, Port Orange, has been described by Binney (1876). Our observations (see page 96) correspond to his data.

Genitalia. — Penis without a sheath, sub-cylindrical, passing without external differentiation into the epiphallus. The flagellum is tapering, about half as broad as the epiphallus and about 1/7 the length of the phallus. The vagina is relatively broad and short. Spermathecal duct and spermatheca are undifferentiated, more or less tapering and truncate at the distal end.



Figs. 190-199. *Drymaeus* (*Mesembrinus*) *dormani* (Binney), genitalia and transverse sections of penis (figs. 191-196, slides H 5410, 5412, 5413, 5414 (3x)), epiphallus (figs. 197-198, slide H 5415 (2x)) and flagellum (fig. 199, slide H 5416). Florida, Brooksville (UF).

Histology. The epithelium of the proximal part of the penis is high-cylindrical, decreasing in height from proximal to distal (40-25 μm high). In the transition-zone from proximal to distal part of the penis the lumen is very narrow and lined by a low-cylindrical to cubic epithelium (ca. 10 μm high), except in the median part where the lumen increases in width and the epithelium is high-cylindrical (40 μm high). The epithelium of the distal part of the penis is also high-cylindrical with cells of ca. 25 μm high. The subepithelial tissue consists of rounded cells of 15-20 μm diameter. The number of these cells, the height of the epitheliumcells and the width of the lumen decrease towards the epiphallus. The epithelium of both the epiphallus and flagellum is ciliated and cubic to low-cylindrical (ca. 13 μm high). Glandular cells are dispersed in the subepithelial tissue of both structures, but are especially prominent near the entrance of the vas deferens.

Material. — U.S.A., Florida, Hernando, Brooksville, Mitchell Road (UF).

Drymaeus (Mesembrinus) dubius (Pfeiffer, 1853)
(pl. 7 fig. 10)

Three subadult type specimens of this species are in the collection of the London museum and one specimen is designated lectotype: shell height 27.5 mm, diameter 11.0 mm (BMNH 1975519). The specimens are labelled 'Andes N. Granada' (ex Cuming). This taxon is here figured for the first time.

Drymaeus (Mesembrinus) dutaillyi (Pfeiffer, 1857)
(pl. 7 fig. 2)

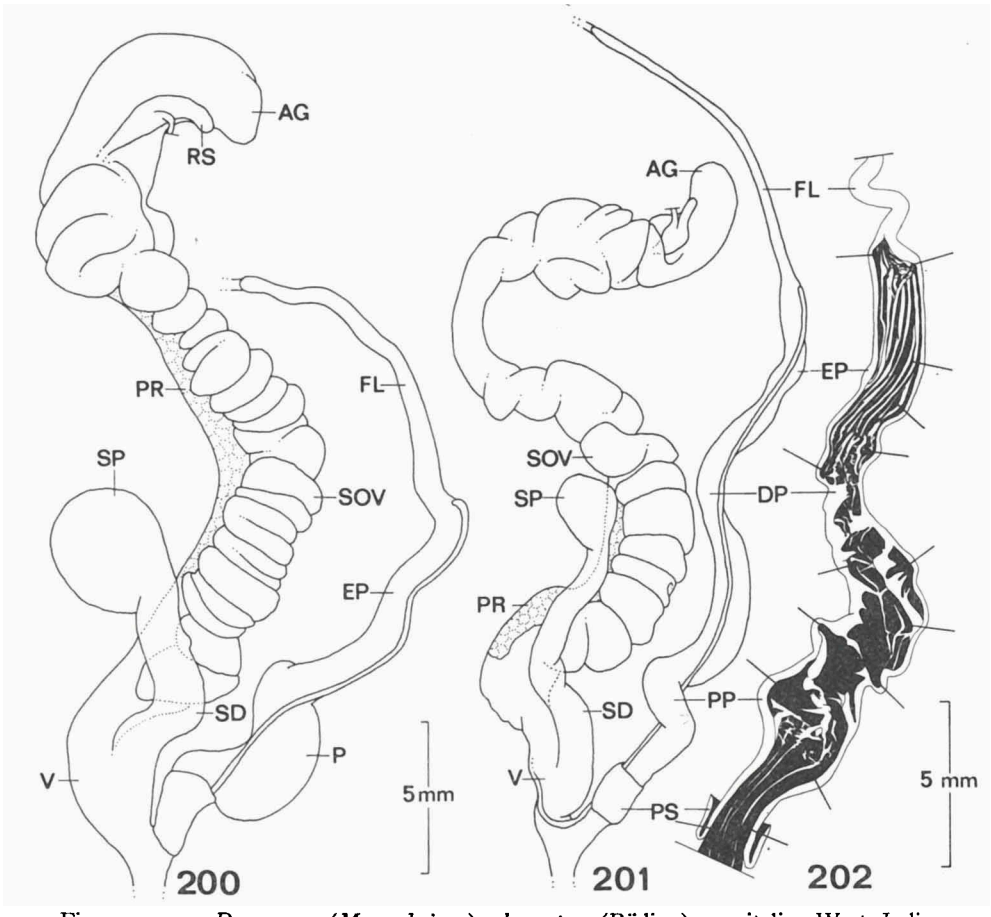
A subadult type specimen has been located in the British Museum (Natural History) and is designated lectotype: shell height 31.0 mm, diameter 12.6 mm (BMNH 1975516). The material is labelled 'Brazil' (ex Cuming ex Dutailly). The species is here figured for the first time.

Drymaeus (Mesembrinus) electrum (Reeve, 1848)
(pl. 7 fig. 3)

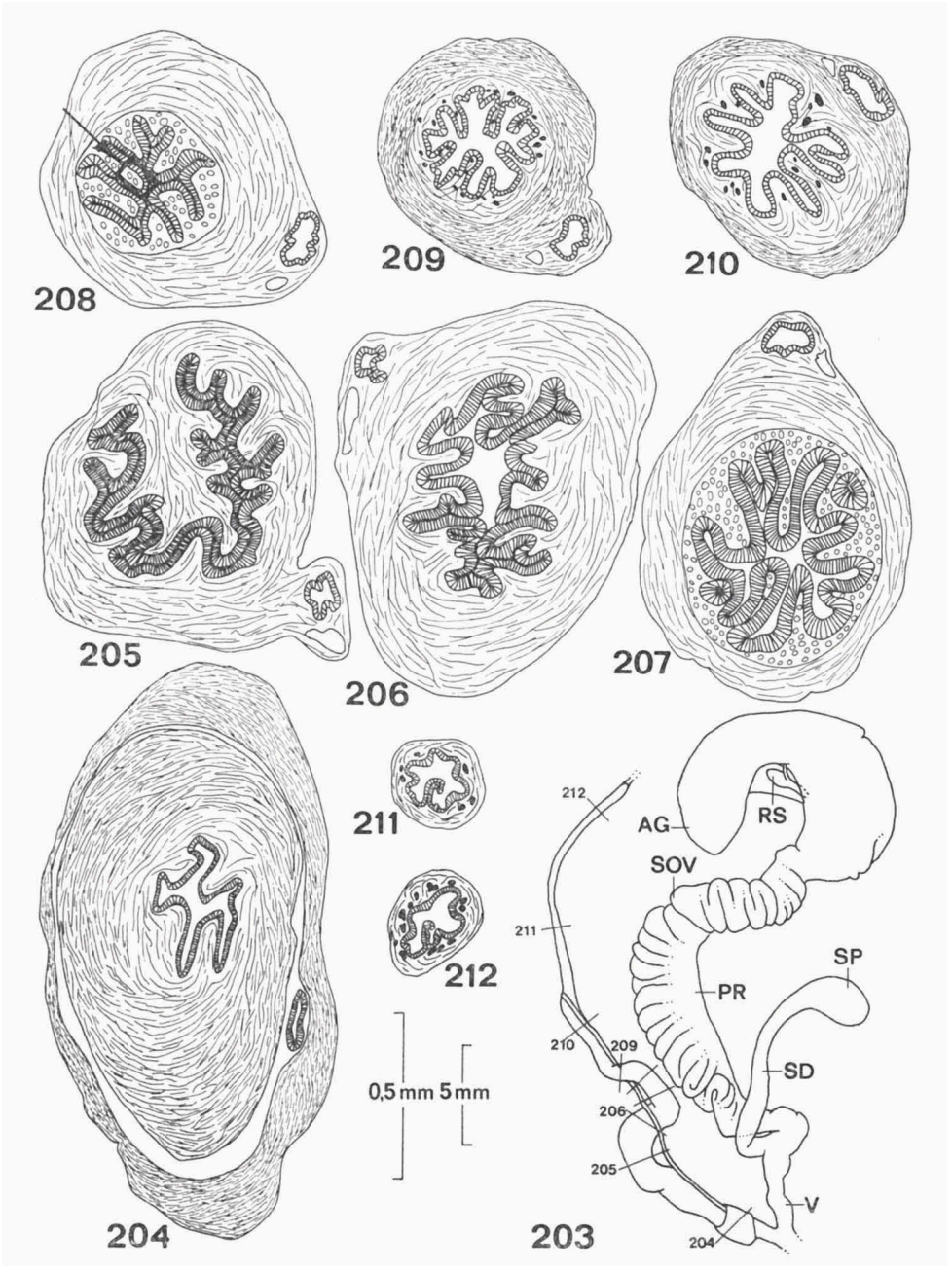
A lectotype is designated from among three type specimens preserved in the London museum: shell height 29.5 mm, diameter 14.3 mm (BMNH 1975510). The specimens originate from the Cuming-collection and are labelled 'Venezuela'.

Drymaeus (Mesembrinus) elongatus (Röding, 1798)
(figs. 200-212)

During work for a partial revision of West Indian bulimulids (see Breure, 1974, 1975) material of this widespread species was studied to investigate the possible existence of any subspecies. The measurements taken at that time are presented in table 1, while the unpublished observations of L. A. W. C. Venmans are given in table 2. These data, which are an addition to those of Baker (1924: table VIII), have been analysed by principal component analysis and cluster analysis, using the BIOPAT-program of Hogeweg and Hesper. From these analyses it must be concluded that it is not justified to divide *Drymaeus elongatus* into subspecies (the computer output will be deposited in the Leiden museum).



Figs. 200-202. *Drymaeus* (*Mesembrinus*) *elongatus* (Röding), genitalia. West Indies, St. Thomas (RMNH).



Figs. 203-212. *Drymaeus* (*Mesembrinus*) *elongatus* (Röding), genitalia and transverse sections of penis (figs. 204-208, slides H 4172, 4175, 4176, 4177, 4179), epiphallus (figs. 209-210, slides H 4180, 4182) and flagellum (figs. 211-212, slides H 4187, 4189). West Indies, Puerto Rico, 10 km E. Guánica (RMNH). Arrow in fig. 208 refers to plate 1 fig. 1.

Table 1. Measurements in Drymaeus elongatus (Röding). If five or more specimens have been measured the mean, 0.95 confidence limits, minimum and maximum value are given respectively; otherwise the individual measurements (in mm) are given. Locality numbers refer to Hummelinck (1940c, 1953).

		N	H	D	HA	WA	LW	PW	W	H/D	HA/H	HA/WA	LW/H
s.n.	MONA ISLAND	4	27.5	10.7	12.4	6.1	18.5	9.9	6.2	2.57	0.45	2.03	0.67
			25.5	9.1	11.0	5.2	17.0	9.5	6.4	2.80	0.43	2.12	0.67
			22.0	9.2	10.6	5.0	15.5	7.9	5.7	2.39	0.45	2.12	0.70
			22.5	9.2	10.5	4.9	15.5	8.4	5.8	2.44	0.47	2.14	0.69
PUERTO RICO													
698	Parguera, Cerro Papayo	2	29.5	13.0	13.0	7.5	19.0	10.5	6.5	2.27	0.44	1.73	0.64
			26.0	12.0	11.5	7.0	18.0	9.5	6.4	2.17	0.44	1.64	0.69
699	Parguera, Salina Papayo	17	29.18	13.32	12.71	7.09	19.38	10.32	6.61	2.20	0.44	1.80	0.66
			1.92	0.64	0.73	0.59	1.17	0.73	0.36	0.13	0.02	0.10	0.02
			26.0	12.5	11.0	6.0	17.0	9.0	6.0	2.00	0.40	1.63	0.63
			32.5	14.5	14.0	8.0	22.0	11.5	7.1	2.48	0.47	1.92	0.69
700	Parguera, Isla Magueyes	4	22.0	10.5	9.5	5.1	15.0	8.2	6.0	2.10	0.43	1.86	0.68
			26.0	12.5	12.5	6.9	18.5	9.5	6.0	2.08	0.48	1.81	0.71
			29.5	13.2	13.2	7.1	19.5	10.4	6.6	2.23	0.45	1.86	0.66
			29.5	13.1	13.0	7.5	19.5	10.5	6.3	2.25	0.44	1.73	0.66
701A	Parguera, Isla Cueva, NW	7	26.43	11.64	11.57	6.36	17.43	9.29	6.26	2.27	0.44	1.82	0.66
			1.86	0.90	1.46	0.80	1.54	0.64	0.33	0.11	0.03	0.09	0.02
			24.0	10.5	9.9	5.4	15.0	8.5	5.7	2.17	0.39	1.67	0.63
			29.5	13.1	13.4	7.5	19.5	10.1	6.5	2.48	0.47	1.92	0.69
702	Ensenada, near former lagunel	9	25.68	12.42	11.87	6.89	17.97	9.37	6.17	2.07	0.46	1.73	0.70
			2.27	0.95	0.76	0.61	1.50	1.09	0.22	0.08	0.02	0.09	0.02
			21.0	10.9	10.6	5.9	15.0	6.8	5.8	1.91	0.43	1.60	0.67
			30.0	15.0	13.6	7.9	21.0	11.4	6.6	2.22	0.51	1.86	0.73
703	8 km E Guánica	5	24.70	12.40	10.90	6.70	16.90	8.70	6.26	1.99	0.44	1.63	0.68
			0.97	0.22	0.55	0.45	0.42	0.57	0.23	0.10	0.03	0.09	0.03
			24.0	12.0	10.1	6.0	16.5	7.9	5.9	1.92	0.39	1.57	0.64
			26.0	12.7	11.2	7.1	17.5	9.6	6.5	2.13	0.46	1.79	0.71
s.n.	Sal Corozo	1	26.5	12.1	11.0	6.4	18.0	9.5	6.5	2.19	0.42	1.72	0.68
ST. CROIX													
s.n.	Spring Gut	5	21.90	9.70	10.30	5.90	15.20	7.60	5.96	2.26	0.47	1.76	0.69
			0.65	0.27	0.45	0.55	0.57	0.22	0.11	0.04	0.01	0.17	0.01
			21.5	9.4	10.0	5.1	14.6	7.4	5.8	2.20	0.45	1.54	0.67
			23.0	10.1	11.0	6.6	16.0	8.0	6.1	2.30	0.49	2.00	0.70
s.n.	Fredensborg, S. slope	1	30.5	12.6	12.6	7.4	19.5	10.0	7.1	2.38	0.42	1.70	0.65
s.n.	Fredensborg	1	30.0	12.1	13.9	7.5	20.0	9.6	7.1	2.48	0.46	1.85	0.67
s.n.	[without exact locality]	6	25.17	10.67	11.17	6.27	16.75	9.03	6.50	2.36	0.44	1.78	0.67
			1.78	0.77	0.82	0.42	1.04	0.39	0.30	0.09	0.02	0.08	0.01
			23.0	9.9	10.2	5.7	15.5	8.5	6.1	2.26	0.41	1.63	0.65
			27.5	11.0	12.4	6.7	18.0	9.5	6.9	2.47	0.46	1.88	0.68
s.n.	[without exact locality]	5	23.60	10.26	10.76	6.10	16.10	8.28	6.38	2.30	0.46	1.76	0.68
			0.89	0.29	0.22	0.10	0.42	0.40	0.26	0.04	0.01	0.06	0.02
			22.5	9.9	10.4	6.0	15.5	7.9	6.1	2.25	0.44	1.68	0.67
			24.5	10.5	11.0	6.2	16.5	8.9	6.8	2.33	0.48	1.80	0.71
s.n.	[without exact locality]	10	24.80	10.51	10.89	6.11	16.50	8.84	6.47	2.36	0.44	1.79	0.67
			1.57	0.49	0.77	0.54	0.97	0.74	0.22	0.06	0.02	0.13	0.02
			23.0	10.0	10.1	5.4	15.5	8.0	6.2	2.28	0.40	1.58	0.63
			28.5	11.7	12.4	7.2	18.5	10.4	6.9	2.44	0.46	2.00	0.69

Table 1 (continued).	N	H	D	HA	WA	LW	PW	W	H/D	HA/H	HA/WA	LW/H
s.n. [without exact locality]	8	25.19	10.80	11.33	6.24	16.63	8.94	6.40	2.33	0.45	1.82	0.66
		1.25	0.57	0.33	0.33	0.80	0.69	0.19	0.07	0.02	0.09	0.01
		24.0	10.1	10.9	5.9	16.0	8.0	6.2	2.22	0.42	1.66	0.65
		27.5	11.8	11.8	7.0	18.0	10.1	6.7	2.43	0.47	1.90	0.67
s.n. East St. Croix	16	24.56	11.22	10.72	6.56	16.56	9.00	6.18	2.19	0.44	1.63	0.67
		2.38	0.80	1.02	0.40	1.57	0.97	0.28	0.11	0.02	0.08	0.02
		20.0	9.5	9.0	6.0	13.6	7.2	5.7	2.00	0.40	1.50	0.63
		29.0	12.6	12.4	7.2	19.5	10.4	6.8	2.32	0.46	1.79	0.70
ANGUILLA												
s.n. Sandy Hill	14	25.18	10.69	10.80	6.27	16.67	9.04	6.58	2.39	0.43	1.73	0.66
		1.38	0.72	0.72	0.58	1.07	0.59	0.22	0.16	0.02	0.10	0.04
		23.5	9.6	9.9	5.5	15.0	8.1	6.2	2.14	0.39	1.59	0.55
		27.5	12.0	12.2	7.5	18.5	10.2	7.0	2.75	0.47	1.88	0.69
s.n. [without exact locality]	14	24.79	10.64	10.74	6.35	16.46	9.04	6.54	2.33	0.43	1.69	0.66
		1.17	0.55	0.57	0.33	0.89	0.58	0.12	0.06	0.02	0.07	0.01
		23.0	9.9	9.8	5.9	15.5	8.4	6.3	2.25	0.40	1.55	0.64
		27.0	11.8	11.8	7.1	18.5	10.4	6.7	2.45	0.46	1.79	0.69
ST. MARTIN												
437A Meschrine Hill, W.	5	23.10	10.20	9.80	5.70	15.40	8.40	6.14	2.27	0.42	1.73	0.67
		1.67	0.67	0.91	0.67	1.08	0.65	0.09	0.09	0.02	0.09	0.02
		22.0	9.5	8.9	4.9	14.0	7.8	6.1	2.14	0.41	1.58	0.64
		26.0	11.0	10.8	6.4	17.0	9.6	6.3	2.36	0.46	1.80	0.69
458A Point Blanche, W.	5	24.00	10.80	11.40	6.20	16.20	9.40	6.20	2.22	0.47	1.84	0.68
		0.70	0.48	0.55	0.45	0.84	0.55	0.22	0.06	0.02	0.10	0.04
		23.0	10.1	10.8	5.9	15.0	8.8	5.9	2.18	0.46	1.71	0.63
		25.0	11.2	12.0	7.1	17.0	10.0	6.5	2.30	0.50	2.00	0.74
458a Point Blanche, W.	12	25.67	11.33	11.00	6.46	16.88	9.38	6.34	2.26	0.43	1.71	0.66
		2.02	0.62	0.74	0.58	1.05	0.68	0.32	0.10	0.02	0.10	0.03
		21.0	10.1	9.7	5.9	14.6	7.9	5.7	2.09	0.39	1.57	0.61
		28.5	12.1	12.0	7.4	18.0	10.1	6.9	2.38	0.46	1.83	0.71
461a Old Battery	1	24.5	11.0	11.0	6.9	17.0	8.8	6.2	2.23	0.45	1.59	0.69
606 Point Blanche Bay	1	26.0	11.1	10.2	6.0	16.5	8.5	7.0	2.34	0.39	1.70	0.63
680 Little Bay Pond	2	26.0	11.4	10.1	6.1	17.0	9.6	6.6	2.28	0.39	1.66	0.65
		24.5	11.5	11.2	6.6	16.5	8.0	6.4	2.13	0.46	1.70	0.67
709 Fort Willem Ruines	19	25.68	11.37	11.08	6.61	17.03	9.13	6.37	2.25	0.43	1.68	0.66
		2.18	0.66	0.75	0.36	1.18	0.78	0.33	0.10	0.02	0.13	0.02
		18.0	9.0	8.5	6.0	13.1	8.4	5.7	2.00	0.39	1.31	0.62
		28.0	12.1	12.0	7.2	18.5	10.1	6.9	2.39	0.47	1.85	0.72
829 Point Blanche Bay	1	23.5	10.0	9.2	5.5	14.6	9.5	6.5	2.35	0.39	1.67	0.62
1132a Flamingo Pond	5	23.10	10.50	9.90	6.20	15.20	8.20	6.24	2.19	0.43	1.60	0.66
		3.07	0.94	1.08	0.45	1.96	1.25	0.32	0.12	0.02	0.15	0.02
		20.5	9.5	8.5	5.9	13.0	7.1	5.8	2.05	0.41	1.42	0.64
		27.0	11.6	11.0	7.0	17.5	9.6	6.6	2.35	0.46	1.83	0.68
s.n. near Flamingo Pond	9	23.50	10.72	10.28	6.06	15.61	8.56	6.16	2.19	0.44	1.70	0.67
		1.54	0.51	0.62	0.46	0.86	0.63	0.33	0.09	0.02	0.09	0.02
		21.5	10.0	9.7	5.5	14.6	8.0	5.4	2.10	0.40	1.57	0.63
		25.5	11.6	11.5	7.0	17.0	9.6	6.5	2.38	0.48	1.82	0.70
s.n. Corner Hill	4	21.5	9.7	9.0	5.5	14.1	8.0	6.2	2.22	0.42	1.64	0.66
		21.5	10.0	9.2	5.6	14.6	8.2	6.0	2.15	0.43	1.64	0.68
		23.5	10.4	9.6	6.0	15.0	8.4	6.5	2.26	0.41	1.60	0.64
		22.5	10.3	9.4	5.6	15.0	8.1	6.2	2.18	0.42	1.68	0.67

Table 1 (continued).		N	H	D	HA	WA	LW	PW	W	H/D	HA/H	HA/WA	LW/H
s.n.	Corner Hill, W.	18	20.58	9.50	9.67	5.39	14.17	7.89	6.04	2.16	0.47	1.81	0.69
			3.20	0.99	1.14	0.85	1.82	1.18	0.36	0.15	0.03	0.17	0.03
			18.0	8.8	8.8	4.2	12.2	6.0	5.6	2.00	0.43	1.50	0.63
			30.0	12.0	12.8	7.9	19.0	10.8	6.8	2.50	0.50	2.25	0.72
s.n.	Corner Hill, W.	19	18.74	9.53	9.89	6.16	14.32	7.84	6.03	2.09	0.50	1.61	0.72
			5.28	0.90	1.24	0.37	1.95	1.01	0.37	0.15	0.02	0.20	0.03
			15.0	8.2	8.2	5.9	12.3	6.0	5.6	1.88	0.46	1.28	0.66
			25.0	11.1	12.0	7.1	17.0	9.0	6.6	2.40	0.53	2.00	0.75
s.n.	Corner Hill, W.	19	20.42	9.71	9.79	5.47	13.71	7.63	5.96	2.09	0.48	1.79	0.67
			3.37	1.05	1.48	0.70	2.17	1.34	0.51	0.17	0.04	0.19	0.02
			14.0	8.0	7.2	4.9	9.9	5.0	5.1	1.75	0.43	1.40	0.64
			25.0	11.5	13.0	7.1	17.0	10.1	7.1	2.50	0.57	2.10	0.71
s.n.	Mullet Pond Bay	19	23.39	11.05	11.21	6.05	16.05	8.76	5.89	2.11	0.48	1.85	0.69
			3.39	1.12	1.43	0.80	2.34	1.24	0.41	0.15	0.02	0.08	0.06
			19.0	8.8	7.6	4.1	14.0	6.0	5.5	1.72	0.45	1.75	0.48
			27.5	12.6	13.0	7.1	18.5	10.0	6.5	2.32	0.53	2.00	0.74
BONAIRE													
193Aa	Fontein, Hofje	1	27.0	12.1	11.2	7.2	17.5	9.5	6.9	2.23	0.41	1.56	0.65
803	W Curuburu	20	27.03	12.18	11.83	6.50	18.05	9.25	6.68	2.22	0.44	1.82	0.67
			2.74	0.85	1.07	0.61	1.60	1.07	0.27	0.11	0.02	0.12	0.01
			20.0	10.0	9.2	5.4	14.0	8.0	6.5	2.00	0.40	1.56	0.65
			30.0	13.1	13.1	8.0	20.0	11.1	7.1	2.38	0.48	2.00	0.70
s.n.	Fontein	1	26.5	13.1	12.6	7.5	18.0	9.4	6.3	2.02	0.48	1.68	0.68
s.n.	Fontein	7	27.14	12.36	11.93	7.07	18.36	9.50	6.51	2.22	0.44	1.69	0.68
			1.21	0.38	0.45	0.19	0.56	0.29	0.28	0.10	0.02	0.07	0.02
			25.5	11.9	11.4	6.8	17.5	8.9	6.2	2.08	0.42	1.60	0.64
			29.5	13.0	12.6	7.6	19.0	10.0	7.0	2.36	0.46	1.79	0.71
s.n.	Lagoen, N. coast	6	28.08	12.83	12.17	7.33	18.67	9.67	6.64	2.19	0.43	1.67	0.67
			2.56	0.52	0.82	0.82	1.13	0.82	0.43	0.14	0.02	0.12	0.03
			25.5	12.0	11.1	6.5	17.5	8.6	6.0	2.00	0.42	1.50	0.64
			32.0	13.6	13.5	8.5	20.5	10.6	7.2	2.37	0.46	1.85	0.71
s.n.	Onima, S. Plateau	2	29.0	13.0	13.9	8.0	20.0	11.2	7.0	2.23	0.48	1.74	0.69
			30.0	13.1	14.0	8.0	20.0	11.8	6.7	2.29	0.47	1.75	0.67
s.n.	Salinja Wayacá/Slagbaai	1	28.0	12.1	11.6	7.0	17.5	10.1	6.9	2.31	0.41	1.66	0.63
s.n.	Fontein, Hofje	1	28.5	13.0	12.4	6.9	19.0	9.4	6.9	2.19	0.44	1.80	0.67
CURAÇAO													
231a	Seroe Teintje, W.	3	26.5	12.0	11.7	6.1	17.5	9.5	6.6	2.21	0.44	1.92	0.66
			22.5	10.6	9.2	6.3	14.5	8.5	6.4	2.12	0.41	1.46	0.64
			27.0	12.0	11.6	6.4	18.0	10.0	6.3	2.25	0.43	1.81	0.67
560	Spaanse Put, Playa Frankie	12	23.92	11.17	11.92	6.33	16.33	8.92	6.36	2.14	0.50	1.89	0.68
			2.50	0.72	1.00	0.65	1.37	0.79	0.24	0.14	0.03	0.09	0.02
			21.0	10.0	10.2	4.9	13.2	7.0	5.8	1.80	0.46	1.71	0.65
			27.0	12.1	13.0	7.1	18.0	10.0	6.7	2.36	0.55	2.00	0.73
909	Pestbaai	3	27.0	11.5	11.0	6.6	17.0	9.5	6.8	2.35	0.41	1.67	0.63
			29.0	11.7	11.1	6.5	18.0	10.5	7.1	2.48	0.38	1.71	0.62
			25.0	11.3	10.6	7.0	17.0	9.4	6.3	2.21	0.42	1.51	0.68
947	Ceru Rondó	1	24.5	11.0	10.6	6.6	16.5	8.5	6.4	2.23	0.43	1.61	0.67
s.n.	Wechi, NW Julianadorp	1	21.5	10.0	8.7	5.4	14.2	8.0	6.5	2.15	0.40	1.61	0.66
s.n.	Road to Siberië	1	25.5	11.4	10.4	7.5	16.5	9.3	6.6	2.24	0.41	1.39	0.65
s.n.	Seroe Christoffel, W.	1	26.0	12.1	11.2	7.1	17.0	9.5	6.2	2.15	0.43	1.58	0.65
s.n.	Seroe Fortuna, SW.	1	27.0	12.5	11.2	7.6	17.5	9.4	6.5	2.16	0.41	1.47	0.65

Table 1 (continued).	N	H	D	HA	WA	LW	PW	W	H/D	HA/H	HA/WA	LW/H
s.n. Tafelberg, top	5	29.10	12.90	12.20	6.90	18.90	10.40	6.64	2.26	0.42	1.77	0.65
		2.01	0.82	0.84	0.42	1.24	0.82	0.17	0.05	0.01	0.12	0.01
		27.0	12.0	11.4	6.5	18.0	9.4	6.4	2.21	0.40	1.64	0.65
		31.5	14.1	13.7	7.6	20.5	11.4	6.8	2.33	0.43	1.93	0.67
s.n. Seroe Fortuna, E.	1	25.0	12.1	11.2	7.1	17.0	9.0	6.3	2.07	0.45	1.58	0.68
s.n. Santa Barbara	2	29.0	12.2	11.5	7.0	19.0	10.3	6.9	2.38	0.40	1.64	0.66
		27.0	11.6	10.7	6.1	18.0	10.5	6.5	2.33	0.40	1.75	0.67
s.n. N Seroe Dakwé, St. Sebastiaan	1	21.0	10.4	9.4	6.5	14.6	7.6	5.9	2.02	0.45	1.45	0.70
s.n. Seroe Papaya, W.	8	25.31	11.88	10.81	6.63	16.63	9.50	6.47	2.19	0.42	1.63	0.64
		2.63	0.64	0.80	0.44	2.31	0.71	0.35	0.11	0.02	0.11	0.07
		24.0	10.6	9.4	5.9	12.2	8.9	6.2	2.08	0.39	1.50	0.47
		29.0	12.4	11.6	7.0	19.5	10.9	7.0	2.33	0.44	1.85	0.69
s.n. Boca St. Marie	5	29.50	11.40	10.40	6.60	15.20	8.90	6.42	2.15	0.42	1.57	0.62
		2.69	0.96	1.43	0.74	2.51	0.82	0.31	0.10	0.02	0.08	0.09
		20.0	10.0	8.0	5.5	12.0	7.4	6.0	2.00	0.40	1.45	0.46
		26.5	12.6	11.7	7.5	17.5	9.6	6.7	2.26	0.44	1.64	0.69
s.n. near cave of Hato	6	24.67	11.67	11.83	6.69	17.00	9.50	6.33	2.11	0.48	1.79	0.64
		3.01	1.37	1.17	0.82	2.10	1.38	0.27	0.09	0.04	0.15	0.03
		19.0	9.2	10.0	5.0	13.1	7.3	6.0	2.00	0.41	1.57	0.63
		27.0	13.0	12.8	7.1	19.0	10.8	6.8	2.25	0.53	2.00	0.72
s.n. Boca Santa Marta, E.	7	26.14	11.71	12.29	6.71	17.29	9.86	6.57	2.23	0.47	1.84	0.66
		3.38	0.95	1.25	0.75	2.21	1.46	0.35	0.17	0.03	0.13	0.02
		19.0	10.1	10.0	5.9	13.2	7.0	5.9	1.90	0.44	1.67	0.63
		29.0	12.8	14.1	7.8	20.0	11.0	7.0	2.42	0.53	2.00	0.69
s.n. Lagune St. Jan	2	24.0	11.1	11.1	6.2	17.0	9.0	6.5	2.16	0.46	1.79	0.71
		23.0	10.9	10.9	6.8	15.2	7.9	6.5	2.11	0.47	1.60	0.66

The synonymy of this species, additional to the data of Pilsbry (1899: 24-25), is:

Bulimus elongatus, Bland, 1861: 351, 354, 358-360; Bland, 1866: 143 (French Guyana).

Bulimulus elongatus, Kobelt, 1880: 280-282, 286; Pfeiffer & Clessin, 1881: 243; Paetel, 1883: 144.

Drymaeus elongatus, Dall & Simpson, 1901: 379, pl. 53 fig. 5; Vernhout, 1914: 179-181, 183-186; Schepman, 1915: 480; Van Benthem Jutting, 1925: 25; Odhner, 1951: 262, fig. 12 [not 13] (genitalia); Clench, 1956: 70; Aguayo, 1961: 95; Aguayo, 1966: 5; Coomans, 1967: 137; Jacobson, 1968: 24; Clench, 1969: 145; Coomans, 1974: 196. Not *Drymaeus elongatus*, Parodiz, 1962: 445 (Nicaragua) [specimen examined].

Cochlogena virgulata, Sowerby, 1825: 39, lot 971.

Bulimus virgulatus, Anton, 1839: 41; Catlow & Reeve, 1845: 162; Albers, 1850: 157; Jay, 1852: 213; Mörch, 1852: 23; Shuttleworth, 1854: 69; Beau, 1857: 492; Schramm, 1869: 17. Not *Bulimus virgulatus*, Tristam, 1864: 412 (Guatemala).

Table 2. Measurements in Drymaeus elongatus (Röding). Mean and observed range are given (in mm). After manuscript notes of L.A.W.C. Venmans.

		N	H	D	HA	H/D	HA/H	W
Anguilla								
483	Long Bay	3	25.1(24.3-25.6)	11.4(11.2-11.7)	12.3(12.0-12.6)	2.2	0.50(0.48-0.50)	6.8(6.8-7.0)
484	Sandy Ground	28	24.8(21.9-27.1)	11.5(10.1-12.8)	12.5(11.0-14.0)	2.2(2.0-2.3)	0.50(0.48-0.56)	6.7(6.3-7.0)
485	Sandy Ground N.	34	21.4(18.2-25.0)	9.8(8.5-11.1)	10.4(8.9-11.9)	2.2(1.8-2.5)	0.48(0.45-0.53)	6.6(6.0-7.0)
		65	23.0(18.2-27.1)	10.6(8.5-12.8)	11.4(8.9-14.0)	2.2(1.8-2.5)	0.48(0.45-0.56)	6.7(6.0-7.0)
St. Martin								
299	Signal Hill, Philipsburg	44	25.5(22.0-28.3)	11.4(10.4-12.5)	11.9(10.6-13.6)	2.2(2.0-2.5)	0.48(0.40-0.53)	6.8(6.0-7.3)
458	Point Blanche	4	25.1(24.0-26.2)	11.4(10.9-12.1)	12.3(11.5-13.4)	2.2(2.1-2.2)	0.48(0.48-0.50)	6.7(6.5-6.8)
458a	Point Blanche, top	8	24.0(22.7-25.0)	11.0(10.2-11.5)	11.7(11.1-12.2)	2.1(2.1-2.2)	0.50(0.48-0.53)	6.7(6.3-6.8)
461a	Old Battery	2	24.2(23.8-24.5)	11.1(11.0-11.2)	11.6(11.3-11.8)	2.2	0.48	6.8
470	Cole Bay Hill	1	26.5	11.4	13.5	2.3	0.50	6.1
471	Lay Bay	1	25.6	10.9	12.4	2.3	0.48	6.8
473	Meschrine Hill, base	3	22.4(21.8-23.5)	10.8(10.4-11.0)	11.3(10.6-12.4)	2.1(2.0-2.1)	0.50(0.48-0.53)	6.4(6.3-6.5)
s.n.	Devils Hole	11	22.7(19.0-25.1)	10.3(9.2-11.1)	10.9(9.6-12.0)	2.2(2.0-2.4)	0.48(0.45-0.50)	6.6(6.2-7.1)
s.n.	East slope of Naked Boy	52	24.2(21.5-27.2)	11.0(10.0-12.2)	11.9(9.8-13.3)	2.2(2.0-2.4)	0.50(0.42-0.53)	6.6(6.0-7.2)
s.n.	BovenPrinsenkwartier	9	25.7(24.2-29.2)	11.8(11.2-13.2)	12.3(11.7-13.7)	2.2(2.1-2.3)	0.48(0.45-0.50)	6.7(6.5-7.0)
s.n.	Great Saltpond	1	25.8	11.5	12.4	2.2	0.48	7.0
s.n.	near Flamingo Pond	12	23.7(21.4-27.3)	10.8(10.0-11.8)	11.3(10.3-12.3)	2.2(2.1-2.4)	0.48(0.43-0.53)	6.7(5.8-7.3)
s.n.	Corner Hill W.	63	23.5(20.2-29.5)	10.7(9.0-12.0)	11.5(10.0-13.2)	2.2(2.1-2.5)	0.48(0.45-0.53)	6.8(6.0-7.5)
680	Little Bay Pond E.	2	25.0(24.3-25.7)	11.7(11.5-11.9)	12.2(11.9-12.5)	2.1(2.0-2.2)	0.49(0.48-0.50)	6.8
		213	24.2(19.0-29.5)	11.0(9.0-13.2)	11.8(9.6-13.7)	2.2(2.0-2.5)	0.48(0.40-0.53)	6.7(5.8-7.5)
St. Barts								
s.n.	SE Grande Saline	1	23.9	10.8	11.9	2.2	0.50	7.0
St. Eustatius								
424	White Wall, base	19	23.3(21.1-26.5)	11.2(10.5-12.0)	11.4(10.4-12.5)	2.1(1.9-2.2)	0.48(0.45-0.53)	6.7(6.5-7.0)
425	White Wall, top	2	22.6(21.6-23.5)	10.8(10.5-11.0)	11.0(10.5-11.4)	2.1	0.48	6.5(6.3-6.8)
s.n.	E of Oranjebaai	1	24.8	11.5	12.7	2.2	0.50	6.6
		22	23.3(21.1-26.5)	11.2(10.5-12.0)	11.4(10.4-12.7)	2.1(1.9-2.2)	0.48(0.45-0.53)	6.7(6.3-7.0)
Margarita								
139	Cerro de Marmoleta	1	26.0	11.5	12.3	2.3	0.48	7.3
s.n.	Cueva Honda del Piache	1	27.8	11.5	12.7	2.4	0.45	7.0
s.n.	Robles, S Hermita	10	19.6(16.7-23.4)	9.2(7.6-10.4)	9.3(7.8-10.6)	2.1(1.9-2.3)	0.48(0.45-0.53)	6.8(6.3-7.3)
		12	20.8(16.7-27.8)	9.6(7.6-11.5)	9.8(7.8-12.7)	2.1(1.9-2.4)	0.48(0.45-0.53)	6.9(6.3-7.3)
Blanquilla								
171	N Valuchu	148	22.6(14.2-28.0)	11.3(8.0-12.8)	11.0(7.3-13.4)	2.0(1.7-2.3)	0.50(0.43-0.56)	6.7(5.7-7.7)
Bonaire								
184A	SW Lima	1	22.6	10.5	11.1	2.2	0.50	7.0
190A	S Fontein	2	29.8(27.1-32.5)	15.6(12.5-18.7)	14.7(13.7-15.6)	2.0(1.7-2.2)	0.49(0.48-0.50)	7.0(6.5-7.5)
190A	Fontein,Bovenste Terras	1	27.6	12.5	13.4	2.2	0.48	7.0
s.n.	Porta Spanjo	9	28.7(27.3-30.5)	12.5(12.3-12.8)	13.6(12.8-14.7)	2.3(2.2-2.5)	0.48(0.45-0.50)	7.3(7.2-7.5)
s.n.	Onima, S. Plateau	4	28.3(26.9-29.5)	13.0(12.8-13.2)	13.8(13.6-14.1)	2.2(2.1-2.3)	0.48(0.48-0.53)	7.1(7.0-7.2)
s.n.	[without exact locality]	1	23.2	11.4	11.9	2.0	0.53	6.6
		18	28.0(22.6-32.5)	12.8(10.5-18.7)	13.5(11.1-15.6)	2.2(1.7-2.5)	0.48(0.45-0.53)	7.2(6.5-7.5)
Curaçao								
206	Steilrand Tafelberg	27	25.4(23.0-27.9)	12.0(10.9-13.1)	12.7(11.9-14.2)	2.1(1.9-2.3)	0.50(0.48-0.53)	6.6(6.2-6.7)
207	near Cave Newport,Fuikbaai	5	24.2(21.5-26.1)	11.8(10.9-12.8)	12.0(11.0-14.1)	2.0(1.9-2.1)	0.50(0.45-0.53)	6.7(6.5-7.0)
212	St. Jago, Schaarloo	1	21.0	10.5	9.5	2.0	0.45	6.9
217	near Cave of Hato	12	24.8(21.4-26.8)	11.8(10.5-12.7)	12.2(10.5-13.3)	2.1(2.0-2.2)	0.50(0.48-0.53)	6.8(6.5-7.0)
221	Groote Berg	7	25.4(22.7-29.2)	11.9(11.3-12.4)	12.3(11.3-13.0)	2.1(2.0-2.4)	0.50(0.45-0.53)	6.7(6.5-7.2)
225	Seroe Cabajé,Porto Marie	6	26.0(23.1-27.8)	12.0(11.1-12.4)	12.2(11.7-12.9)	2.2(2.1-2.2)	0.48(0.43-0.50)	6.8(6.5-7.2)
227a	Seroe di Cueba	17	24.6(20.6-27.2)	11.4(9.9-12.4)	11.9(10.4-13.5)	2.1(2.0-2.3)	0.48(0.45-0.53)	6.9(6.5-7.5)
228	Galbas boshi,Seroe di Cueba	3	27.0(26.3-27.5)	12.6	13.1(12.9-13.2)	2.2(2.1-2.2)	0.49(0.48-0.50)	7.0(7.0-7.2)
229	SW Seroe Bartool	38	26.6(23.0-29.6)	12.1(10.7-12.8)	12.7(11.2-13.8)	2.2(1.9-2.4)	0.48(0.43-0.53)	7.0(6.2-7.5)
231	Seroe Tointje,Savonet	9	27.1(23.5-29.3)	12.5(11.2-13.5)	13.5(12.0-15.3)	2.2(2.0-2.3)	0.50(0.48-0.53)	6.8(6.2-7.0)
233	Rooi Sorsaka	13	27.5(24.5-31.0)	12.8(12.0-13.5)	13.2(12.4-14.3)	2.1(2.0-2.4)	0.48(0.45-0.53)	6.8(6.0-7.2)
238	Boshi di Westpunt	1	27.4	12.5	12.7	2.2	0.45	7.0
240a	NW Playa Aban Kuip	1	24.5	12.3	11.5	2.0	0.48	6.7
243	N St. Kruis Baai	2	27.6(26.7-28.5)	12.3(12.1-12.4)	12.8(12.3-13.2)	2.3(2.2-2.3)	0.46	7.1(7.0-7.2)

Table 2 (continued).

243a	Seroe Commandant	12	26.2(22.9-30.8)	12.4(11.3-14.1)	13.4(12.2-15.0)	2.1(2.0-2.2)	0.50(0.48-0.56)	6.6(6.2-7.0)
245a	near Hofje St. Kruis	4	28.3(27.3-29.7)	12.5(12.1-13.0)	13.4(12.5-14.4)	2.3(2.2-2.3)	0.48(0.45-0.48)	7.0(7.0-7.2)
329	Tafelberg Sta. B	1	30.3	13.0	13.9	2.6	0.45	7.0
330	Tafelberg Sta. B	3	26.9(25.5-28.9)	12.8(12.0-13.8)	13.5(12.4-14.5)	2.1	0.50(0.48-0.53)	6.8(6.8-7.0)
341	Bullen Baai	1	22.0	10.0	10.0	2.2	0.45	6.5
560	Playa Frankie	18	24.7(22.0-26.4)	11.4(10.7-12.2)	12.1(10.5-13.1)	2.2(2.1-2.3)	0.48(0.45-0.50)	6.8(6.5-7.3)
s.n.	1½ km W Tanki Monpos,Hato	32	24.9(17.1-29.0)	11.5(9.2-13.1)	11.9(8.9-14.0)	2.2(1.9-2.3)	0.48(0.45-0.53)	6.8(6.0-7.5)
s.n.	Fuik Baai,Newport Bath	22	26.9(24.1-31.2)	12.5(11.7-13.5)	13.1(11.7-14.2)	2.2(2.0-2.4)	0.48(0.45-0.53)	6.8(6.5-7.3)
s.n.	Seroe Teintje	9	25.5(22.5-28.0)	11.7(11.0-13.0)	11.9(11.0-13.0)	2.2(2.0-2.3)	0.45(0.43-0.50)	6.8(6.7-7.0)
s.n.	S Westpunt Baai	1	26.0	11.0	10.5	2.4	0.40	7.3
s.n.	near Cave of Hato	3	23.5	11.2(11.0-11.5)	11.2(11.0-11.5)	2.1(2.0-2.1)	0.49(0.48-0.50)	7.0(6.8-7.3)
s.n.	Santoe Pretoe, S St.Kruis	4	25.0(24.8-25.2)	11.2(10.8-11.7)	11.8(11.0-12.4)	2.3(2.2-2.3)	0.48(0.43-0.50)	6.8(6.5-7.3)
s.n.	near Grot Noordkant	1	29.3	12.2	12.7	2.4	0.43	7.5
s.n.	Seroe Teintje	5	27.1(25.2-29.0)	11.6(11.1-12.0)	12.7(12.1-13.2)	2.3(2.2-2.5)	0.48(0.45-0.50)	7.1(6.8-7.3)
s.n.	Hato	19	24.0(20.8-27.6)	11.6(10.5-12.6)	11.6(10.2-12.8)	2.1(1.9-2.2)	0.50(0.45-0.53)	6.6(6.1-7.3)
s.n.	San Pedro, North coast	2	26.2(25.7-26.8)	11.8(11.1-12.4)	12.1(11.7-12.4)	2.3(2.2-2.3)	0.45	6.8
s.n.	Knip, South coast	11	25.4(23.8-28.7)	11.7(11.3-12.1)	11.8(11.3-12.7)	2.2(2.0-2.4)	0.48(0.43-0.48)	6.9(6.7-7.5)
s.n.	Port Marie	28	25.4(23.4-29.1)	11.8(10.7-12.7)	12.1(11.0-13.4)	2.1(2.0-2.3)	0.48(0.45-0.50)	6.7(6.2-7.2)
s.n.	Seroe Rondo/S. Kloot	2	20.8(18.0-23.5)	10.2(9.1-11.3)	10.4(9.2-11.5)	2.1(2.0-2.1)	0.50	6.5(6.2-6.7)
s.n.	Trenkie and St.Nicolaas	6	24.5(21.2-27.2)	11.1(9.6-12.3)	11.6(10.0-12.4)	2.2(2.1-2.3)	0.48(0.45-0.50)	7.0(6.7-7.2)
s.n.	Seroe Cabajé	16	23.5(19.8-26.8)	11.3(10.0-12.6)	12.2(10.0-13.5)	2.1(2.0-2.2)	0.53(0.48-0.56)	6.5(6.2-7.0)
s.n.	Lagune St. Jan	2	22.6(22.3-22.9)	10.3(10.0-10.6)	11.4(11.1-11.6)	2.2	0.50	7.0
s.n.	near Cave of Hato	6	25.8(23.7-28.6)	12.0(11.4-12.7)	12.5(11.9-13.0)	2.2(2.0-2.5)	0.48(0.43-0.56)	6.9(6.5-7.5)
s.n.	Boca Santa Marta	6	26.9(25.0-29.1)	12.0(11.1-13.6)	12.4(11.6-13.9)	2.2(2.1-2.4)	0.45(0.45-0.48)	7.2(6.8-7.5)
s.n.	Beach of Santa Marta	1	27.6	11.8	11.8	2.3	0.43	7.8
		357	25.6(17.1-31.2)	11.9(9.1-14.1)	12.4(8.9-15.3)	2.2(1.9-2.5)	0.48(0.40-0.56)	6.8(6.0-7.5)
Aruba								
263	Rooi Francis	1	26.4	11.1	11.8	2.4	0.45	7.5
267	Seroe Canashito, E.	1	19.9	10.1	10.0	2.0	0.50	6.5
		2	23.2(19.9-26.4)	10.6(10.1-11.1)	10.9(10.0-11.8)	2.2(2.0-2.4)	0.48(0.45-0.50)	7.0(6.5-7.5)

Bulimulus virgulatus, Albers, 1860: 214; Paetel & Schaufuss, 1869: 81; Paetel, 1873: 101; Kobelt, 1880 [1876-1881]: pl. 82 fig. 10; Kobelt, 1880: 278, 280-282; Paetel, 1883: 144; Paetel, 1889: 225.

Drymaeus virgulatus, H. B. Baker, 1924: 80, pl. 14 fig. 52 (radula); H. B. Baker, 1926: 45, pl. 18 fig. 92 (genitalia); Schmitt, 1936: 377; Hummelinck, 1940a: 354 (Los Testigos, Blanquilla); Hummelinck, 1940b: 99 (Margarita; N. E. Colombia); Hummelinck, 1940c: 116; Richards, 1940: 303; Richards & Hummelinck, 1940: 7, 13; Van der Schalie, 1948: 89, pl. 8 fig. 3; Venmans & Verdcourt, 1950: 1, fig., pls 1-2 (radula); De Jong & Kristensen, 1968: 13, pl. 4 fig. 5.

Bulimus caribaeorum, Menke, 1830: 27; Pfeiffer, 1840: 29; Pfeiffer, 1841: 23.

Bulimus apiculatus, Catlow & Reeve, 1845: 150.

Bulimulus apiculatus, Paetel, 1889: 224.

Bulimus proteus, Pfeiffer, 1841: 23.

Bulimulus elongatus proteus, Paetel, 1889: 225.

Bulimulus kammereri, Paetel, 1873: 101.

Bulimulus kaemereri, Paetel, 1883: 144; Paetel, 1889: 224.

Bulimus extinctus, Pfeiffer, 1868: 114; Pfeiffer, 1877: 151.

Bulimulus extinctus, Kobelt, 1880: 281; Pfeiffer & Clessin, 1881: 233.
Drymaeus elongatus forma *extinctus*, Coomans, 1967: 138.
Bulimus anguillensis, Pfeiffer, 1877: 177.
Bulimulus anguillensis, Kobelt, 1880: 281; Pfeiffer & Clessin, 1881: 246; Paetel, 1883: 143.
Drymaeus elongatus anguillensis, Coomans, 1967: 138; Coomans, 1974: 196.
Drymaeus elongatus beattyi Clench, 1951: 273, figs. 4-6 (West Indies, Puerto Rico, Mona Island); Aguayo, 1961: 95; Aguayo, 1966: 5.

Genitalia. — The genitalia have been figured by Semper (1874), Baker (1926) and Odhner (1951). In figs. 200-202 two specimens from St. Thomas, Virgin Islands, are represented.

Histology. Both the proximal and distal part of the penis have a high-cylindrical epithelium, except for the most proximal part near the genital atrium where the epithelium is low-cylindrical. The high-cylindrical epitheliumcells have a cell height of 25 μm in the proximal part and 30 μm in the distal part. The subepithelial tissue of the distal part of the penis consists of rounded cells of ca. 15 μm diameter, of which the cytoplasm stains light blue with alcian blue. The epithelium of both the epiphallus and flagellum is cubic (ca. 10 μm high) and glandular cells are dispersed in the subepithelial tissue.

Material. — West Indies, Puerto Rico, 10 km E. Guánica (RMNH) [figs. 203-212]; Virgin Islands, St. Thomas (RMNH) [figs. 200-202].

Drymaeus (Mesembrinus) emeus (Say, 1829)
(figs. 213-221)

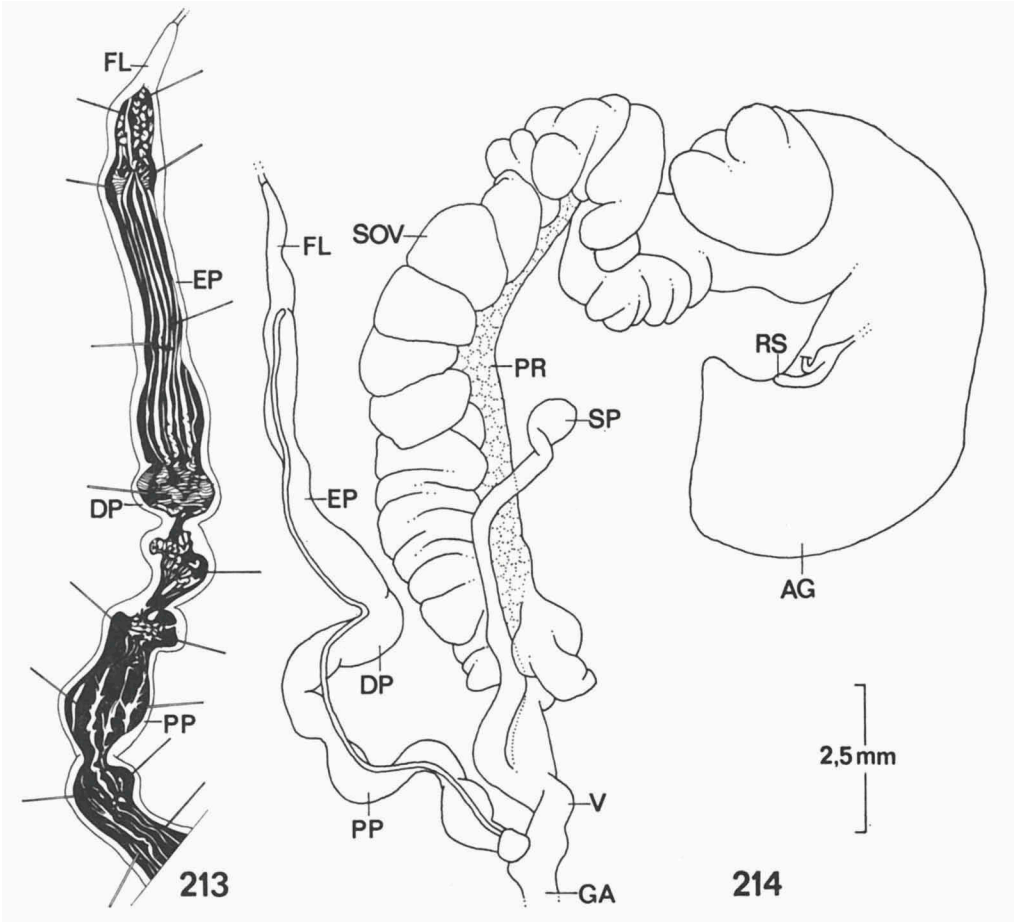
Genitalia. — Penis with a very short sheath, more or less sub-cylindical and hardly constricted at the transition to the epiphallus, which is sub-cylindrical. The flagellum is tapering, about half as broad as the epiphallus and ca. 1/6 the length of the phallus. The vagina is rather short. The spermathecal duct is about half as long as the spermoviduct, sub-cylindrical and with a relatively small spermatheca at the distal end.

Internally a few longitudinal pilasters are present in the proximal part of the penis. Two constrictions in the lumen, with a wider part in between, mark the transition to the distal part of the penis, where the wall bears short, transverse pilasters. The epiphallus has ca. eight continuous longitudinal pilasters and two pillow-shaped organs alongside the entrance of the vas deferens. In the flagellum one longitudinal pilaster and several short, transverse ones are present.

Material. — Mexico, Veracruz, base of volcán St. Martin (UF).

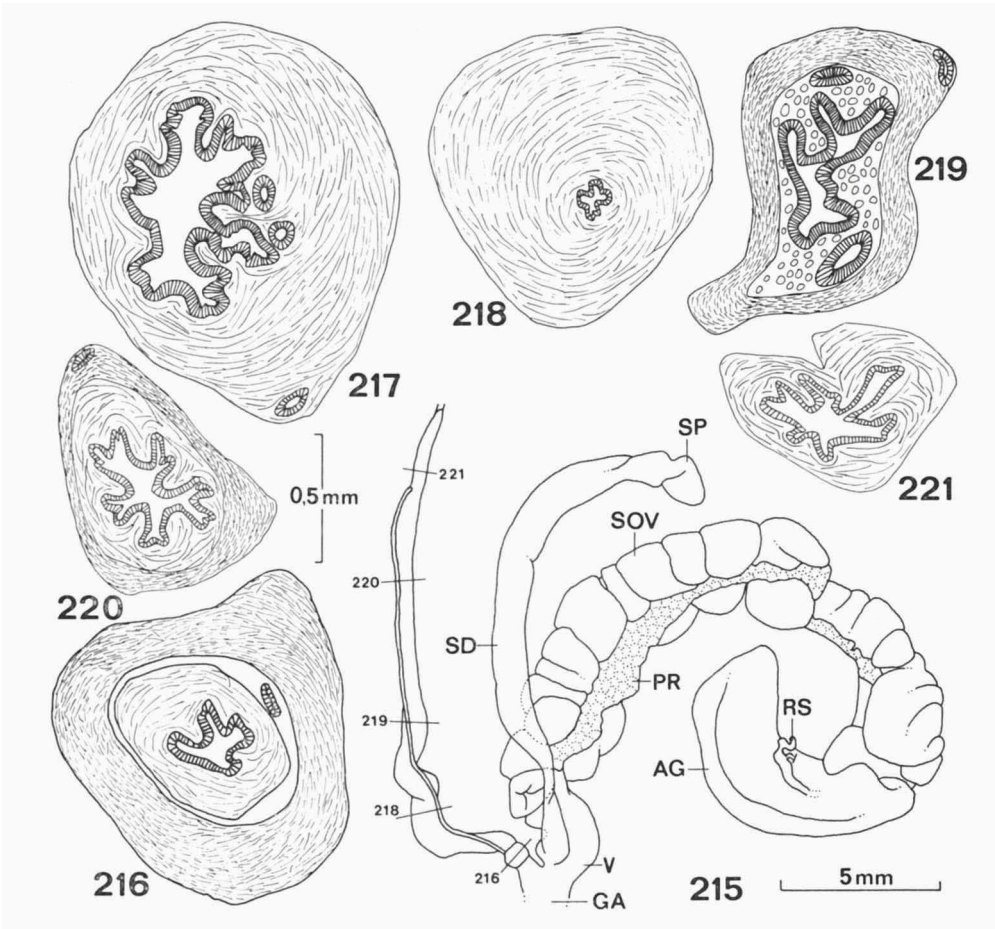
Five specimens from Brazil, Espírito Santo, Baixo Guandú (RMNH)

are tentatively referred to this species. The genitalia closely resemble those of Mexican specimens and differ only in the relatively shorter vagina and the broader spermathecal duct (which is probably due to the presence of spermatophores).



Figs. 213-214. *Drymaeus* (*Mesembrinus*) *emeus* (Say), genitalia. Mexico, Veracruz, volcán St. Martin (UF).

Histology. Proximal part of the penis with a high-cylindrical epithelium (ca. 25 μm high), which decreases towards the transition-zone, where it is low-cylindrical and 10 μm high. In the distal part of the penis the epithelium is ca. 35 μm high; the secretion granules in the cytoplasm stain deep blue with alcian blue and pink with haemalum-eosin. The subepithelial tissue is made up by rounded cells of ca. 15 μm diameter. The epithelium of epiphallus and flagellum is ciliated and cubic (ca. 10 μm high).



Figs. 215-221. *Drymaeus (Mesembrinus) emeus* (Say), genitalia and transverse sections of penis (figs. 216-219, slides H 4158, 4159, 4161, 4162), epiphallus (fig. 220, slide H 4166) and flagellum (fig. 221, slide H 4168). Brazil, Espírito Santo, Baixo Guandú (RMNH).

Drymaeus (Mesembrinus) extraneus (Haas, 1955) (fig. 222)

This taxon was described as a *Bulimulus* (*Lissoacme*) species, but examination of the holotype showed that this classification is incorrect; the taxon belongs to Pilsbry's *Drymaeus virginalis*-group (1898: 309) and may prove to be a junior synonym of one of the species of this group.

Genitalia. — Penis without a sheath, tapering and passing without external differentiation into the epiphallus. The flagellum is sub-cylindrical, as broad as the epiphallus and about 1/6 the length of the phallus. The vagina is rather

long. The spermathecal duct is about half as long as the spermoviduct, subcylindrical, with an elongate spermatheca at the distal end.

Material. — Venezuela, Edo. Bolívar, Chimantá-massif, summit of Apacará-tepui, 2100 m (FMNH).

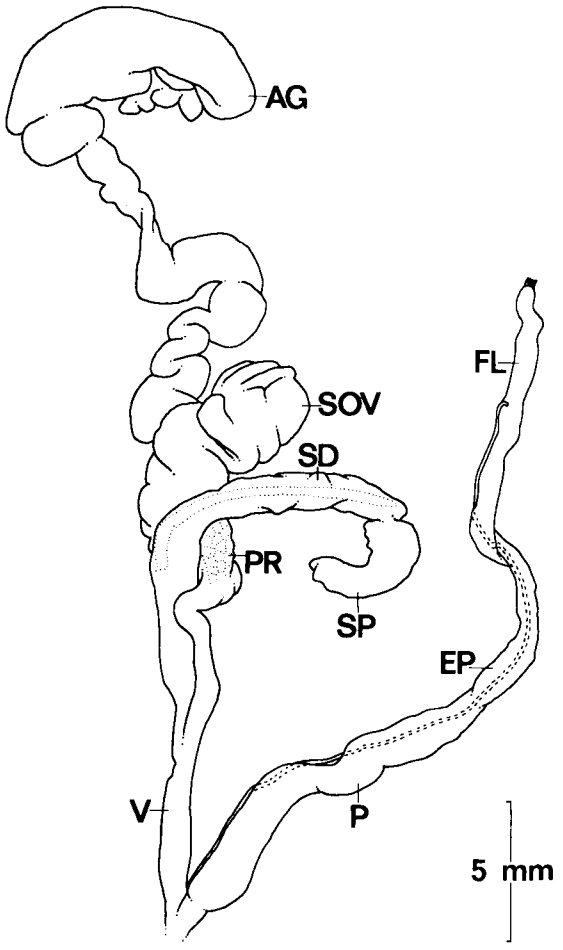


Fig. 222. *Drymaeus* (*Mesembrinus*) *extraneus* (Haas), genitalia. Venezuela, Bolívar, Apacará-tepui (FMNH).

Drymaeus (Mesembrinus) fidustus (Reeve, 1849)

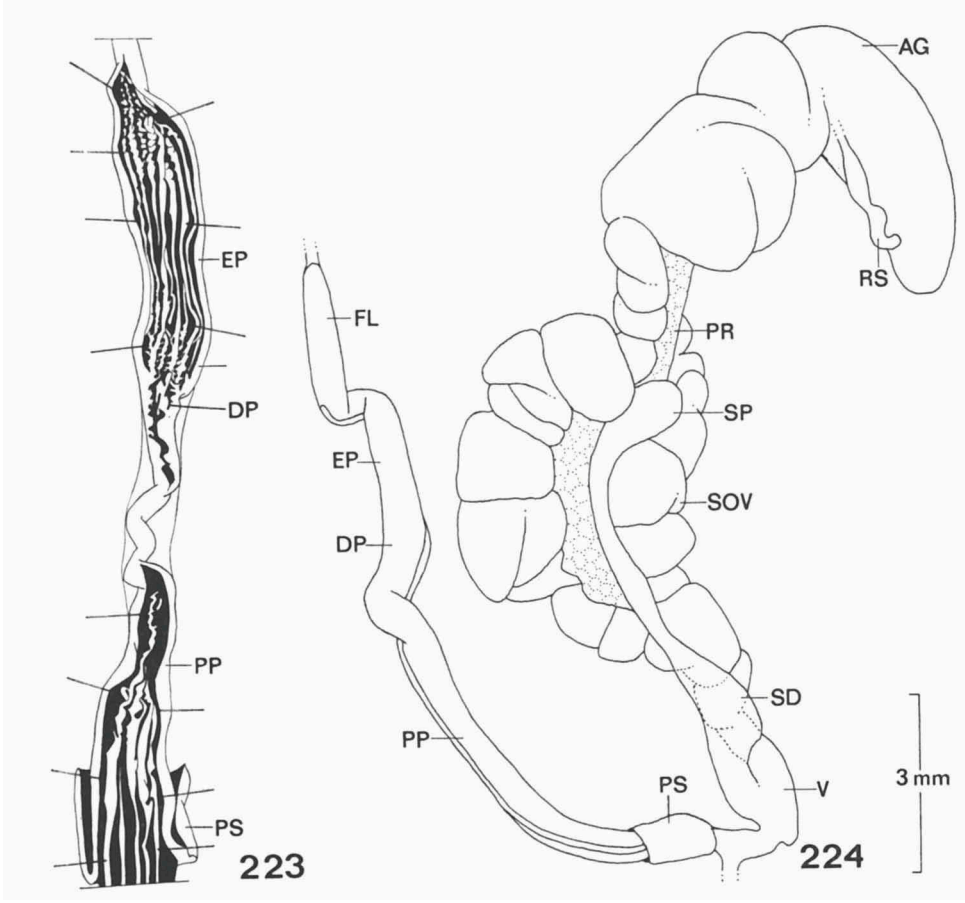
The specimen that corresponds to Reeve's figure (1849: pl. 76 fig. 557) is designated lectotype: shell height 22.5 mm, diameter 11.6 mm (BMNH 1975517). The material includes one paralectotype.

Drymaeus (Mesembrinus) flavidulus (E. A. Smith, 1877)

A lectotype is designated from among three type specimens, which are preserved in the British Museum (Natural History): shell height 21.0 mm, diameter 9.5 mm (BMNH 1975134). The specimens are labelled 'Zarama, S. Ecuador'.

Drymaeus (Mesembrinus) fuscobasis (E. A. Smith, 1877)

Type material of this species has been located in the London museum and one specimen is designated lectotype: shell height 29.0 mm, diameter 12.5 mm (BMNH 1975139). The material is labelled 'Tarapoto, Andes of Peru' (ex Cuming ex Spruce).



Figs. 223-224. *Drymaeus* (*Mesembrinus*) *gereti* Ancey, genitalia. Brazil, Espírito Santo, Baixo Guandú (RMNH).

Drymaeus (Mesembrinus) gereti Ancey, 1901
(figs. 223-224)

Genitalia. — Penis with a short sheath (ca. 1/12 the length of the phallus), sub-cylindrical, passing without external differentiation into the epiphallus. The flagellum is sub-cylindrical, as broad as the epiphallus and about 1/6 the length of the phallus. The vagina is relatively short. The spermathecal duct is ca. 2/3 the length of the spermoviduct, its proximal part swollen but otherwise sub-cylindrical; the spermatheca is elongate-globose.

Internally the proximal part of the penis bears rather strong pilasters in longitudinal direction. The transition to the distal part of the penis is very narrow. The longitudinal pilasters in the distal part of the penis are more complex than those of the proximal part. The pilasters of the epiphallus are rather strong, with two pillow-shaped organs near the entrance of the vas deferens.

Material. — Brazil, Espírito Santo, Baixo Guandú (RMNH).

Drymaeus (Mesembrinus) gratus (Pfeiffer, 1856)
(pl. 7 fig. 9)

A type specimen of this species is preserved in the British Museum (Natural History) and is designated lectotype: shell height 28.0 mm, diameter 12.2 mm (BMNH 1975521). The specimen is labelled 'Columbia' (ex Cuming) and glued on a card-board on which is added 'Venezuela'; the locality given by Pfeiffer is 'Columbia'. This species is here figured for the first time.

Drymaeus (Mesembrinus) hachensis (Reeve, 1850)

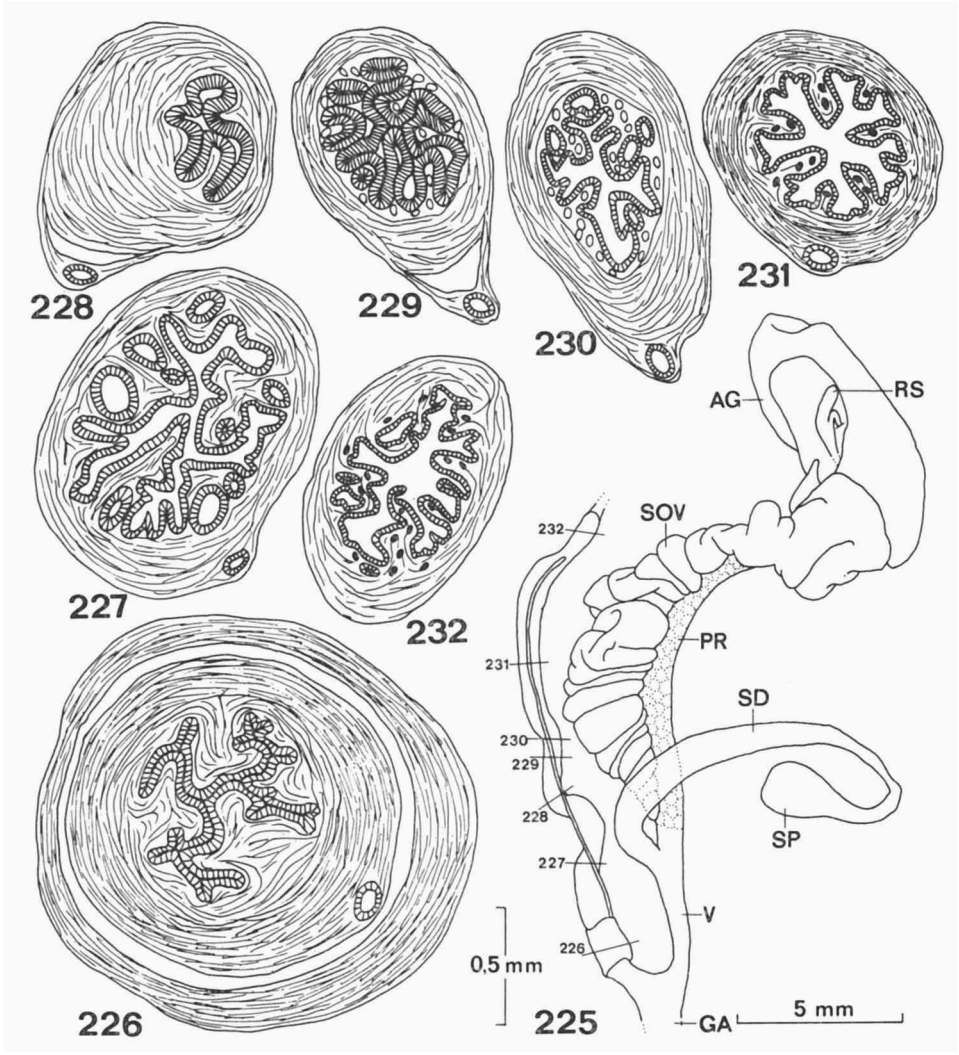
The specimen corresponding to Reeve's figure (1850: pl. 85 fig. 627) is designated lectotype: shell height 26.5 mm, diameter 11.3 mm (BMNH 1975392). The material originates from the Cuming-collection and is labelled 'Rio Hacha, Guatemala'.

Drymaeus (Mesembrinus) hegewischi (Pfeiffer, 1842)
(figs. 225-232)

Genitalia. — Penis with a sheath (ca. 1/9 the length of the phallus), sub-cylindrical, passing without external differentiation into the epiphallus. The flagellum is sub-cylindrical, about as long as the penis sheath. The vagina is relatively long. The spermathecal duct is more or less tapering, with an elongate-globose spermatheca at the distal end.

Histology. The lumen of the proximal part of the penis is (very) narrow and rather complex, with blind-ending short tubes parallel to the lumen. The

epithelium is low-cylindrical (ca. 20 μm) and the cells have a large, basal nucleus (ca. 7 μm diameter). The epithelium of both the transition-zone and the distal part of the penis is high-cylindrical (cell height ca. 30 μm). The distal part of the penis produces secretion granules staining dark blue with alcian blue. The subepithelial tissue consists of rounded cells of ca. 15 μm



Figs. 225-232. *Drymaeus* (*Mesembrinus*) *hegewischi* (Pfeiffer), genitalia and transverse sections of penis (figs. 226-229, slides H 5532, 5534, 5536, 5538), epiphallus (figs. 230-231, slides H 5539, 5542) and flagellum (fig. 232, slide H 5546). Mexico, Puebla, NE. Chietla (UF).

diameter in the distal penis and contain dispersed glandular cells in epiphallus and flagellum.

Material. — Mexico, Puebla, NE. of Chietla, 400 feet (UF).

Drymaeus (Mesembrinus) immaculatus (C. B. Adams, 1850)
(pl. 7 fig. 4)

A lectotype is designated from among three type specimens, which are preserved in the London museum: shell height 30.5 mm, diameter 13.3 mm (BMNH 1975540). The material is labelled 'Jamaica' (ex Cuming).

Drymaeus (Mesembrinus) incarnatus (Pfeiffer, 1855)
(pl. 7 fig. 5)

Type specimens of this hitherto unfigured species have been found in the British Museum (Natural History) and one is designated lectotype: shell height 31.0 mm, diameter 13.3 mm (BMNH 1975566). The material originates from the Cuming-collection and is labelled 'Venezuela'.

Drymaeus (Mesembrinus) indistinctus (Pfeiffer, 1852)

Two specimens of this species are preserved in the British Museum (Natural History) and one of them is designated lectotype: shell height 26.5 mm, diameter 13.8 mm (BMNH 1975403). The material originates from the Cuming-collection and is without locality label.

Drymaeus (Mesembrinus) inglorius (Reeve, 1848)
(figs. 233-234)

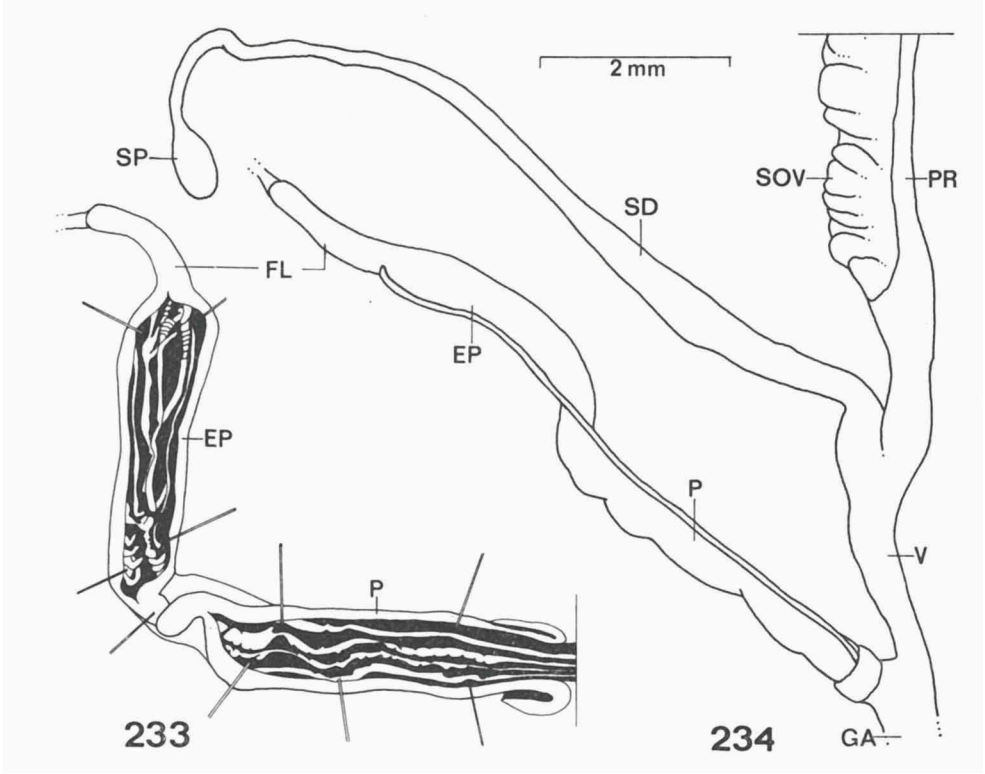
The specimen that corresponds to the original figure (Reeve, 1848: pl. 55 fig. 368) is here designated lectotype: shell height 26.0 mm, diameter 13.4 mm (BMNH 1975536). The material, which includes two paralectotypes, is without locality label and originates from the Cuming-collection.

Genitalia. — Penis with a very short sheath, more or less sub-cylindrical, passing without external differentiation into the epiphallus. The flagellum is sub-cylindrical, nearly half as broad as the epiphallus and ca. 1/6 the length of the phallus. The vagina is rather long. The spermathecal duct is more or less tapering; the relatively small spermatheca is elongate-globose.

Internally the proximal part of the penis has rather strong, longitudinal pilasters. The transition-zone has a very narrow lumen. The distal part of the penis has short pilasters in a transverse direction. Epiphallus with longi-

tudinal pilasters and pillow-shaped organs alongside the entrance of the vas deferens.

Material. — Mexico, Oaxaca, Oaxaca (UF).



Figs. 233-234. *Drymaeus* (*Mesembrinus*) *inglorius* (Reeve), genitalia. Mexico, Oaxaca (UF).

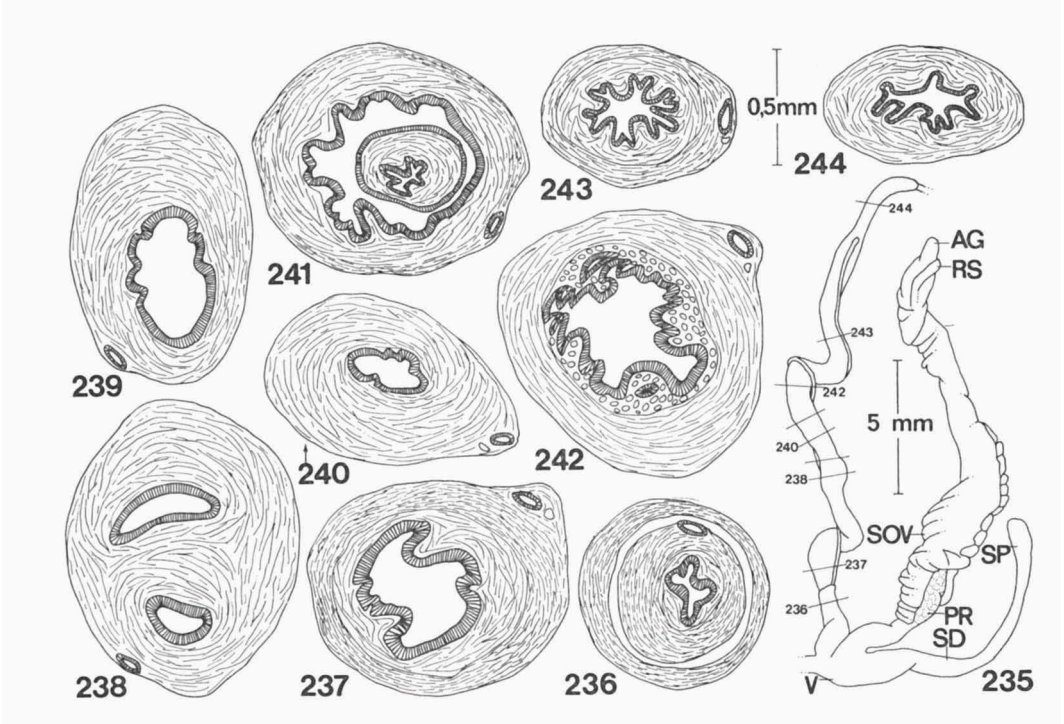
Drymaeus (Mesembrinus) interpunctus (Martens, 1887)
(figs. 235-244)

Genitalia. — Penis with a sheath (ca. 1/11 the length of the phallus), sub-cylindrical, passing without external differentiation into the epiphallus. The flagellum is sub-cylindrical, nearly as broad as the epiphallus and about 1/7 the length of the phallus. The vagina is very short. The spermathecal duct is about half as long as the spermoviduct, sub-cylindrical, with a hardly differentiated spermatheca at the distal end.

Histology. The epithelium of the proximal part of the penis is high-cylindrical (cell height 25-30 μm); the cells have large and elongated, basal nuclei. The lumen of the transition-zone is constricted twice (lined by a

low-cylindrical epithelium), with a wider part in between (the epithelium is high-cylindrical in this part; see fig. 161a). The distal part of the penis, which intrudes the proximal part, has a high-cylindrical epithelium (cell height 30 μm). The subepithelial tissue consists of rounded cells. The epithelium of both the epiphallus and flagellum is ciliated and cubic (ca. 10 μm high).

Material. — Paraguay, Guaira, Villarica (RMNH).



Figs. 235-244. *Drymaeus* (*Mesembrinus*) *interpunctus* (Martens), genitalia and transverse sections of penis (figs. 236-242, slides H 4241, 4242, 4243 (2x), 4244 (2x), 4245), epiphallus (fig. 243, slide H 4246) and flagellum (fig. 244, slide H 4247). Paraguay, Guaira, Villarica (RMNH).

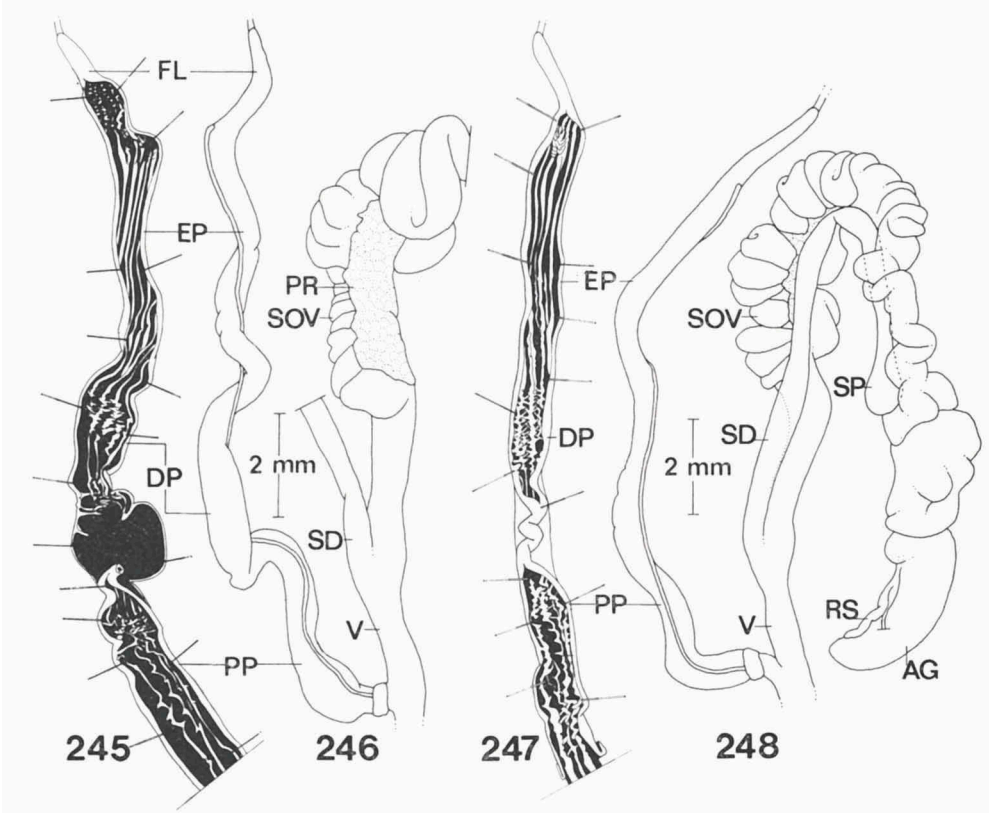
Drymaeus (Mesembrinus) inusitatus (Fulton, 1900) (figs. 245-246)

Genitalia. — Penis with a very short sheath, its proximal part swollen, but otherwise sub-cylindrical and passing without external differentiation into the epiphallus. The flagellum is tapering, nearly as broad as the epiphallus and about 1/8 the length of the phallus.

Internally the lumen of the proximal part of the penis has four longitudinal,

relatively weak pilasters. In the transition-zone the very narrow lumen passes through a tube, that is spirally twisted, before entering the distal part of the penis. The pilasters in both the distal part of the penis and in the epiphallus are longitudinally directed.

Material. — Costa Rica, Limón, 28.3 mi W. of Limón (UF).



Figs. 245-246. *Drymaeus* (*Mesembrinus*) *inusitatus* (Fulton), genitalia. Costa Rica, 28.3 mi W Limón (UF). Scale line = 2 mm. (N.B.: the narrow transition between proximal and distal part of the penis has partly been removed in fig. 245).
Figs. 247-248. *Drymaeus* (*Mesembrinus*) *moricandi* (Pfeiffer), genitalia. Mexico, Veracruz, 19 mi SW. and 0.8 mi N. Fortín (UF).

Drymaeus (Mesembrinus) keppelli (Pfeiffer, 1853)
(pl. 7 fig. 11)

A type specimen of this hitherto unfigured species is preserved in the London museum and designated lectotype: shell height 33.5 mm, diameter 14.4 mm (BMNH 1975538). The material is labelled 'Andes of Peru' (ex Cuming ex Keppell).

Drymaeus (Mesembrinus) limpidus (Drouët, 1859)

One specimen in the London museum (BMNH 1908.6.13.35) corresponds to Drouët's description and originates from French Guyana. It proved to be a *Drymaeus* species, while Pilsbry (1899: 223) treated this taxon as a *Simpulopsis* species.

Drymaeus (Mesembrinus) loxensis (Pfeiffer, 1846)
(pl. 7 fig. 6)

Three type specimens of this species are preserved in the British Museum (Natural History) and one is here designated lectotype: shell height 35.0 mm, diameter 14.7 mm (BMNH 1975553). The material is labelled 'El Catamaya near Loxa. Republic of the Equator. on Bushes. Mr. Hartweg' (ex Cuming).

Drymaeus (Mesembrinus) lusorius (Pfeiffer, 1855)
(pl. 7 fig. 12)

A type specimen of this hitherto unfigured species is preserved in the London museum and is designated lectotype: shell height 25.0 mm, diameter 11.0 mm (BMNH 1975543). The material is labelled 'Brazil, Bank of Ama[zon]' (ex Cuming).

Drymaeus (Mesembrinus) manupictus (Reeve, 1848)
(pl. 7 fig. 7)

A specimen of this species has been located in the London museum and is designated lectotype: shell height 33.0 mm, diameter 14.2 mm (BMNH 1975522); it corresponds to the original figure and is labelled 'Venezuela' and 'Merida, Columb. [sic, Venezuela] '(ex Cuming).

Drymaeus (Mesembrinus) miliaris (Philippi, 1867)

Redescription. — Shell narrowly perforate, with slightly convex sides; elongate; thin. Colour pale yellowish, with whitish axial streaks that give the impression of being riblets. Surface rather shining, with spiral striae and incrassate growth striae. Whorls nearly flat; suture well impressed. Aperture subovate. Peristome thin, the basal margin hardly expanded; white. Columella slightly folded. Parietal region with a white callus.

Measurements (in mm):

shell		aperture		number of
height	diameter	height	width	whorls
19.0	9.7	7.8	5.1	5.9
18.5	8.7	7.4	5.0	6.0

Material. — Peru, Dept. Loreto, Santa Maria, 4 miles downstream from Iquitos (UF, RMNH).

Drymaeus (Mesembrinus) moricandi (Pfeiffer, 1847)
(figs. 247-248)

A type specimen is preserved in the British Museum (Natural History) and designated lectotype: shell height 23.5 mm, diameter 13.0 mm (BMNH 1975212). The material is labelled 'Central America' and originates from the Cuming-collection.

Genitalia. — Penis with a very short sheath, sub-cylindrical, passing without external differentiation into the epiphallus. The flagellum is tapering, ca. 1/6 the length of the phallus. The vagina is rather long. The spermathecal duct is ca. 3/4 the length of the spermoviduct, sub-cylindrical; the spermatheca is rather undifferentiated and relatively small.

Internally the proximal and distal part of the penis bear longitudinal, rather strong pilasters, which give off short side branches. The epiphallus has continuous longitudinal pilasters and two pillow-shaped pilasters at the entrance of the vas deferens.

Material. — Mexico, Veracruz, 19 mi SW. and 0.8 mi N. of Fortín, above Río Metlac (UF).

Drymaeus (Mesembrinus) moritinctus (Martens, 1893)

The specimen that corresponds to Martens, 1893: pl. 14 fig. 9 is here designated lectotype: shell height 25.5 mm, diameter 12.1 mm (BMNH 1901.6.22.841). The material, which includes six paralectotypes, is labelled 'Chilpancingo' and originates from the Godman-collection.

Drymaeus (Mesembrinus) moussoni (Pfeiffer, 1853)

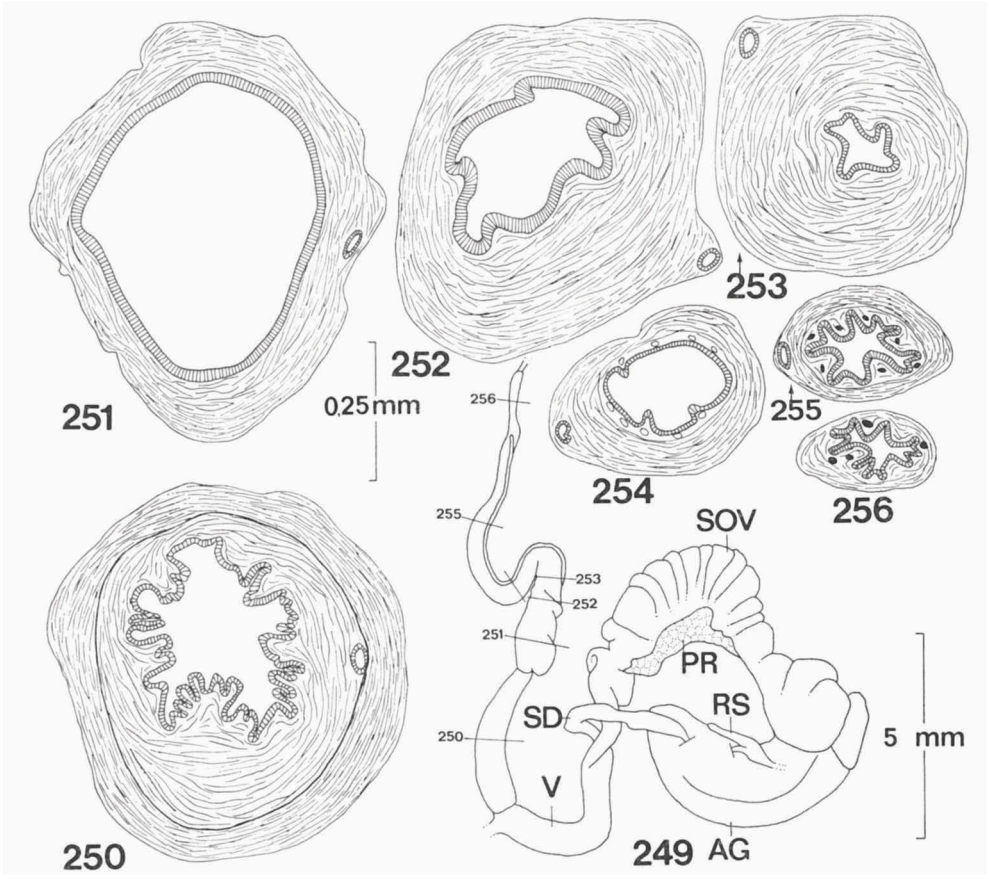
Three type specimens of this species are preserved in the London museum and one is designated lectotype: shell height 26.5 mm, diameter 13.2 mm (BMNH 1975210). The specimens are labelled 'Haiti' (ex Cuming ex Sallé).

Drymaeus (Mesembrinus) multilineatus (Say, 1825)
(figs. 249-256)

Baker (1923) and Pilsbry (1946) have described the radula and genitalia respectively, of specimens from Florida. Our observations on specimens from Mexico correspond pretty well with their data.

Genitalia. — Penis with a long sheath (ca. 1/4 the length of the phallus), swollen above the distal end of the sheath but otherwise more or less sub-

cylindrical and passing without external differentiation into the epiphallus. The flagellum is sub-cylindrical, about half as broad as the epiphallus and ca. 1/8 the length of the phallus. The vagina is long.

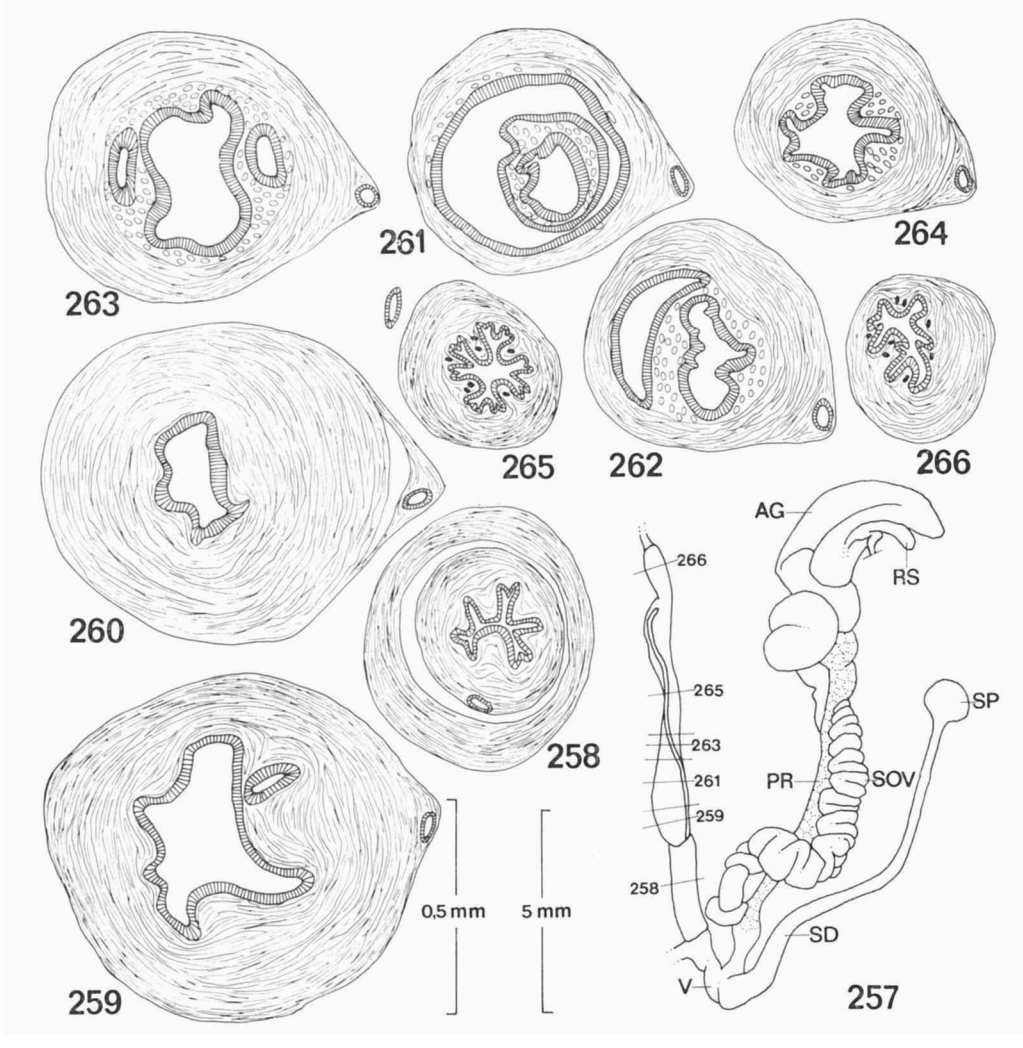


Figs. 249-256. *Drymaeus* (*Mesembrinus*) *multilineatus* (Say), genitalia and transverse sections of penis (figs. 250-254, slides H 4035, 4036 (4x)), epiphallus (fig. 255, slide H 4034) and flagellum (fig. 256, slide H 4034). Mexico, 4 mi WNW. Tehuantepec (UF).

Histology. The most proximal part of the penis has a low-cylindrical epithelium (cell height 12 μm). More distally (corresponding to the externally swollen part) the lumen is circular and lined by a high-cylindrical epithelium (ca. 30 μm high). In the transition-zone the epithelium is cubic (cell height 10 μm) and lines a very narrow lumen. In the distal part of the penis the epithelium is high-cylindrical (ca. 25 μm high), with secretion granules that stain dark blue with alcian blue. In the subepithelial tissue rounded cells are observed that stain faintly blue with the same dye. In both the epiphallus and

flagellum the epithelium is cubic (cell height ca. 10 μm) and ciliated. The glandular cells in the subepithelial tissue stain purple with haemalum-eosin and dark blue with alcian blue.

Material. — Mexico, Oaxaca, 4.0 mi WNW. of Tehuantepec (UF).



Figs. 257-266. *Drymaeus* (*Mesembrinus*) *perductorum* Rehder, genitalia and transverse sections of penis (figs. 258-264, slides H 5400, 5401, 5402, 5403 (3x), 5404), epiphallus (fig. 265, slide 5404) and flagellum (fig. 266, slide 5406). Mexico, Guerrero, 5 km W. Grutas de Cacahuamilpa (UF).

Drymaeus (Mesembrinus) perductorum Rehder, 1943
(figs. 257-266)

Genitalia. — Penis with a long sheath (ca. 1/4 the length of the phallus), swollen above the distal end of the sheath and more distally tapering, passing without external differentiation into the epiphallus, which is swollen near the entrance of the vas deferens. The flagellum is short (ca. 1/7 the length of the phallus), sub-cylindrical. The vagina is relatively short. The spermathecal duct is sub-cylindrical; the spermatheca is globose.

Histology. In the most proximal part the epithelium of the penis is low-cylindrical (ca. 15 μm high). More distally this epithelium is high-cylindrical (ca. 25 μm high), lining a relatively wide (proximal part of the penis) or a very narrow (transition-zone) lumen. The distal part of the penis intrudes the transition-zone and has the same epithelium-type. In this part short tubes are situated parallel to the main lumen. The ciliated epithelium of both the epiphallus and flagellum is ca. 10 μm high. The glandular cells in the sub-epithelial tissue stain faintly blue with alcian blue and are concentrated near the entrance of the vas deferens.

Material. — Mexico, Guerrero, 5 km W. Grutas de Cacahuamilpa, 4400 feet (UF).

Drymaeus (Mesembrinus) pertristis Pilsbry, 1898

This taxon was introduced as a new name for *Bulimus tristis* Pfeiffer, 1855, not Jay, 1839. Three syntypes of *Bulimus tristis* Pfeiffer have been located in the British Museum (Natural History).

Drymaeus (Mesembrinus) pervariabilis (Pfeiffer, 1853)
(pl. 6 fig. 3)

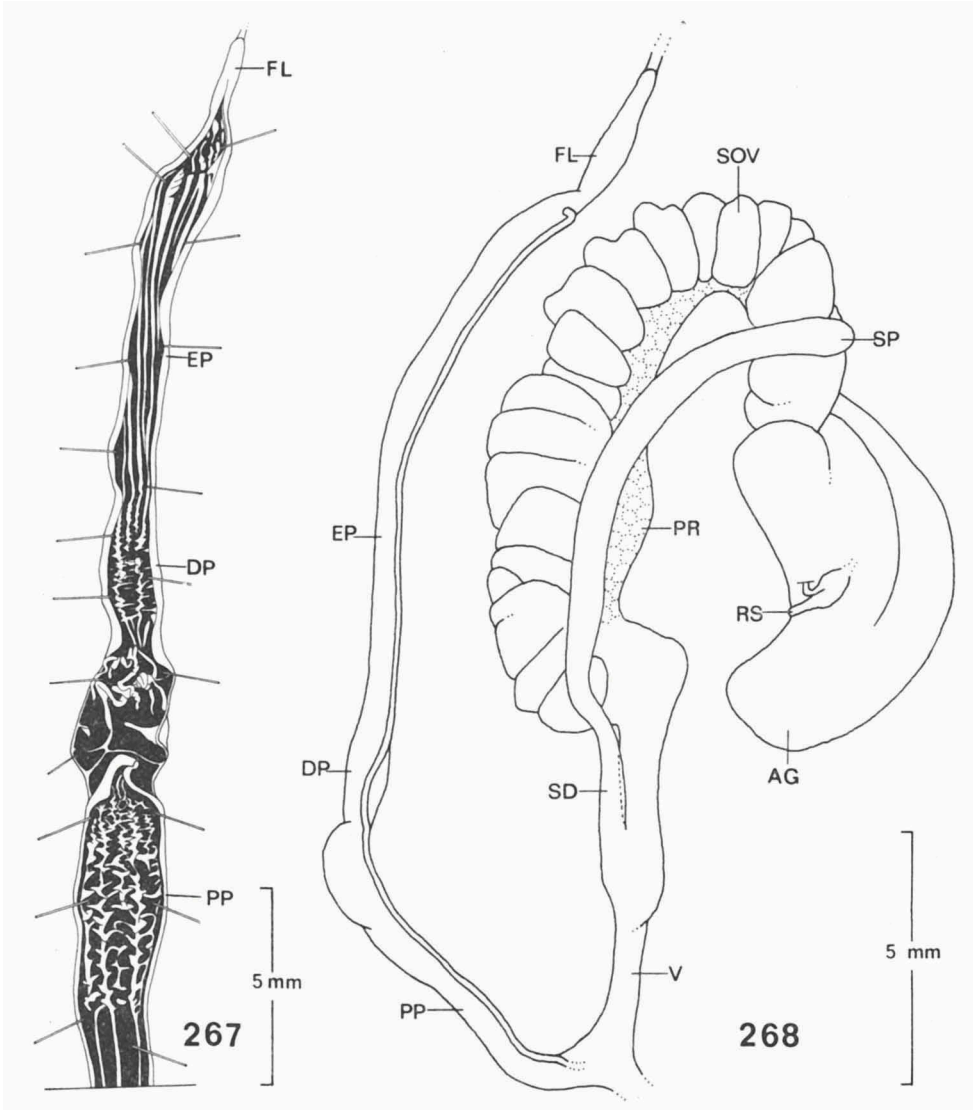
Three type specimens have been located in the London museum and one of them is designated lectotype: shell height 33.0 mm, diameter 17.5 mm (BMNH 1975547). The material is labelled 'New Granada' (ex Cuming). This taxon is here figured for the first time.

This species has been considered a synonym of *Drymaeus depictus* (Reeve, 1849) (see Pilsbry, 1897-1898: 300), but differs from that taxon, e.g. in the colour pattern and the expanded peristome (see pl. 6 figs. 3, 5).

Drymaeus (Mesembrinus) primulus (Reeve, 1848)

Two type specimens of this taxon have been found in the London museum and the specimen that corresponds to Reeve's figure (1848: pl. 57 fig. 385)

is designated lectotype: shell height 25.5 mm, diameter 11.6 mm (BMNH 1975478). The material originates from the Cuming-collection and is labelled 'Venezuela'. This taxon was synonymized by Pilsbry (1898: 247) with *Drymaeus studeri* (Pfeiffer, 1847), from which it differs in the more ventricose whorls, the colour pattern and the relatively larger aperture.



Figs. 267-268. *Drymaeus* (*Mesembrinus*) *recluzianus martensianus* Pilsbry, genitalia. Costa Rica, San José (UF). (N.B.: the narrow transition between proximal and distal part of the penis has partly been removed in fig. 267).

Drymaeus (Mesembrinus) recluzianus martensianus Pilsbry, 1899
(figs. 267-268)

Genitalia. — Penis without a proximal sheath, sub-cylindrical; the transition-zone between proximal and distal part of the penis is swollen. The penis passes without external differentiation into the epiphallus, which is sub-cylindrical. The flagellum is tapering, ca. 1/7 the length of the phallus. The vagina is rather short. The spermathecal duct is slightly shorter than the spermoviduct, sub-cylindrical, with an undifferentiated spermatheca.

Internally the proximal part of the penis has rather strong longitudinal pilasters, which give off short side branches. In the transition-zone the lumen is very narrow and spirally twisted before entering the distal part. The distal penis and epiphallus have longitudinal pilasters, of which one near the entrance of the vas deferens is pillow-shaped.

Material. — Costa Rica, San José, 3800 feet (UF).

Drymaeus (Mesembrinus) roseatus (Reeve, 1848)

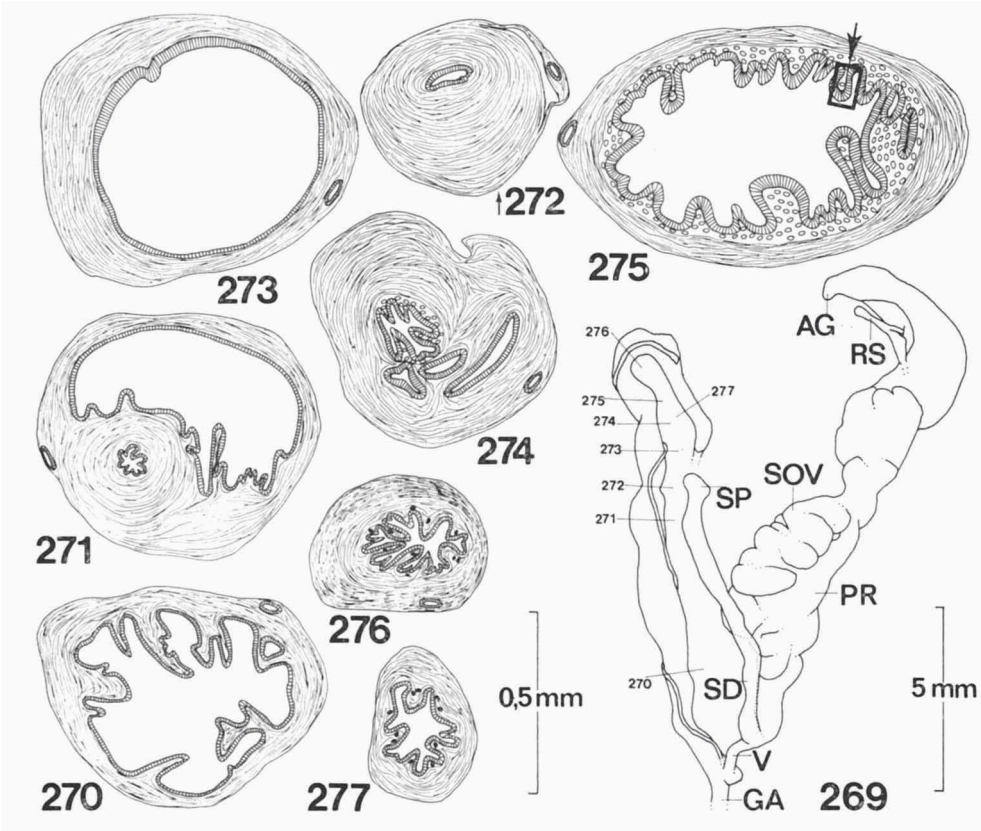
The specimen that corresponds to Reeve, 1848: pl. 54 fig. 353b is here designated lectotype: shell height 35.5 mm, diameter 14.7 mm (BMNH 1975309). There are two paralectotypes in the same collection and the material is labelled 'Venezuela' (ex Cuming).

Drymaeus (Mesembrinus) rufescens pinchoti Pilsbry, 1930
(figs. 269-277)

The description of the genitalia given below forms an addition to that of Pilsbry (1930).

Genitalia. — Penis without a proximal sheath, more or less swollen and passing without external differentiation into the epiphallus. The flagellum is subcylindrical, about half as broad as the epiphallus and ca. 1/6 the length of the phallus. The vagina is short. The spermathecal duct is sub-cylindrical, about 3/4 the length of the spermoviduct; the spermatheca is hardly differentiated from the duct.

Histology. The lumen of the proximal part of the penis is narrowed by infoldings; some short tubes are split off from the main lumen. The epithelium is cubic (cell height 10 μm). In the transition-zone the same epithelium-type lines the very narrow lumen; the distal part of this zone has a relatively wide lumen. The epithelium of the distal part of the penis is high-cylindrical (cell height ca. 25 μm) and produces a secretion that stains dark blue with alcian blue. The cytoplasm of the subepithelial rounded cells stains faintly blue with alcian blue. The ciliated epithelium of both the epiphallus



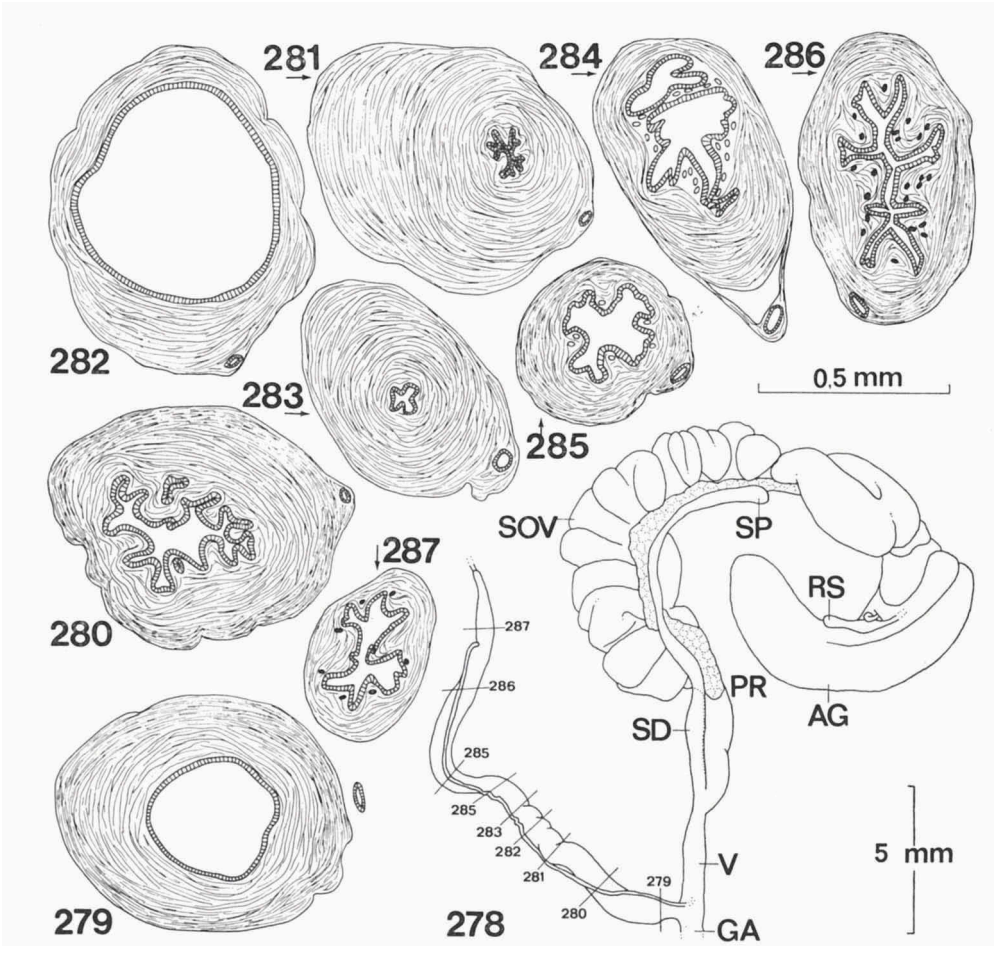
Figs. 269-277. *Drymaeus* (*Mesembrinus*) *rufescens pinchoti* Pilsbry, genitalia and transverse sections of penis (figs. 270-275, slides H 5388, 5391, 5392, 5393, 5394 (2x)), epiphallus (fig. 276, slide H 5395) and flagellum (fig. 277, slide H 5393). West Indies, Old Providence Island (UF). Arrow in fig. 275 refers to plate 1 fig. 2.

and flagellum is ca. 10 μm high. The glandular cells in the subepithelial tissue stain faintly blue with alcian blue.

Material. — West Indies, Old Providence Island (UF).

Drymaeus (Mesembrinus) semimaculatus Pilsbry, 1898 (figs. 278-287)

Genitalia. — Penis without a proximal sheath, more or less sub-cylindrical and passing without external differentiation into the epiphallus. The flagellum is tapering, about 1/6 the length of the phallus. The vagina is rather long. The spermathecal duct is sub-cylindrical, slightly shorter than the spermoviduct; the spermatheca is undifferentiated.



Figs. 278-287. *Drymaeus* (*Mesembrinus*) *semimaculatus* Pilsbry, genitalia and transverse sections of penis (figs. 279-285, slides H 5450, 5452, 5453, 5454, 5455, 5456, 5457), epiphallus (fig. 286, slide H 5459) and flagellum (fig. 287, slide H 5460). Costa Rica, Cartago, Tapanti (UF).

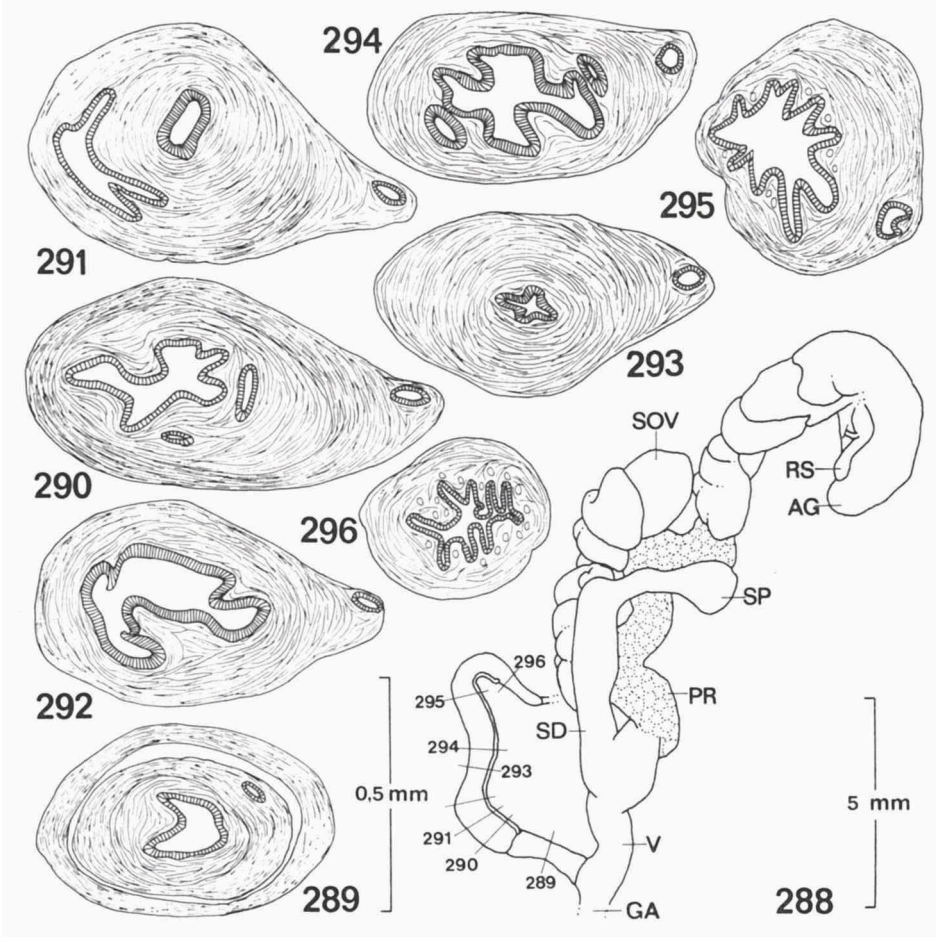
Histology. In the most proximal part of the penis the lumen is circular, but more distally it is narrowed by infoldings. In the transition-zone the lumen is constricted twice, with a wider part in between. The epithelium of this last mentioned part is low-cylindrical (cell height 17 μm) and is also present in the proximal part of the penis. In the narrow part of the transition-zone the epithelium is cubic (cell height 10 μm). In the distal part of the penis short tubes are situated parallel to the main lumen, which is lined by a low-cylindrical epithelium (ca. 17 μm high). The cells of this epithelium stain dark blue with alcian blue. The subepithelial tissue consists of rounded

cells of 15 μm diameter. In both the epiphallus and flagellum glandular cells are dispersed in the subepithelial tissue and the ciliated epithelium is ca. 10 μm high.

Material. — Costa Rica, Cartago, Tapanti, 3400 feet (UF).

Drymaeus (Mesembrinus) semipellucidus (Tristam, 1861)
(figs. 288-296)

Genitalia. — The phallus-complex is relatively short. The penis has a proximal sheath (ca. 1/4 the length of phallus), is sub-cylindrical and passes



Figs. 288-296. *Drymaeus* (*Mesembrinus*) *semipellucidus* (Tristam), genitalia and transverse sections of penis (figs. 289-294, slides H 5525, 5526, 5527 (3x), 5528), epiphallus (fig. 295, slide H 5529) and flagellum (fig. 296, slide H 5529). Nicaragua, 2.4 mi N. Masatepe (UF).

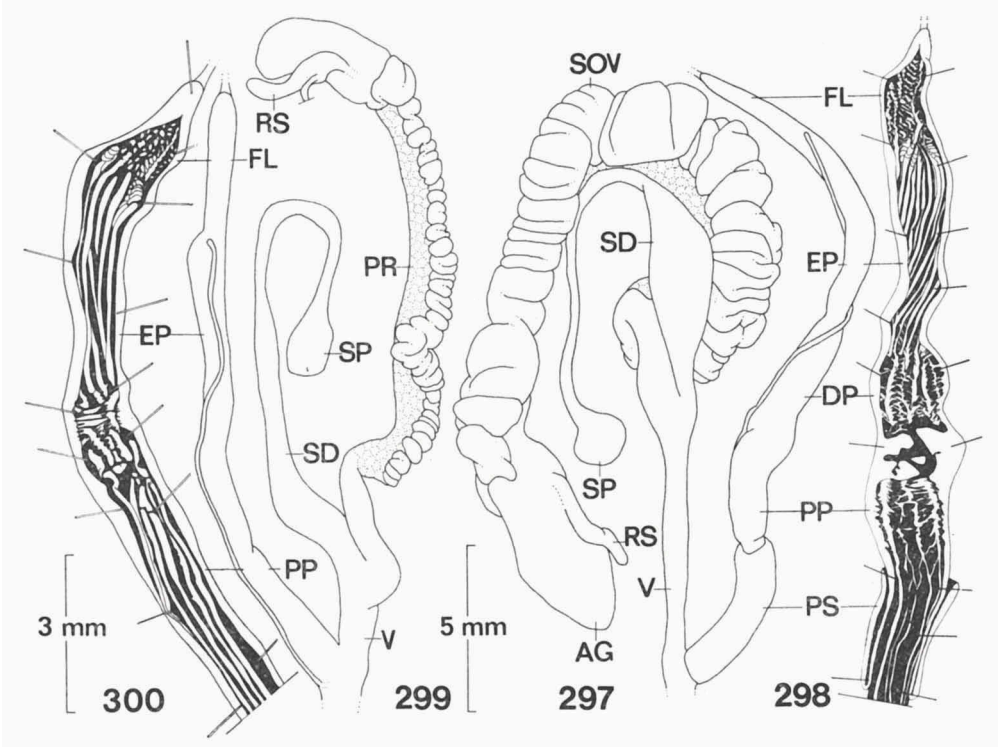
without external differentiation into the epiphallus. The flagellum is tapering, about 1/5 the length of the phallus. The spermathecal duct is sub-cylindrical and relatively broad, with a rather undifferentiated, globose spermatheca.

Histology. The epithelium of both the proximal part of the penis and transition-zone is low-cylindrical (cell height ca. 15 μm), except the median part of the transition-zone, where the lumen is relatively wide and the epithelium is high-cylindrical (ca. 25 μm high). The epithelium of the distal part of the penis is also high-cylindrical; in the subepithelial tissue the typically rounded cells were only sparsely present.

Material. — Nicaragua, Masaya, 2.4 mi N. of Masatepe (UF).

Drymaeus (Mesembrinus) serperastrus (Say, 1829)
(figs. 297-298)

The radula of this species has been described by Strebel & Pfeffer (1882) and Solem (1955). Our observations correspond with those of Strebel &



Figs. 297-298. *Drymaeus* (*Mesembrinus*) *serperastrus* (Say), genitalia. Mexico, Sinaloa, 22 mi NNW. Mazatlán (UF).
Figs. 299-300. *Drymaeus* (*Mesembrinus*) *uhdeanus* (Martens), genitalia. Mexico, Veracruz, 8.5 mi SW. Ciudad Mendoza (UF).

Pfeffer, while Solem himself remarked that his data on a specimen from Yacatán were different from those published by the two German authors. According to Solem (o.c.) this species has a penis with a sheath of reduced length.

Genitalia. — The length of the penis sheath is ca 1/5 the length of the phallus; above the distal end of the sheath the penis is slightly swollen, but otherwise it is sub-cylindrical and passes without external differentiation into the epiphallus. The flagellum is tapering, about as long as the penis sheath. The vagina is sub-cylindrical, relatively long. The proximal part of the spermathecal duct is swollen, but the remaining part of this duct is sub-cylindrical; the spermatheca is globose.

Internally the proximal part of the penis has longitudinal pilasters, which are rather strongly developed near the transition-zone to the distal part of the penis. In this part the pilasters give off sides branches that partially overlap each other. The pilasters of the epiphallus are smooth, with pillow-shaped organs alongside the entrance of the vas deferens. This entrance is covered by the longitudinal curved fold of the flagellum.

Material. — Mexico, Sinaloa, *22* mi NNW. Mazatlán (UF).

Drymaeus (Mesembrinus) signifer (Pfeiffer, 1855)

A type specimen of this unfigured species has been found in the British Museum (Natural History) and is designated lectotype: shell height 33.0 mm, diameter 14.6 mm (BMNH 1975216). The material originates from the Cuming-collection and is labelled 'Venezuela?'.

Drymaeus (Mesembrinus) studeri (Pfeiffer, 1847)

The specimen corresponds to Reeve's pl. 57 fig. 384 (1848) is designated lectotype: shell height 25.0 mm, diameter 11.3 mm (BMNH 1975480). Two paralectotypes are in the same collection and the specimens are labelled 'Merida, New Granada' (ex Cuming).

Drymaeus (Mesembrinus) tenuilabris (Pfeiffer, 1866)
(pl. 7 fig. 8)

A type specimen of this unfigured species is preserved in the London museum and is designated lectotype: shell height 30.5 mm, diameter 15.0 mm (BMNH 1975338). The locality label reads 'Venezuela' (ex Cuming).

Drymaeus (Mesembrinus) tropicalis (Morelet, 1849)

Three type specimens of this species are preserved in the London museum and one is designated lectotype: shell height 28.0 mm, diameter 13.5 mm (BMNH 1893.2.4.210). The material is labelled 'Campeche' (ex Morelet).

This taxon closely resembles *Drymaeus inusitatus* (Fulton, 1900) and the differences mainly concern the colour pattern and the expansion of the peristome.

Drymaeus (Mesembrinus) uhdeanus (Martens, 1864)
(figs. 299-300)

Genitalia. — Penis without a proximal sheath, sub-cylindrical, passing without external differentiation into the epiphallus. The flagellum is sub-cylindrical, about half as broad as the epiphallus and ca. 1/4 the length of the phallus. The vagina is relatively short. The spermathecal duct is more or less tapering, with an elongate-truncate spermatheca at the distal end.

Internally the proximal part of the penis has longitudinal, rather strongly developed pilasters, while these pilasters are more transversally directed in its distal part. The epiphallus has two pillow-shaped organs near the entrance of the vas deferens.

Material. — Mexico, Veracruz, 8.5 mi SW. Ciudad Mendoza, 5200 feet (UF).

Drymaeus (Mesembrinus) umbraticus (Reeve, 1849)

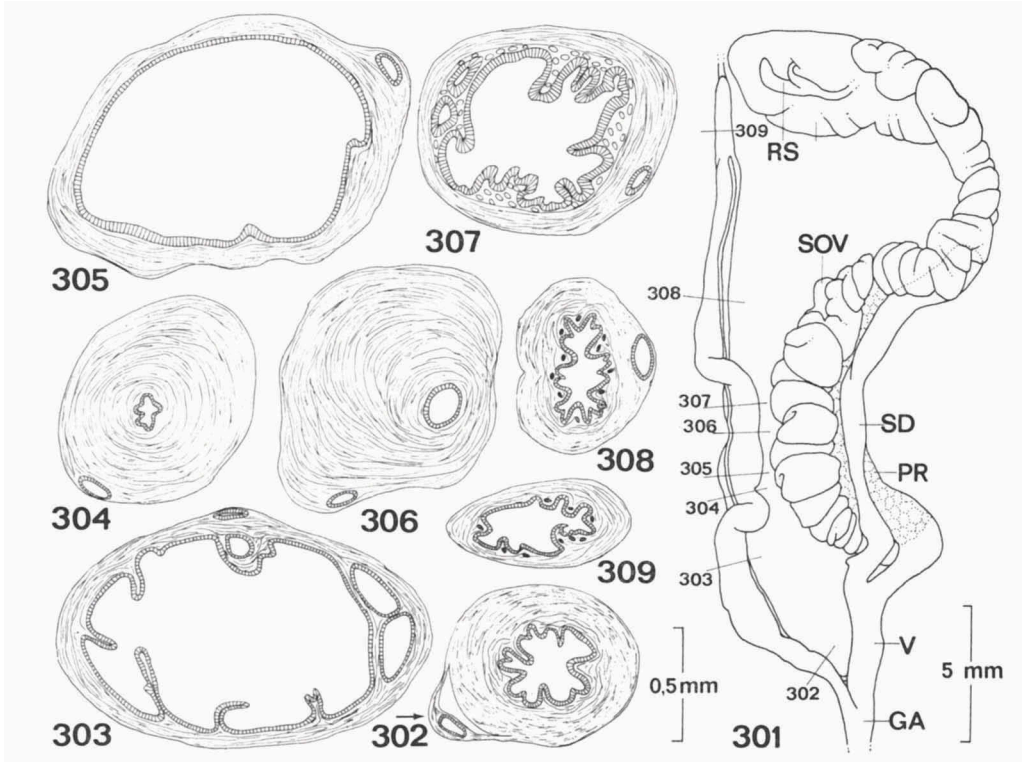
This taxon very closely resembles *Drymaeus dominicus* (Reeve), with which it may prove to be synonymous; the name *umbraticus* will then have priority over *dominicus*.

A type specimen of this taxon is preserved in the London museum and is designated lectotype: shell height 16.0 mm, diameter 8.2 mm (BMNH 1975184); it is labelled 'Central America' (ex Cuming).

Drymaeus (Mesembrinus) vincentinus (Pfeiffer, 1846)
(figs. 301-309)

Three type specimens of this species are preserved in the British Museum (Natural History) and one is here designated lectotype: shell height 30.0 mm, diameter 12.6 mm (BMNH 1975219). The specimens originate from the Cuming-collection and are labelled 'St. Vincent'.

Genitalia. — Penis without a proximal sheath, more or less sub-cylindrical, tapering towards the genital atrium and passing without external differentiation into the epiphallus. The flagellum is sub-cylindrical, about half as broad as the epiphallus and ca. 1/7 the length of the phallus. The vagina is rather



Figs. 301-309. *Drymaeus* (*Mesembrinus*) *vincentinus* (Pfeiffer), genitalia and transverse sections of penis (figs. 302-307, slides H 5501, 5509, 5512, 5513, 5515, 5514), epiphallus (fig. 308, slide H 5516) and flagellum (fig. 309, slide H 5522). West Indies, Trinidad (RMNH).

short. The spermathecal duct is sub-cylindrical, about 3/4 the length of the spermoviduct and with an undifferentiated spermatheca at the distal end.

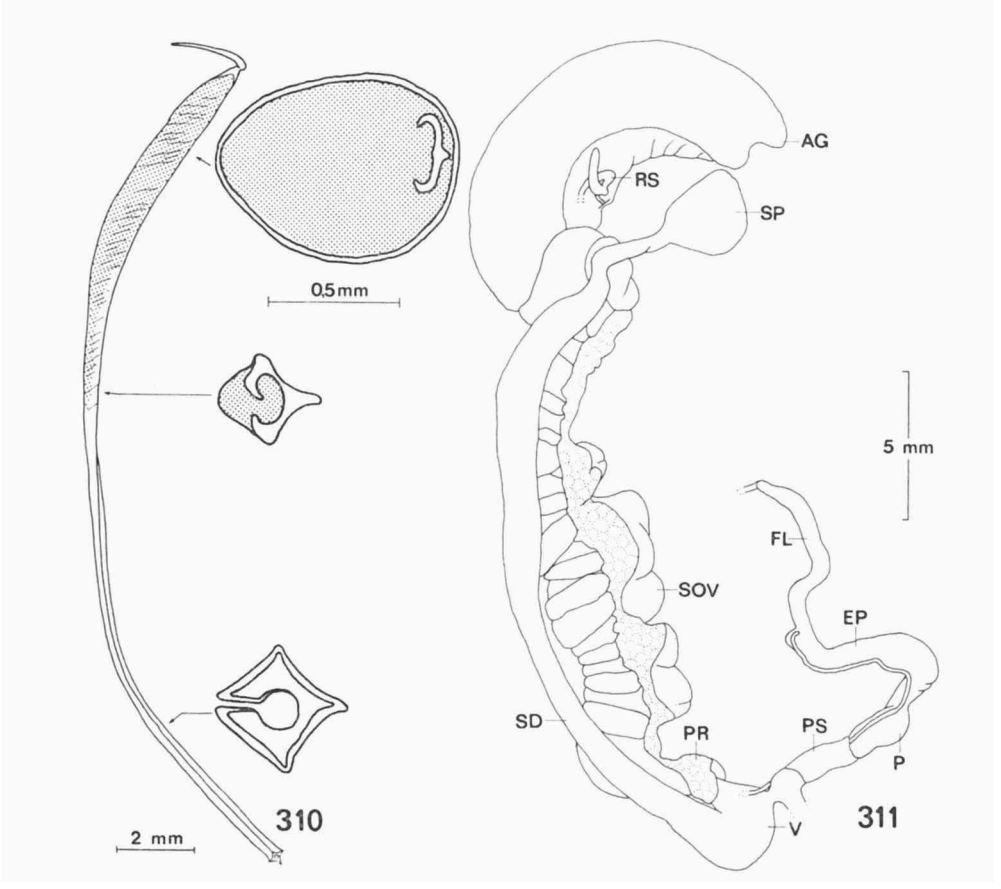
Histology. The most proximal part of the penis has a rather narrow lumen, but more distally this lumen is relatively wide, with short tubes parallel to the main lumen. In the transition-zone the lumen is constricted twice, with a wider part in between. The epithelium of both the proximal part of the penis and transition-zone is low-cylindrical (10-15 μm high). In the distal part of the penis the epithelium is high-cylindrical (cell height ca. 35 μm). The subepithelial tissue is made up by rounded cells (ca. 17 μm diameter). In both the epiphallus and flagellum the epithelium is ciliated and low-cylindrical (12 μm high). The glandular cells, which are dispersed in the subepithelial tissue, are more numerous near the entrance of the vas deferens.

Material. — Trinidad, Oropuche cave (RMNH).

Oxychona blanchetiana (S. Moricand, 1833)
(figs. 310-311)

Genitalia. — Penis with a sheath (ca. 1/7 the length of the phallus), more or less swollen and passing without external differentiation into the epiphallus. The flagellum is sub-cylindrical, nearly half as broad as the epiphallus and about half as long as the phallus. The vagina is very short and swollen. The spermathecal duct is more or less sub-cylindrical, its distal part narrow and with a globose spermatheca. The broadest part of the spermatophore is proximally situated. Internally the supporting rod has two curved extremities.

Material. — Brazil, Bahia, Coaraci, Fazenda Boa Esperança (RMNH).

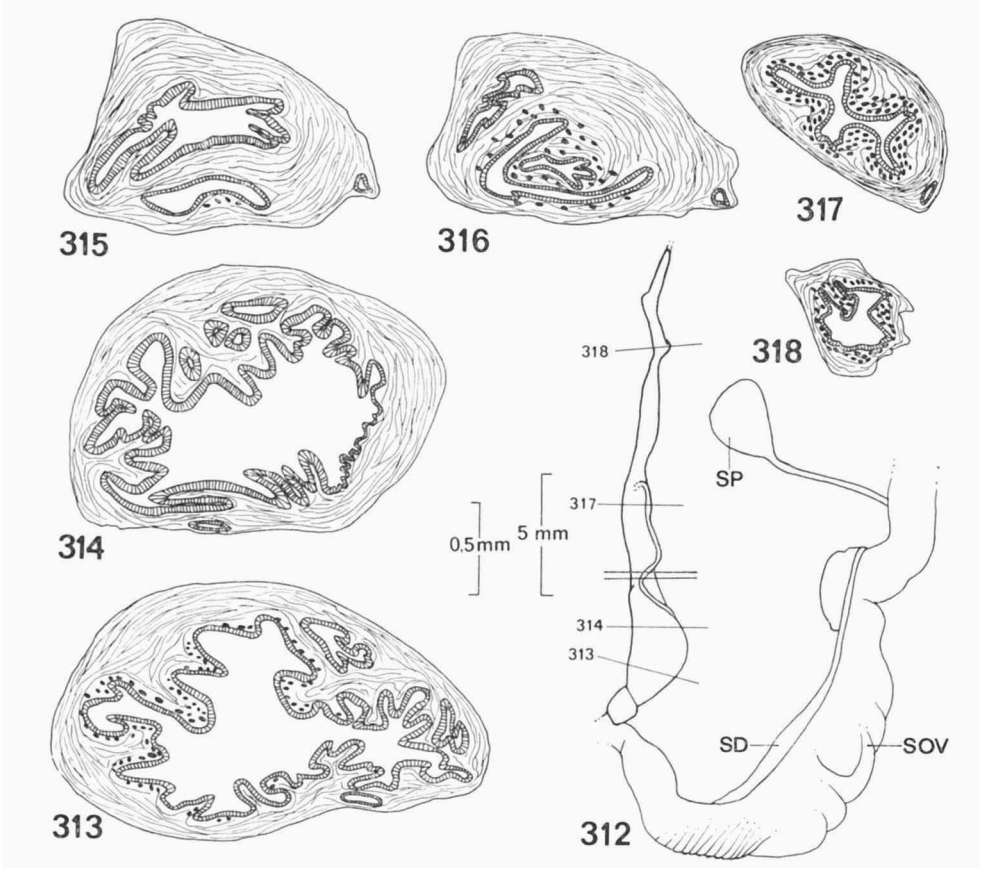


Figs. 310-311. *Oxychona blanchetiana* (Moricand), genitalia and spermatophore. Brazil, Bahia, Coaraci (RMNH).

Otostomus signatus (Spix, 1827)
(figs. 312-318)

Genitalia. — Penis with a short sheath (ca. 1/15 the length of the phallus), swollen. The epiphallus is tapering and about as long as the penis. The flagellum is more or less sub-cylindrical, its distal part tapering, about half as broad as the epiphallus and ca. half the length of phallus. The vagina is very short. The spermathecal duct is sub-cylindrical, with an elongate-globose spermatheca at the distal end.

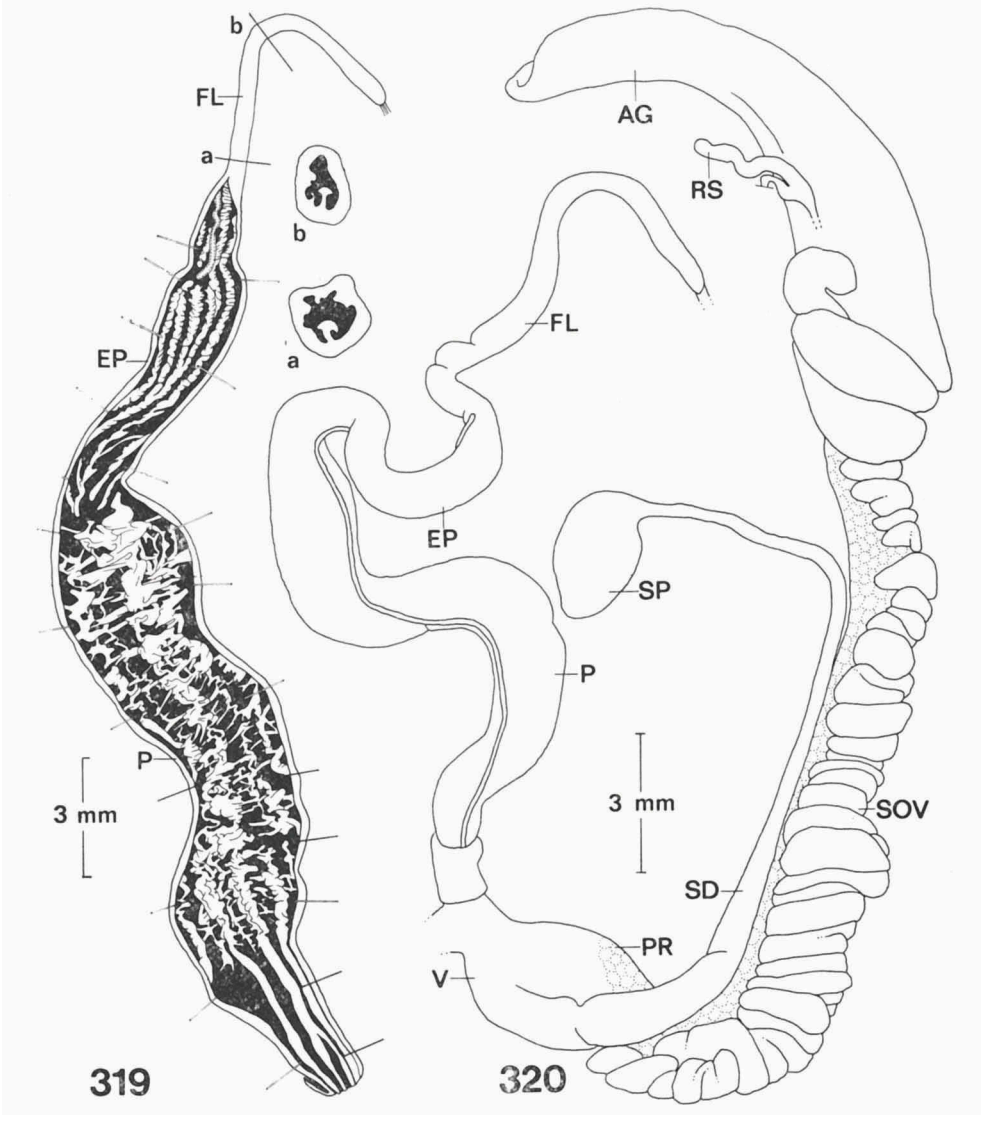
Histology. The lumen of the proximal part of the penis is narrowed by many infoldings and lined by a high-cylindrical epithelium of ca. 30 μm high. In the subepithelial tissue glandular cells are dispersed, which resemble those that are present in the epiphallus. Short blind-ending tubes are situated



Figs. 312-318. *Otostomus signatus* (Spix), genitalia and transverse sections of penis (figs. 313-316, slides H 3226, 3223 (2x), 3224), epiphallus (figs. 315-317, slides H 3223, 3224, 3229) and flagellum (fig. 318, slide H 3239). Brazil, Bahia, Lomanto Junior (RMNH).

parallel to the main lumen. The epithelium of the distal part of the penis is also high-cylindrical (cell height ca. 50 μm), while the ciliated epithelium of the epiphallus is ca. 20 μm high. Glandular cells, which stain dark blue with alcian blue, are dispersed in the subepithelial tissue of both the epiphallus and flagellum. In the flagellum a double-curved longitudinal fold has been observed.

Material. — Brazil, Bahia, Lomanto Junior, Fazenda São José (RMNH).



Figs. 319-320. *Cochlorina aurisleporis* (Bruguière), genitalia. Brazil, Espírito Santo, Linhares (RMNH).

Cochlorina aurisleporis (Bruguière, 1792)
(figs. 319-320)

Genitalia. — Penis with a short sheath (ca. 1/17 the length of the phallus), more or less sub-cylindrical, its most proximal part rather narrow, passing without external differentiation into the epiphallus. The flagellum is sub-cylindrical, about half as broad as the epiphallus and ca. 2/5 the length of the phallus. The vagina is very short. The spermathecal duct is sub-cylindrical, its proximal part rather broad; the spermatheca is elongate-globose.

Internally the penis has rather strong, longitudinal pilasters, which are transversally connected over the greatest part of their length, thus forming a complex pattern. The pilasters in the epiphallus are more or less plicate. The longitudinal curved fold of the flagellum is double-curved, as shown by two transverse sections.

Remarks. — Breure (1979: 98) already noted the close resemblance of *Cochlorina, Oxychona* and *Otostomus* with regard to the anatomy, viz. (1) the presence of a double-curved longitudinal fold in the flagellum; (2) the relatively long flagellum and (3) the relatively short vagina.

Material. — Brazil, Espírito Santo, Linhares (RMNH).

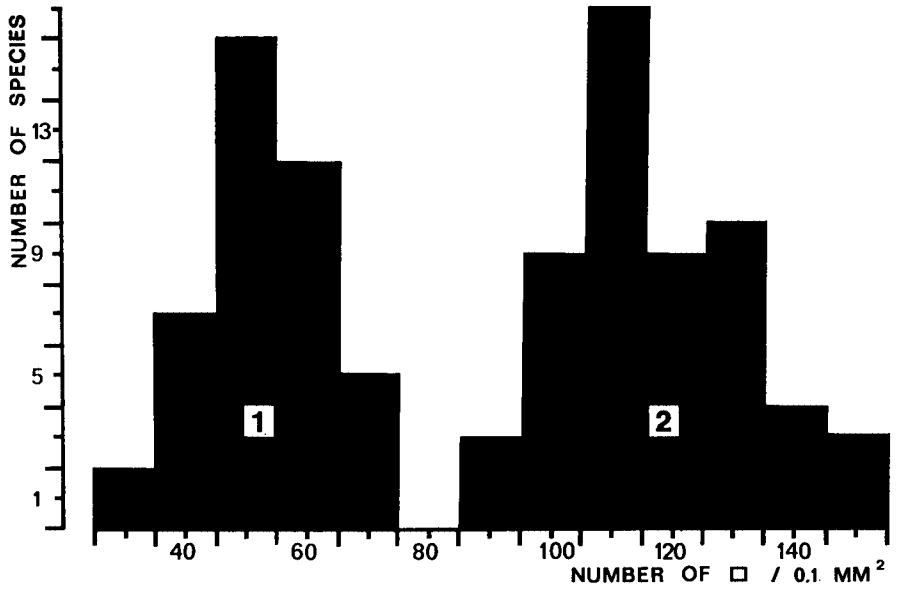


Fig. 321. Frequency-distribution of the size of the sculpture of the protoconch in 97 *Drymaeus* populations.

Appendix I — Protoconch sculpture

Of 86 randomly chosen *Drymaeus* species (representing 97 populations) the number of squares from the protoconch sculpture, per 0.1 mm², was counted [1]) (Table 3, column a) and divided in 13 classes of 10 squares per 0.1 mm² (Table 3, column b).

After frequency-counting the observations appear to be distributed with two maximums (fig. 321). With the combined X^2-test of Fisher for normality, we found that each of the groups is normally distributed. ($X_1^2 = 0.46$, $p_1 = 0.8$; $X^2 = 1.94$, $p_2 = 0.5$), using a level of significance of 0.05. The

Table 3

Number of squares from the protoconchsculpture of *Drymaeus*, per 0.1 mm². Column (a) gives the number of squares actually counted. Column (b) gives the corresponding classes. Data of species that appear more than once in this list have been taken from different populations

Species	a	b	Species	a	b	Species	a	b
Drymaeus (Drymaeus) aequatorianus	47	50	*D. (D.) morbidus*	130	130	*D. (M.) gereti*	102	100
D. (D.) angulobasis	126	130	*D. (D.) marrinus*	50	50	*D. (M.) hegewischi*	49	50
D. (D.) ambustus chamaeleon	119	120	*D. (D.) nystianus*	103	100	*D. (M.) inglorius*	37	40
D. (D.) attenuatus	119	120	*D. (D.) papyraceus*	56	60	*D. (M.) interpunctus*	106	110
D. (D.) attenuatus	107	110	*D. (D.) poecilus*	44	40	*D. (M.) interruptus*	128	130
D. (D.) beyerleanus	61	60	*D. (D.) punctatus*	66	70	*D. (M.) inusitatus*	147	150
D. (D.) bogotensis	68	70	*D. (D.) rudis*	41	40	*D. (M.) irazuensis*	151	150
D. (D.) catenae	57	60	*D. (D.) schunkei*	53	50	*D. (M.) livescens*	142	140
D. (D.) chrysomelas	51	50	*D. (D.) scitulus*	137	140	*D. (M.) miliaris*	113	110
D. (D.) celendinensis	116	120	*D. (D.) scitulus rubrovariegatus*	150	150	*D. (M.) moricandi*	100	100
D. (D.) cognatus	57	60	*D. (D.) serratus*	58	60	*D. (M.) moritinstus*	39	40
D. (D.) confluens	52	50	*D. (D.) solidus*	52	50	*D. (M.) multilineatus*	109	110
D. (D.) costaricensis	108	110	*D. (D.) strigatus*	59	60	*D. (M.) multilineatus*	112	110
D. (D.) dunkeri	37	40	*D. (D.) sulcosus*	49	50	*D. (M.) nigrofasciatus*	91	90
D. (D.) expansus	43	40	*D. (D.) trujillensis*	100	100	*D. (M.) peractorum*	53	50
D. (D.) farrisi	67	70	*D. (D.) vexillum*	110	110	*D. (M.) reclusianus martensianus*	105	110
D. (D.) felix	41	40	*D. (D.) violaceus*	63	60	*D. (M.) rufescens pinchoti*	121	120
D. (D.) fenestratus	28	30	*Drymaeus (Mesembrinus) alternans*	111	110	*D. (M.) semimaculatus*	117	120
D. (D.) fenestratus	28	30	*D. (M.) alternans*	116	120	*D. (M.) semipellucidus*	104	100
D. (D.) fenestrellus	99	100	*D. (M.) alternans*	107	110	*D. (M.) serperastrus*	47	50
D. (D.) flexuosus	51	50	*D. (M.) amoenus*	113	110	*D. (M.) serperastrus*	57	60
D. (D.) fusoides	62	60	*D. (M.) auriflexus*	66	70	*D. (M.) sulphureus*	130	130
D. (D.) germaini	46	50	*D. (M.) baquaerti*	107	110	*D. (M.) translucens*	133	130
D. (D.) ghiesbreghti	47	50	*D. (M.) cactivorus*	86	90	*D. (M.) trigonostomus*	92	90
D. (D.) ghiesbreghti iodostylus	58	60	*D. (M.) cozumelensis*	107	110	*D. (M.) tripictus*	124	120
D. (D.) glaucostomus	56	60	*D. (M.) depictus*	138	140	*D. (M.) uhdeanus*	46	50
D. (D.) hemypilabryi	97	100	*D. (M.) elongatus*	130	130	*D. (M.) vincentinus*	113	110
D. (D.) hygrohylaeus	67	70	*D. (M.) elongatus*	132	130	*D. (M.) virginalis*	117	120
D. (D.) josephus	45	50	*D. (M.) emeus*	109	110	*D. (M.) virgo*	109	110
D. (D.) lattrei	56	60	*D. (M.) emeus*	142	140	*D. (M.) spec. A*	113	110
D. (D.) mayus	45	50	*D. (M.) flavidulus*	126	130	*D. (M.) spec. B*	130	130
D. (D.) mexicanus	97	100	*D. (M.) flavidus*	101	100	*D. (M.) spec. C*	131	130
D. (D.) morbidus	124	120						

[1]) The number of squares was counted just after 1½ whorl, at the lower part of the whorl.

TABLE 4

Survey of radula structure in *Drymaeus*. Asterisks refer to the occurrence of mutations in lateromarginal teeth

Species	Components	Formula
Drymaeus (Drymaeus) attenuatus	C-8, LM-12 (62)	C/1 + LM 62/3
D. (D.) ambustus chamaeleon	C-11, LM-12 (52)	C/3 + LM 52/3
D. (D.) beyerleanus	C-8, L-4 (1), LM-12 (67)	C/1 + L 1/2 + LM 67/3
D. (D.) bogotensis	C-8, L-4 (1), LM-12 (51)	C/1 + L 1/2 + LM 51/3
D. (D.) canaliculatus	C-10, L-4 (1), LM-12 (41)	C/1 + L 1/2 + LM 41/3
D. (D.) cleefi	C-11, LM-12 (83)	C/3 + LM 83/3
D. (D.) costaricensis *	C-11, LM-12 (70)	C/3 + LM 70/3
D. (D.) expansus	C-10, L-4 (2), LM-12 (45)	C/1 + L 2/2 + LM 45/3
D. (D.) farrisi	C-8, LM-12 (73)	C/1 + LM 73/3
D. (D.) fenestratus	C-11, LM-12 (67)	C/3 + LM 67/3
D. (D.) hygrohylaeus	C-8, L-4 (1), LM-12 (63)	C/1 + L 1/2 + LM 63/3
D. (D.) morbidus	C-11, L-4 (2), LM-12 (39)	C/1 + L 2/2 + LM 39/3
D. (D.) nystianus *	C-8, L-4 (4), LM-12 (58)	C/1 + L 4/2 + LM 58/3
D. (D.) papyraceus	C-11, LM-12 (76)	C/3 + LM 76/3
D. (D.) poecilus	C-8, LM-12 (87)	C/1 + LM 87/3
D. (D.) punctatus	C-10, L-4 (3), LM-12 (53)	C/1 + L 3/2 + LM 53/3
D. (D.) schunkei	C-10, L-4 (2), LM-12 (41)	C/1 + L 2/2 + LM 41/3
D. (D.) scitulus	C-11, LM-12 (73)	C/3 + LM 73/3
D. (D.) serratus	C-10, L-4 (2), LM-12 (51)	C/1 + L 2/2 + LM 51/3
D. (D.) strigatus	C-10, L-3 (1), LM-12 (43)	C/1 + L 2/2 + LM 43/3
D. (D.) sulcosus	C-8, LM-12 (66)	C/1 + LM 66/3
D. (D.) vexillum	C-8, L-4 (1), LM-12 (41)	C/1 + L 1/2 + LM 41/3
D. (D.) yapacanensis	C-11, LM-12 (62)	C/3 + LM 62/3
Drymaeus (Mesembrinus) aurifluus *	C-12, LM-18 (56)	C/3 + LM 56/3
D. (M.) amoenus	C-12, LM-18 (82)	C/3 + LM 82/3
D. (M.) alternans	C-12, LM-18 (76-88)	C/3 + LM 76-88/3
D. (M.) emeus *	C-12, LM-18 (88)	C/3 + LM 88/3
D. (M.) elongatus	C-12, LM-18 (69-83)	C/3 + LM 69-83/3
D. (M.) extraneus *	C-12, LM-18 (90)	C/3 + LM 90/3
D. (M.) dominicus clarissimus *	C-12, LM-9 (146)	C/2 + LM 146/4
D. (M.) dormani *	C-12, LM-18 (71)	C/3 + LM 71/3
D. (M.) gereti	C-12, LM-18 (87)	C/3 + LM 87/3
D. (M.) hegewischi *	C-12, LM-18 (73)	C/3 + LM 73/3
D. (M.) inglorius	C-12, LM-18 (73)	C/3 + LM 73/3
D. (M.) interpunctus *	C-12, LM-18 (74)	C/3 + LM 74/3
D. (M.) multilineatus	C-12, LM-9 (95+x)	C/3 + LM 95+x/4
D. (M.) perductorum	C-12, LM-18 (78)	C/3 + LM 78/3
D. (M.) reclusianus martensianus	C-12, LM-18 (76)	C/3 + LM 76/3
D. (M.) rufescens pinchoti	C-12, LM-18 (55+x)	C/3 + LM 55+x/3
D. (M.) semimaculatus	C-12, LM-18 (77)	C/3 + LM 77/3
D. (M.) semipellucides	C-12, LM-18 (144)	C/3 + LM 144/4
D. (M.) serperastrus *	C-12, LM-18 (68)	C/3 + LM 68/3
D. (M.) sulphureus	C-12, LM-18 (80)	C/3 + LM 80/3
D. (M.) tripictus	C-12, LM-18 (119)	C/3 + LM 119/3
D. (M.) uhdeanus	C-12, LM-18 (72)	C/3 + LM 72/3
D. (M.) vincentinus	C-12, LM-18 (84)	C/3 + LM 84/3

means and standard deviations of both groups are: $\bar{x}_1 = 51.79$, $s_1 = 9.96$ and $\bar{x}_2 = 116.92$, $s_2 = 15.99$. Groups 1 and 2 largely correspond with the subgenera *Drymaeus* and *Mesembrinus* respectively. See also plate 3 figs. 1-2 in Breure, 1979.

In *Drymaeus* (*Drymaeus*) some species from N-Peru (e.g., *morbidus, nystianus, vexillum*) (1) have a fine sculpture on the protoconch (number of squares per 0.1 mm^2 more than ca. 100) and (2) lack the large, rounded subepithelial (glandular) cells in the distal part of the penis. In these respects they strongly resemble species of *Neopetraeus* (which occur in the same region).

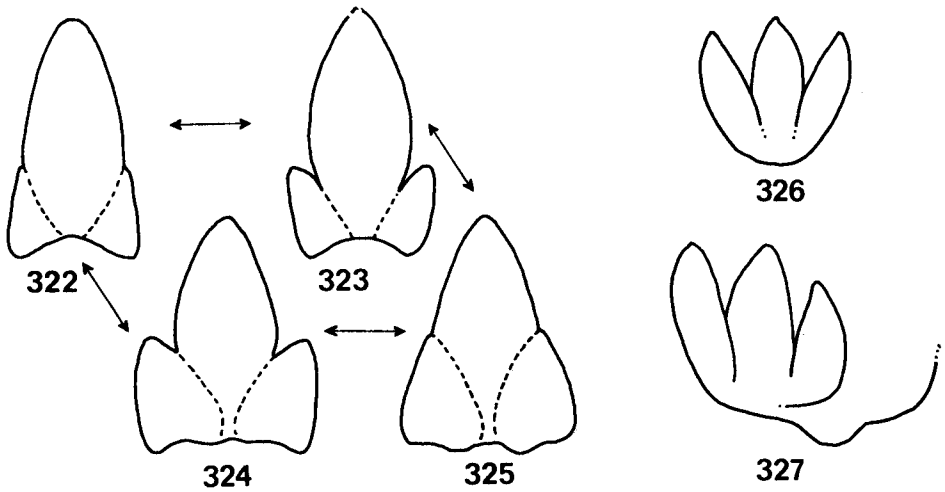
Contrasting with this, some species of *Drymaeus* (*Mesembrinus*) have a protoconch-sculpture with relatively few squares per 0.1 mm^2 (e.g., *hegewischi, inglorius, perductorum*). The shells of these species strongly resemble *Drymaeus* (*D.*) *sulcosus*; these species are nevertheless placed in *Mesembrinus* on account of (a) the structure of the radula, (b) the structure of the genitalia and (c) the unexpanded peristome of the shell.

Appendix II — Radula

In general the central teeth of species of *Drymaeus* (*Drymaeus*) are slightly smaller than the lateral teeth. The mesocones of the central teeth are more or less acute and triangular to ovate. The relative length of the ectocones is variable; the rate to which the ectocones are fused to the mesocones is variable too (figs. 322-325). The tooth types of figs. 322 and 323 are regarded as monocuspid, whereas those of figs. 324 and 325 are clearly tricuspid. Transitions between these four types do occur, and they are regarded to represent type C-8 (see Breure, 1978). When the ectocones are clearly differentiated the central teeth represent type C-11, while in some species central teeth of type C-10 do occur. The lateral teeth, of which the mesocones are more or less acute, represent type L-4; those with the ectocones reduced better suit type L-3. The lateromarginal teeth represent type LM-12.

The transverse rows of the radula are more or less perpendicular to the longitudinal axis. In 23 species of *Drymaeus* (*Drymaeus*) studied the number of teeth of a transverse row (in the middle of the radula) varies from 82-174 (average: 116).

In species of *Drymaeus* (*Mesembrinus*) the size of the radula teeth is about half the size of those in species of the nominate subgenus. The central teeth are tricuspid, with elongate, ovate to lanceolate mesocones and ecto-



Figs. 322-325. Different forms of central teeth in *Drymaeus* (*Drymaeus*) (type C-8); arrows indicate transitions between the four forms.
Fig. 326. Central tooth-type C-12.
Fig. 327. Lateromarginal tooth-type LM-18.

cones, which are about equal in length (type C-12: fig. 326). Very exceptionally mutations of this tooth type have been observed and either the mesocones or the ectocones are absent. In *Drymaeus* (*Mesembrinus*) *sulphureus* (Pfeiffer) the ectocones are absent in the specimens studied, but Solem (1955) has figured a radula of this species with tricuspid central teeth. In *Drymaeus* (*Mesembrinus*) *dormani* and *D.* (*M.*) *dominicus* the mesocones of the central teeth are absent; this situation corresponds for *dominicus* with the description of Baker (1923). In *dominicus* and *dormani*, as well as in some other species (see table 4), mutations of lateromarginal teeth do also occur. It may be noted that the number of mutations in *Mesembrinus* species is higher than in species of *Drymaeus* s.s. (see table 4); this agrees with the observations of Solem (1955: 3-4). The lateromarginal teeth have either two subequal cusps, which are elongate-ovate to lanceolate and with the ectocones serrate in the outermost teeth (LM-18: fig. 327) or four subequal cusps (LM-9).

The transverse rows of the radula are V- or W-shaped and the number of teeth varies from 112-292 (average: 170; 23 species studied).

The raduale of species of *Drymaeus* lack the supporting denticles described by Solem (1972). In several species, however, the teeth are attached to the basal membrane at both the posterior and anterior side of the basal plate (plate 2 figs. 1, 3, 8). Possibly this system has the same function as the sup-

porting denticles, viz. to 'prevent the teeth from chimmying' (Solem, 1955).

The structure of the radula in the species of *Drymaeus* studied by us is presented in table 4 (cf. Breure, 1978: Table 3).

Appendix III — Mandibula

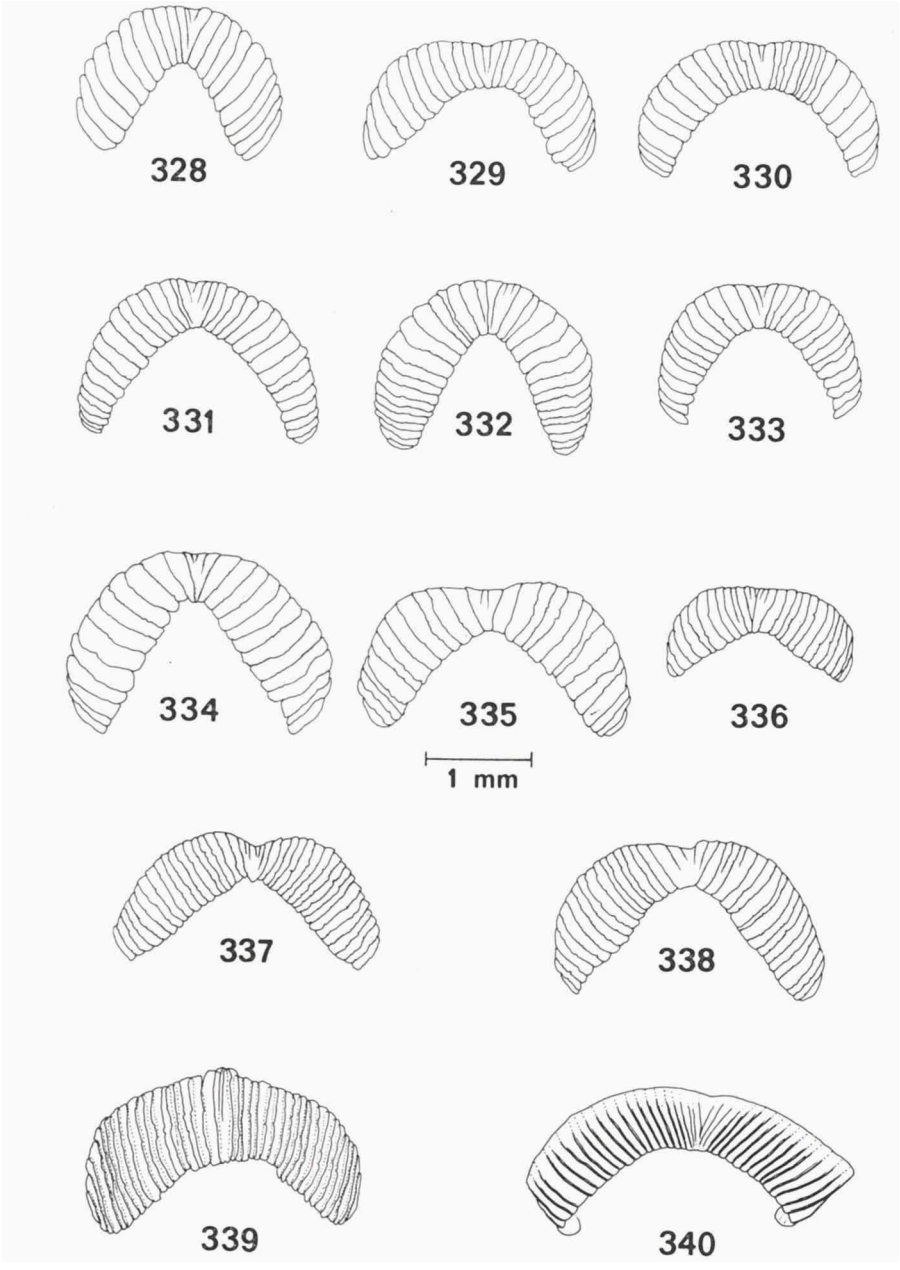
The mandibulae of 46 species of *Drymaeus* were examined. Two types are distinguished, which roughly correspond to the two subgenera.

Group A comprises species of *Drymaeus* s. str. and a few species of *Drymaeus* (*Mesembrinus*). The mandibula has as a maximum 18 plates on each side of the central part; the plates are about four times as long as wide and their length decreases towards the central part. Two subgroups may be distinguished:

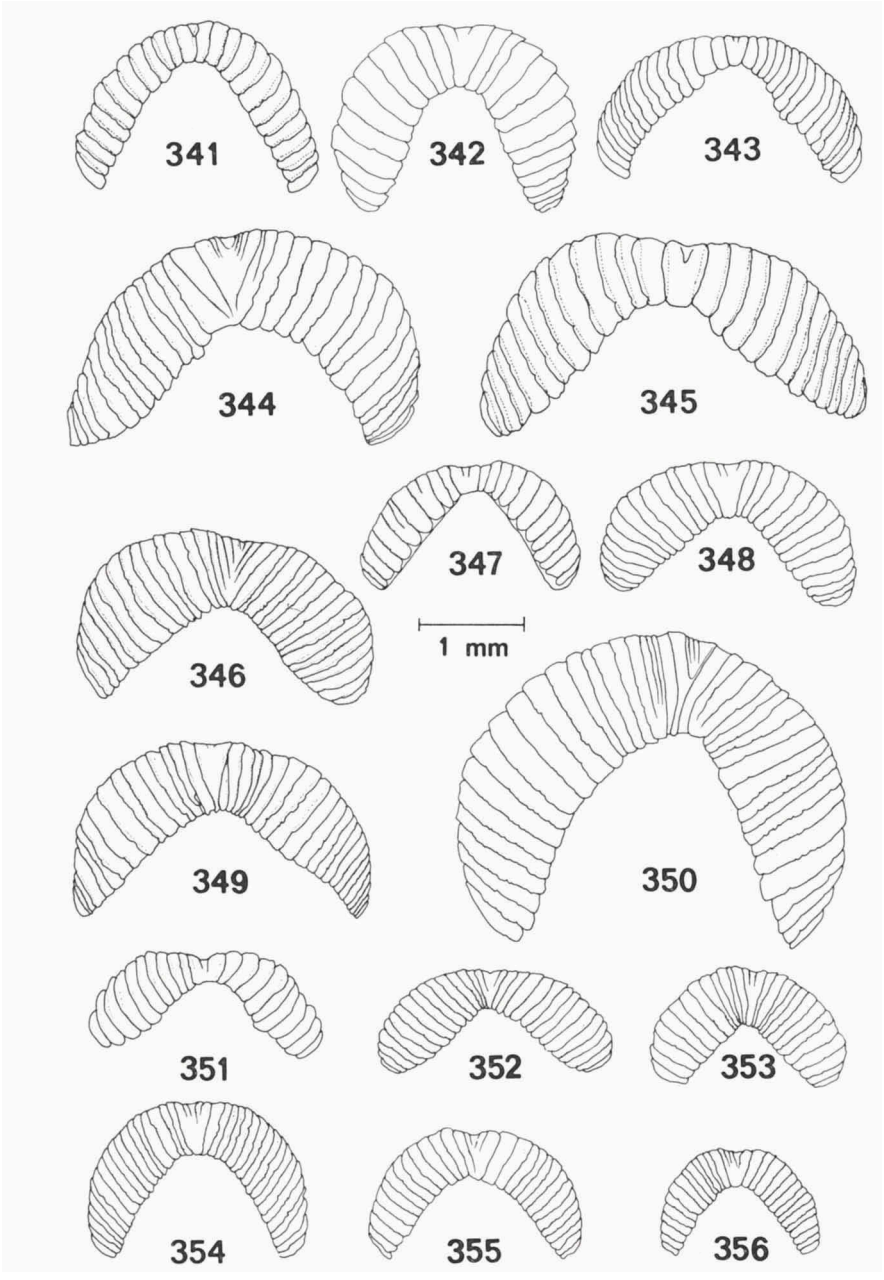
(1) the central part consists of three fused plates, with about 13 plates on each side. This type has been observed in the following *Drymaeus* (*D.*) species: *ambustus* (fig. 330), *beyerleanus* (fig. 342), *bogotensis* (fig. 341), *canaliculatus* (fig. 335), *farrisi* (fig. 348), *hygrohylaeus* (fig. 345), *morbidus* (fig. 328), *nystianus* (fig. 336), *schunkei* (fig. 347), *scitulus* (fig. 334), *serratus* (fig. 351), *strigatus* (fig. 352), *vexillum* (fig. 329) and *yapacanensis* (fig. 343). Similar mandibulae have been observed in *Neopetraeus* species.

(2) the central part consists of more than three fused plates and there are ca. 17 plates on each side. This type has been observed in *Drymaeus* (*D.*) species: *attenuatus* (fig. 332), *cleefi* (fig. 339), *costaricensis* (fig. 331), *fenestratus* (fig. 344), *fenestrellus* (fig. 333), *papyraceus* (fig. 349), *poecilus* (fig. 357), *punctatus* (fig. 346), *rudis* (fig. 359) and *sulcosus* (fig. 350). It has also been observed in *Drymaeus* (*Mesembrinus*) species: *aurifluus* (fig. 355), *hegewischi* (fig. 354), *inglorius* (fig. 356), *perductorum* (fig. 358) and *uhdeanus* (fig. 353). Moreover, mandibulae of this type have been observed in *Otostomus* and *Cochlorina* species (figs. 337-338).

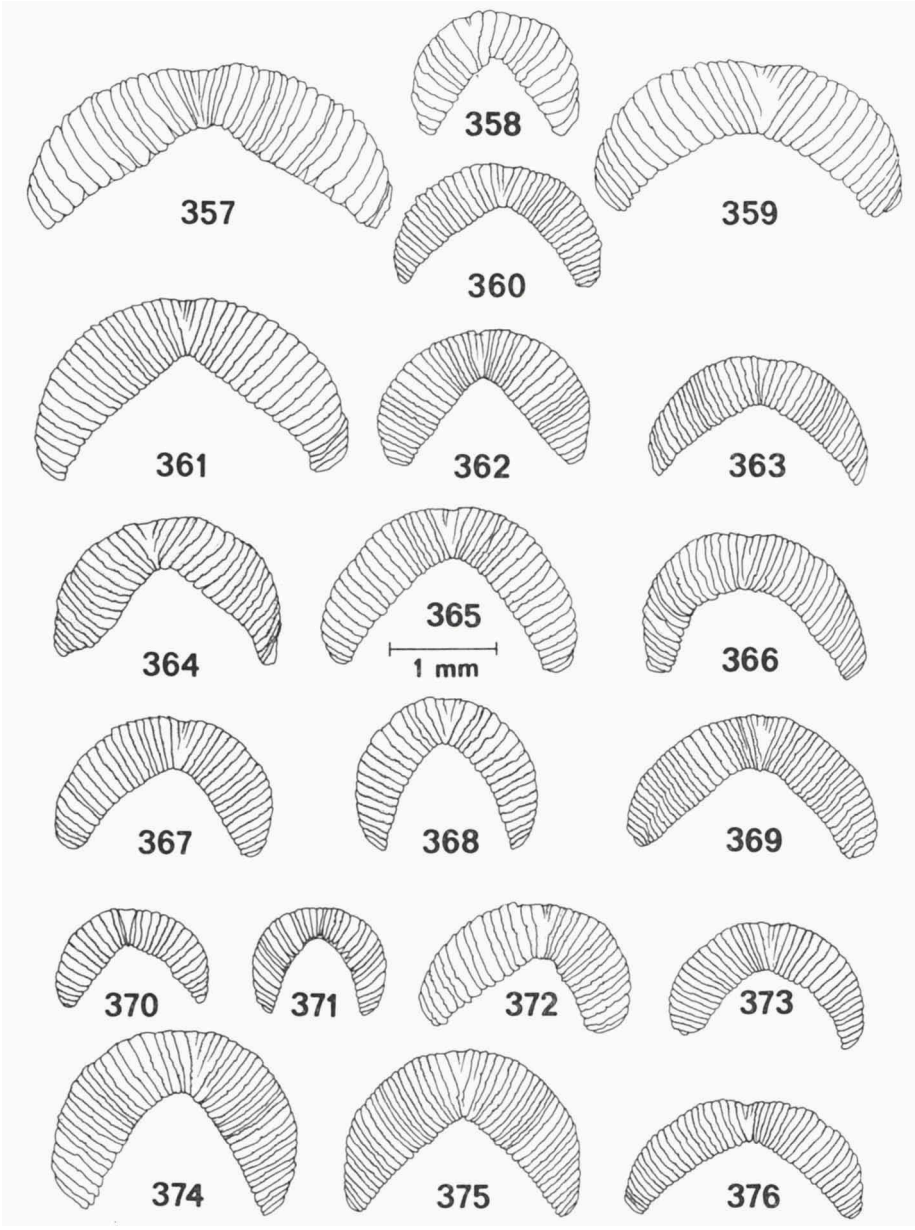
Group B comprises only species of *Drymaeus* (*Mesembrinus*). The mandibula has 20 plates or more on each side of the central part; the plates are about eight times as long as wide and about equal in length. This type has been observed in the following *Drymaeus* (*Mesembrinus*) species: *alternans* (figs. 360, 364), *amoenus* (fig. 376), *dominicus* (fig. 363), *dormani* (fig. 362), *elongatus* (fig. 373), *emeus* (fig. 365), *extraneus* (fig. 340), *gereti* (fig. 366), *interpunctus* (fig. 368), *multilineatus* (fig. 370), *recluzianus martensianus* (fig. 367), *rufescens pinchoti* (fig. 374), *semimaculatus* (fig. 369), *semipellucidus* (fig. 371), *serperastrus* (fig. 361), *tripictus* Albers (fig. 372) and *vincentinus* (fig. 375).



Figs. 328-340. Mandibulae: fig. 328, *Drymaeus* (*Drymaeus*) *morbidus* (Philippi); fig. 329, *D.* (*D.*) *vexillum* (Wood); fig. 330, *D.* (*D.*) *ambustus chamaeleon* (Pfeiffer); fig. 331, *D.* (*D.*) *costaricensis* (Pfeiffer); fig. 332, *D.* (*D.*) *attenuatus* (Pfeiffer); fig. 333, *D.* (*D.*) *fenestrellus* (Martens); fig. 334, *D.* (*D.*) *scitulus* (Reeve); fig. 335, *D.* (*D.*) *canaliculatus* (Pfeiffer); fig. 336, *D.* (*D.*) *nystianus* (Pfeiffer); fig. 337, *Cochlorina aurisleporis* (Bruguière); fig. 338, *Otostomus signatus* (Spix); fig. 339, *D.* (*D.*) *cleefi* spec. nov.; fig. 340, *D.* (*Mesembrinus*) *extraneus* (Haas).



Figs. 341-356. Mandibulae: fig. 341, *D.* (*D.*) *bogotensis* (Pfeiffer); fig. 342, *D.* (*D.*) *beyerleanus* (Hupé); fig. 343, *D.* (*D.*) *yapacanensis* spec. nov.; fig. 344, *D.* (*D.*) *fenestratus* (Pfeiffer); fig. 345, *D.* (*D.*) *hygrohylaeus* (d'Orbigny); fig. 346, *D.* (*D.*) *punctatus* Da Costa; fig. 347, *D.* (*D.*) *schunkei* Haas; fig. 348, *D.* (*D.*) *farrisi* (Pfeiffer); fig. 349, *D.* (*D.*) *papyraceus* (Mawe); fig. 350, *D.* (*D.*) *sulcosus* (Pfeiffer); fig. 351, *D.* (*D.*) *serratus* (Pfeiffer); fig. 352, *D.* (*D.*) *strigatus* (Reeve); fig. 353, *D.* (*Mesembrinus*) *uhdeanus* (Martens); fig. 354, *D.* (*M.*) *hegewischi* (Pfeiffer); fig. 355, *D.* (*M.*) *auriffluus* (Pfeiffer); fig. 356, *D.* (*M.*) *inglorius* (Reeve).



Figs. 357-376. Mandibulae: fig. 357, *D.* (*D.*) ***poecilus*** (d'Orbigny); fig. 358, *D.* (*Mesembrinus*) ***perductorum*** Rehder; fig. 359, *D.* (*D.*) ***rudis*** (Anton); fig. 360, *D.* (*M.*) ***alternans*** (Beck); fig. 361, *D.* (*M.*) ***serperastrus*** (Say); fig. 362, *D.* (*M.*) ***dormani*** (Binney); fig. 363, *D.* (*M.*) ***dominicus clarissimus*** Pilsbry; fig. 364, *D.* (*M.*) ***alternans*** (Beck); fig. 365, *D.* (*M.*) ***emeus*** (Say); fig. 366, *D.* (*M.*) ***gereti*** Ancey; fig. 367, *D.* (*M.*) ***reclusianus martensianus*** Pilsbry; fig. 368, *D.* (*M.*) ***interpunctus*** (Martens); fig. 369, *D.* (*M.*) ***seminaculatus*** Pilsbry; fig. 370, *D.* (*M.*) ***multilineatus*** (Say); fig. 371, *D.* (*M.*) ***semipellucidus*** (Tristam); fig. 372, *D.* (*M.*) ***tripictus*** (Albers); fig. 373, *D.* (*M.*) ***elongatus*** (Röding); fig. 374, *D.* (*M.*) ***rufescens pinchoti*** Pilsbry; fig. 375, *D.* (*M.*) ***vincentinus*** (Pfeiffer); fig. 376, *D.* (*M.*) ***amoenus*** (Pfeiffer).

References

AGUAYO, C. G., 1961. Aspecto general de la fauna malacológica puerto-riqueña. — Carib. J. Sci., 1: 89-105.

——, 1966. Una lista de los moluscos terrestres y fluviales de Puerto Rico. — Stahlia, 5: 1-17.

ALBERS, J. C., 1850. Die Heliceen, nach natürlicher Verwandtschaft systematisch geordnet von Joh. Christ. Albers: 1-262 (Berlin).

——, 1860. Die Heliceen nach natürlicher Verwandtschaft systematisch geordnet von Joh. Christ. Albers. 2e Ausgabe: i-xviii, 1-359 (Berlin).

ANGAS, C. F., 1878. Descriptions of nine new species of land and marine shells from various localities. — Proc. zool. Soc. Lond., 1878: 311-314.

ANTON, H. E., 1839. Verzeichniss der Conchylien welche sich in der Sammlung von Hermann Eduard Anton befinden: 1-110 (Halle).

BAKER, H. B., 1923. The Mollusca collected by the University of Michigan-Walker expedition in southern Vera Cruz, Mexico, IV. — Occ. Papers Mus. Zool. Univ. Mich., 135: 1-16.

——, 1924. Land and freshwater molluscs of the Dutch Leeward Islands. — Occ. Papers Mus. Zool. Univ. Mich., 152: 1-159.

——, 1926. The Mollusca collected by the University of Michigan-Wiliamson expedition in Venezuela, IV. — Occ. Papers Mus. Zool. Univ. Mich., 167: 1-49.

BEAU, 1857. Catalogue des coquilles recueillies à la Guadeloupe et ses dépendances. — Rev. coloniale, (2) 18: 479-505.

BENTHEM JUTTING, T. VAN, 1925. On a collection of non-marine Mollusca from Curaçao. — Bijdr. Dierk., 24: 25-32.

BINNEY, W. G., 1876. On the lingual dentition, jaw and genitalia of Carelia, Onchidella and other Pulmonata. — Proc. Acad. nat. Sci. Philad., 1876: 183-192.

BLAND, T., 1861. On the geographical distribution of the genera and species of land shells of the West Indian islands, with a catalogue of the species of each island. — Ann. Lyc. nat. Hist. N.Y., 7: 9-35.

——, 1866. Remarks on the origin and distribution of the operculated land shells which inhabit the continent of America and the West Indies. — Amer. J. Conch., 2: 136-143.

BREURE, A. S. H., 1973. Index to the neotropical land Mollusca described by Alcide d'Orbigny, with notes on the localities of the mainland species. — Basteria, 37: 113-135.

——, 1974. Caribbean land molluscs: Bulimulidae, I. Bulimulus. — Stud. Fauna Curaçao, 45: 1-80.

——, 1975. Caribbean land molluscs: Bulimulidae, II. Plekocheilus and Naesiotus. — Stud. Fauna Curaçao, 46: 71-93.

——, 1976. Types of Bulimulidae (Mollusca, Gastropoda) in the Muséum national d'Histoire naturelle, Paris. — Bull. Mus. natn Hist. nat. Paris, (3) 331, Zool., 233: 1137-1187.

——, 1978. Notes on and descriptions of Bulimulidae (Mollusca, Gastropoda). — Zool. Verh. Leiden, 164: 1-255.

——, 1979. Systematics, phylogeny and zoogeography of Bulimulinae (Mollusca). — Zool. Verh. Leiden, 168: 1-215.

BREURE, A. S. H. & A. A. C. ESKENS, 1978. Observations on the formation of spermatophores in a bulimulid land snail, Drymaeus canaliculatus (Pfeiffer, 1845) (Mollusca, Gastropoda, Pulmonata). — Neth. J. Zool., 27: 271-276.

CATLOW, A. & L. A. REEVE, 1845. The conchologist's nomenclator, a catalogue of all the recent species of shells: 1-326 (London).

CLENCH, W. J., 1951. Land shells of Mona Island, Puerto Rico. — J. Conch. Paris, 90: 269-276.

——, 1956. Land shells of Barbuda Island, Lesser Antilles, — Nautilus, 70: 69-70.

CLENCH, W. J., 1969. Land shells of Jost Van Dyke. Virgin Islands. — Nautilus, 82: 144-145.
COOMANS, H. E., 1967. The non-marine Mollusca of St. Martin (Lesser Antilles). — Stud. Fauna Curoçao, 24: 118-145.
——, 1974. Life and malacological work of Hendrik Elingsz van Rijgersma (1835-1877), a Dutch physician and scientist on St. Martin, Netherlands Antilles. — Bijdr. Dierk., 44: 115-214.
DALL, W. H. & C. T. SIMPSON, 1902. The Mollusca of Puerto Rico. — Bull. U.S. Fish Commn., 20 (1): 351-524.
HUMMELINCK, P. WAGENAAR, 1940a. Land and freshwater mollusks from the smaller Venezuelan island. — Arch. néerl. Zool., 4: 352-354.
——, 1940b. A survey of the mammals, lizards and mollusks. — Stud. Fauna Curaçao, 1: 59-108.
——, 1940c. Zoogeographical remarks. — Stud. Fauna Curaçao, 1: 109-130.
JACOBSON, M. K., 1968. The land Mollusca of St. Croix, Virgin Islands. — Sterkiana, 32: 18-28.
JAY, J. C., 1852. Catalogue of the shells, ..., contained in the collection of John C. Jay, M.D. Fourth edition: 1-479 (New York).
JONG, K. M. DE & I. KRISTENSEN, 1968. Gegevens over de mollusken van Curaçao uitgezonderd de mariene gastropoden. RIVON-Meded., 276: 1-45.
KOBELT, W., 1876-1881. Illustriertes Conchylienbuch: i-xvi, 1-392 (Nürnberg).
——, 1880. Die geographische Verbreitung der Mollusken, III. Die Inselfaunen. — Jb. dt. malak. Ges., 7: 1-30, 241-286.
MARTENS, E., 1890-1901. Land and freshwater Mollusca. In: F. D. GODMAN & O. SALVIN, Biologica Centrali-Americana: i-xxviii, 1-706 (London).
MENKE, C. T., 1830. Synopsis methodica molluscorum ... [second edition]: i-xvi, 1-168 (Pyrmonti).
MÖRCH, O. A. L., 1852. Catalogus conchyliorum quae reliquit D. Alphonso d'Aguirra & Gadea comes de Yoldi, ..., I: 1-170 (Hafniae).
ODHNER, N. H., 1951. Studies on Galapagos bulimulids. — J. Conch. Paris, 90: 253-268.
PAETEL, F., 1873. Catalog der Conchylien-Sammlung von Fr. Paetel nebst uebersicht des angewandten Systems: 1-172 (Berlin).
——, 1883. Catalog der Conchylien-Sammlung von Fr. Paetel: 1-271 (Berlin).
——, 1888-1890. Catalog der Conchylien-Sammlung von Fr. Paetel, II. Die Land und Süsswasser-Gastropoden: i-xii, 1-505 (Berlin).
PAETEL, F. & L. W. SCHAUFUSS, 1869. Molluscorum systema et catalogus. System und Aufzählung sämmtlicher Conchylien der Sammlung von Fr. Paetel: 1-119 (Dresden).
PARODIZ, J. J., 1962. New and little-known species of South and Central American land snails (Bulimulidae). — Proc. U.S. natn Mus., 113: 429-456.
PFEIFFER, L., 1840. Kritisches Register zu Martini und Chemnitz systematischem Konchylien-Kabinet: i-viii, 1-112 (Kassel).
——, 1841. Symbolae ad historiam heliceorum, 1: 1-88 (Casselis).
——, 1855. Descriptions of forty-seven new species of Helicea, from the collection of H. Cuming, Esq. — Proc. zool. Soc. Lond., 1855: 91-101.
——, 1858. Desciptions of ten new species of Bulimus, from the collection of H. Cuming, Esq. — Proc. zool. Soc. Lond., 1858: 256-258.
——, 1868. Monographia heliceorum viventium ..., 6: 1-598 (Cassel).
——, 1877. Monographia heliceorum viventium ..., 8: 1-729 (Cassel).
PFEIFFER, L. & S. CLESSIN, 1881. Nomenclator heliceorum viventium: 1-617 (Cassel).
PHILIPPI, R. A., 1845-1847. Abbildungen und Beschreibungen neuer oder wenig gekannter Conchylien, 2: 1-231 (Cassel).
PILSBRY, H. A., 1897-1898. American Bulimulidae: Bulimulus, Neopetraeus, Oxychona and South American Drymaeus. — Man. Conch., (2) 11: 1-399.

PILSBRY, H. A., 1899. American Bulimulidae: North American and Antillean Drymaeus, Leiostracus, Orthalicinae and Amphibuliminae. — Man. Conch., (2) 12: 1-258.
——, 1930. Results of the Pinchot South Sea expedition, 1. Land mollusks of the Caribbean islands, Grand Cayman, Swan, Old Providence and St. Andrew. — Proc. Acad. nat. Sci. Philad., 82: 221-261.
——, 1946. Land Mollusca of North America (north of Mexico). — Monogr. Acad. nat. Sci. Philad., 3, 2 (1): i-vi, 1-520.
REEVE, L. A., 1848-1850. Conchologica iconica or illustrations of the shells of molluscous animals, 5. Bulimus: i-xi, 89 pls. + legend (London).
REZENDE, H. E. B., 1975. Superfamília Bulimuloidea do Brasil, Bulimulidae: Drymaeus papyraceus (Mawe, 1823) (Mollusca, Gastropoda, Pulmonata). — Arq. Mus. nac. Rio de J., 55: 129-152.
RICHARDS, H. G., 1940. Moluscos coleccionados en la Isla de Margarita. — Bol. Soc. venez. Cienc. nat., 6: 302-307.
RICHARDS, H. G. & P. WAGENAAR HUMMELINCK, 1940. Land and freshwater mollusks from Margarita Island, Venezuela. — Notul. Naturae, 62: 1-16.
SCHALIE, H. VAN DER, 1948. The land and freshwater mollusks of Puerto Rico. — Misc. Publs. Mus. Zool. Univ. Mich., 70: 1-134.
SCHEPMAN, M. M., 1915. Mollusca. In: H. D. BENJAMINS & J. F. SNELLEMANS, Encyclopaedie van Nederlandsch West-Indië: 477-482 ('s-Gravenhage & Leiden).
SCHMITT, W. L., 1936. Macruran and Anomuran Crustacea from Bonaire, Curaçao and Aruba. — Zool. Jb. (Syst.), 67: 363-378.
SCHRAMM, A., 1869. Catalogue des coquilles et des crustacés de la Guadeloupe ...: 1-24 (Basse-Terre).
SEMPER, C. G., 1870-1885. Reisen im Archipel der Philippinen, II. Wissenschaftliche Resultaten, 3. Landmollusken: i-vi, 1-337 (Wiesbaden).
SHUTTLEWORTH, R. J., 1854. Catalogue of the terrestrial and fluviatile shells of St. Thomas, West Indies. — Ann. Lyc. nat. Hist. N.Y., 6: 68-73.
SOLEM, A., 1955. Mexican mollusks collected for Dr. Bryant Walker in 1926. XI. Drymaeus. — Occ. Papers Mus. Zool. Univ. Mich., 566: 1-20.
——, 1972. Malacological applications of scanning electron microscopy, II. Radular structure and functioning. — Veliger, 14: 327-336.
SOWERBY, G. B., 1825. A catalogue of the shells contained in the collection of the late Earl of Tankerville: 1-92 (London).
STREBEL, H. & G. PFEFFER, 1882. Beitrag zur Kenntnis der Fauna mexikanischer Land- und Süsswasser-Conchylien, V: 1-144 (Hamburg).
TRISTAM, H. B., 1864. Supplemental catalogue of terrestrial and fluviatile mollusks collected in Guatamala by O. Salvin. — Proc. zool. Soc. Lond., 1863: 411-414.
VAN MOL, J. J., 1971. Notes anatomiques sur les Bulimulidae (Mollusques, Gastéropodes, Pulmonés). — Annls. Soc. r. zool. Belg., 101: 183-225.
VENMANS, L. A. W. C. & B. VERDCOURT, 1950. Abnormalities in the radula of Drymaeus virgulatus (Fér.). — Basteria, 14: 1-3.
VERNHOUT, J. H., 1914. The land and freshwater molluscs of the Dutch West Indian Islands. — Notes Leyden Mus., 36: 177-189.
WEYRAUCH, W. K., 1960. Zwanzig neue Landschnecken aus Peru. — Arch. Moll., 89: 23-48.

Explanation of plates

The following abbreviations are used with respect to the plates: e, epithelium; se, subepithelial tissue; g, epiphallial glandular cells; L, lumen; B, basal plate; BM, basal membrane; C, central tooth.

Plate 1

Fig. 1. *Drymaeus* (*Mesembrinus*) *elongatus* (Röding), detail of the proximal part of penis (alcian blue; slide H 4179). Fig. 2. *Drymaeus* (*Mesembrinus*) *rufescens pinchoti* Pilsbry, detail of the proximal part of penis (alcian blue; slide H 5394). Fig. 3. *Drymaeus* (*Drymaeus*) *hygrohylaeus* (d'Orbigny), detail of the transition between epiphallus and proximal part of penis (alcian blue; slide H 4222). Fig. 4. *Drymaeus* (*Drymaeus*) *beyerleanus* (Hupé), detail of the proximal part of the penis (alcian blue; slide H 4071). Arrow indicates the connection of subepithelial cells with the lumen. The scale line (30 μm) refers to all figures of plate 1. The exact positions of the details of this plate are indicated in textfigs. 208, 275, 82 and 11 respectively.

Plate 2

Fig. 1. *Drymaeus* (*Drymaeus*) *beyerleanus* (Hupé), central and two first lateral teeth, showing interaction (1008-21), × 1200. Fig. 2. *Drymaeus* (*Drymaeus*) *canaliculatus* (Pfeiffer), lateral view of central part of radula (1003-28), × 245. Figs. 3-4. *Drymaeus* (*Drymaeus*) *cleefi* spec. nov. 3, central and four lateromarginal teeth (1349-30), × 1100; 4, utmost marginal zone of radula (1347-30), × 1100. Fig. 5. *Drymaeus* (*Drymaeus*) *expansus* (Pfeiffer), central, two lateral and three marginal teeth (1008-26), × 620. Fig. 6. *Drymaeus* (*Drymaeus*) *fenestratus* (Pfeiffer), central and two lateromarginal teeth (1066-7), × 1225. Fig. 7. *Drymaeus* (*Drymaeus*) *hygrohylaeus* (d'Orbigny), central, one lateral and five marginal teeth (1004-14), × 600. Fig. 8. (*Drymaeus*) *morbidus* (Philippi), lateral view of central and two lateral teeth (1003-29), × 100.

Plate 3

Fig. 1. *Drymaeus* (*Drymaeus*) *poecilus* (d'Orbigny), central and six lateromarginal teeth (1017-3), × 590. Fig. 2. *Drymaeus* (*Drymaeus*) *punctatus* Da Costa, central and lateral teeth (1114-33), × 1150. Fig. 3. *Drymaeus* (*Drymaeus*) *scitulus* (Reeve), central and first lateromarginal teeth (1176-22), × 2400. Fig. 4. *Drymaeus* (*Drymaeus*) *strigatus* (Reeve), central, two lateral and three marginal teeth (1008-36), × 625. Figs. 5-6. *Drymaeus* (*Drymaeus*) *yapacanensis* spec. nov. 5, central and two lateromarginal teeth, × 1300. 6, lateromarginal teeth from the utmost marginal zone of radula, showing interaction, × 1300. Fig. 7. *Drymaeus* (*Mesembrinus*) *alternans* (Beck), central and four lateromarginal teeth (1085-21), × 1120. Fig. 8. *Drymaeus* (*Mesembrinus*) *dominicus clarissimus* Pilsbry, central and six lateromarginal teeth; note the mutational lateromarginal teeth left of central tooth (1092-23), × 1100.

Plate 4

Fig. 1. *Drymaeus* (*Mesembrinus*) *dormani* (Binney), lateral view of central part of radula (1072-33), × 1100. Fig. 2. *Drymaeus* (*Mesembrinus*) *elongatus* (Röding), lateral view of central part of radula (1085-9), × 1200. Fig. 3. *Drymaeus* (*Mesembrinus*) *hegewischi* (Pfeiffer), central and five lateromarginal teeth (1027-7), × 1260. Fig. 4. *Drymaeus* (*Mesembrinus*) *interpunctus* (Martens), detail of the central part of radula (1013-29), × 2200. Fig. 5. *Drymaeus* (*Mesembrinus*) *perductorum* Rehder, central and six lateromarginal teeth (1099-28), × 1250. Fig. 6. *Drymaeus* (*Mesembrinus*) *tripictus* (Albers), central and five lateromarginal teeth (1078-27), × 1150. Fig. 7. *Drymaeus*

(*Mesembrinus*) *sulphureus* (Pfeiffer), central and five lateromarginal teeth (1094-17), × 1175. Fig. 8. *Drymaeus* (*Mesembrinus*) *vincentinus* (Pfeiffer), central and five lateromarginal teeth (1069-12), × 1200.

Plate 5

Fig. 1. *Drymaeus* (*Drymaeus*) *auris* (Pfeiffer), "Venezuela"; shell height 39.0 mm; lectotype (BMNH 1975499). Fig. 2. *Drymaeus* (*Drymaeus*) *fenestratus* (Pfeiffer), "Mexico"; shell height 44.0 mm; lectotype (BMNH 1975525). Fig. 3. *Drymaeus* (*Drymaeus*) *flexuosus* (Pfeiffer), "Marinata, New Granada"; shell height 39.5 mm; lectotype (BMNH 1975202). Fig. 4. *Drymaeus* (*Drymaeus*) *fabrefactus* (Reeve), "New Granada"; shell height 38.5 mm; lectotype (BMNH 1975531). Fig. 5. *Drymaeus* (*Drymaeus*) *coarctatus* (Pfeiffer), "Brazil"; shell height 34.5 mm; lectotype (BMNH 1975560). Fig. 6. *Drymaeus* (*Drymaeus*) *canaliculatus* (Pfeiffer), shell height 36.5 mm; lectotype (BMNH 1975514). Figs. 7-8. *Drymaeus* (*Drymaeus*) *cleefi* spec. nov., Colombia, Depto. Santander, Páramo del Almorzadero, Piedra de Molino; shell height 33.0 mm; holotype (RMNH 55375). Fig. 9. *Drymaeus* (*Drymaeus*) *yapacanensis* spec. nov., Venezuela, Territoria Amazonas, Cerro Yapacana; shell height 31.2 mm; holotype (RMNH 55331).

Plate 6

Fig. 1. *Drymaeus* (*Drymaeus*) *recedens* (Pfeiffer), "Peru, Meobamba"; shell height 27.5 mm; lectotype (BMNH 1975477). Fig. 2. *Drymaeus* (*Drymaeus*) *dunkeri* (Pfeiffer), "Mexico, Michoacan"; shell height 35.0 mm; lectotype (BMNH 1975512). Fig. 3. *Drymaeus* (*Mesembrinus*) *pervariabilis* (Pfeiffer), "New Granada"; shell height 33.0 mm; lectotype (BMNH 1975547). Fig. 4. *Drymaeus* (*Mesembrinus*) *bugabensis* (Martens), "Bugaba, Panama"; shell height 26.5 mm; lectotype (BMNH 1901.6.22.958). Fig. 5. *Drymaeus* (*Mesembrinus*) *depictus* (Reeve), "Venezuela"; shell height 28.0 mm; lectotype (BMNH 1975529). Fig. 6. *Drymaeus* (*Drymaeus*) *vespertinus* (Pfeiffer), "Province of Patas, Andes of Peru"; shell height 35.0 mm; lectotype (BMNH 1975471). Fig. 7. *Drymaeus* (*Drymaeus*) *serratus* (Pfeiffer), "Meobamba, Eastern Peru"; shell height 26.5 mm; lectotype (BMNH 1975475). Fig. 8. *Drymaeus* (*Drymaeus*) *gueinzii* (Pfeiffer), "Peru, Meobamba"; shell height 23.0 mm; lectotype (BMNH 1975539). Fig. 9. *Drymaeus* (*Drymaeus*) *clathratus* (Pfeiffer), "Province of Patas"; shell height 30.0 mm; lectotype (BMNH 1975449). Fig. 10. *Drymaeus* (*Drymaeus*) *arcuatostriatus* (Pfeiffer), "Peru"; shell height 30.0 mm; lectotype (BMNH 1975455). Fig. 11. *Drymaeus* (*Drymaeus*) *buckleyi* (Sowerby), "Ecuador"; shell height 27.5 mm; lectotype (BMNH 1907.11.21.48).

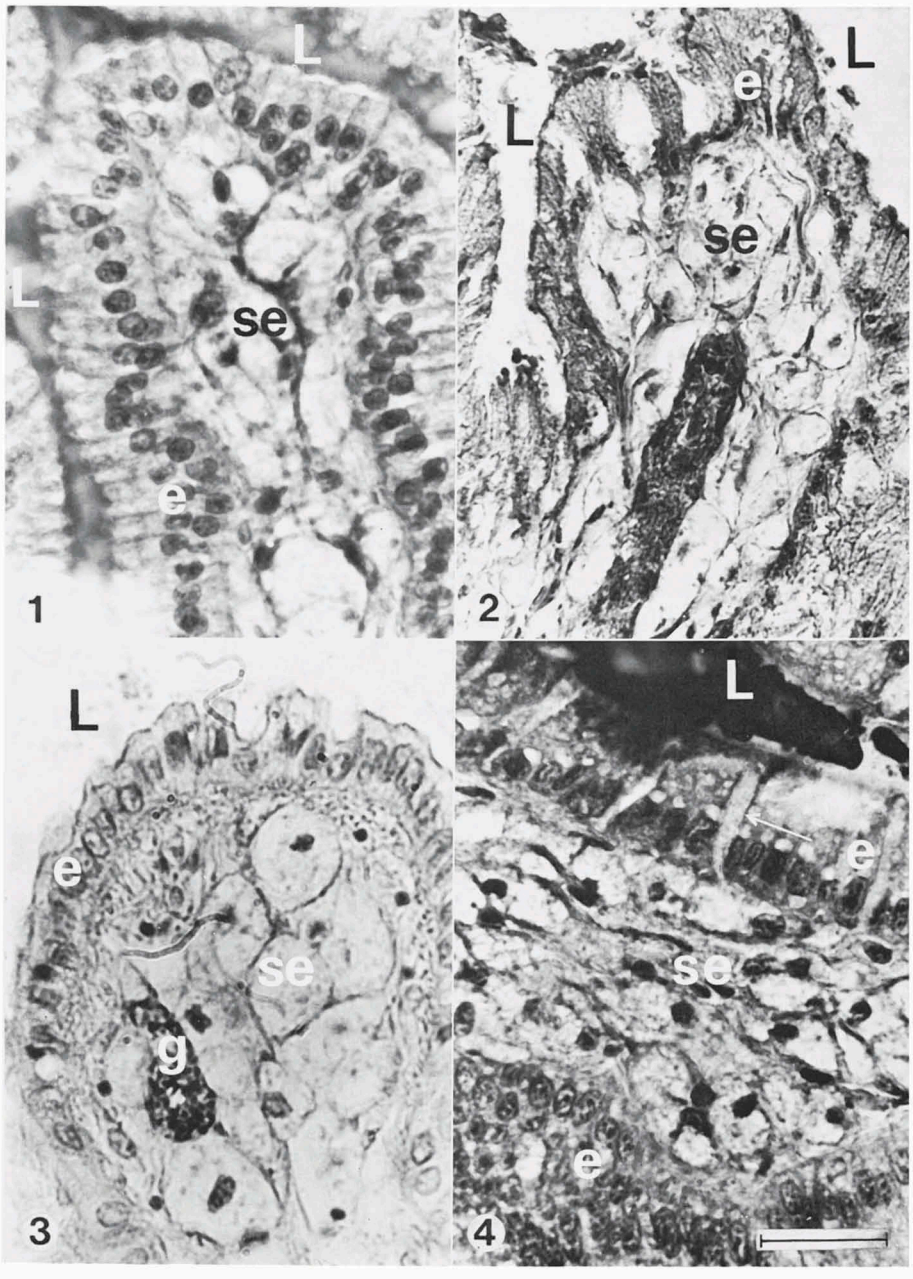
Plate 7

Fig. 1. *Drymaeus* (*Mesembrinus*) *deshayesi* (Pfeiffer), "New Granada"; shell height 44.5 mm; lectotype (BMNH 1975526). Fig. 2. *Drymaeus* (*Mesembrinus*) *dutaillyi* (Pfeiffer), "Brazil"; shell height 31.0 mm; lectotype (BMNH 1975516). Fig. 3. *Drymaeus* (*Mesembrinus*) *electrum* (Reeve), "Venezuela"; shell height 29.5 mm; lectotype (BMNH 1975510). Fig. 4. *Drymaeus* (*Mesembrinus*) *immaculatus* (Adams), "Jamaica"; shell height 30.5 mm; lectotype (BMNH 1975540). Fig. 5. *Drymaeus* (*Mesembrinus*) *incarnatus* (Pfeiffer), "Venezuela"; shell height 31.0 mm; lectotype (BMNH 1975566). Fig. 6. *Drymaeus* (*Mesembrinus*) *loxensis* (Pfeiffer), "El Catamaya near Loxa, Republic of the Equator"; shell height 35.0 mm; lectotype (BMNH 1975553). Fig. 7. *Drymaeus* (*Mesembrinus*) *manupictus* (Reeve), "Venezulea"; shell height 33.0 mm; lectotype (BMNH 1975522). Fig. 8. *Drymaeus* (*Mesembrinus*) *tenuilabris* (Pfeiffer), "Venezulea"; shell height 30.5 mm; lectotype (BMNH 1975338). Fig. 9. *Drymaeus* (*Mesem-*

brinus) *gratus* (Pfeiffer), "Columbia"; shell height 28.0 mm; lectotype (BMNH 1975521). Fig. 10. *Drymaeus* (*Mesembrinus*) *dubius* (Pfeiffer), "Andes N. Granada"; shell height 27.5 mm; lectotype (BMNH 1975519). Fig. 11. *Drymaeus* (*Mesembrinus*) *keppelli* (Pfeiffer), "Andes of Peru"; shell height 33.5 mm; lectotype (BMNH 1975538). Fig. 12. *Drymaeus* (*Mesembrinus*) *lusorius* (Pfeiffer), "Brazil, Bank of Ama(zon)"; shell height 25.0 mm; lectotype (BMNH 1975543).

Plate 8

Fig. 1. *Drymaeus* (*Drymaeus*) *confluens* (Pfeiffer), "New Granada"; shell height 39.5 mm; lectotype (BMNH 1975196). Fig. 2. *Drymaeus* (*Drymaeus*) *geometricus* (Pfeiffer), "Valley of the Madeleine, New Granada"; shell height 35.0 mm; lectotype (BMNH 1975564). Fig. 3. (*Drymaeus*) *bivittatus* (Sowerby), "Brazils"; shell height 27.0 mm; lectotype (BMNH 1975559). Fig. 4. *Drymaeus* (*Drymaeus*) *punctatus* Da Costa, "Chanchamayo, Peru"; shell height 36.5 mm; holotype (BMNH 1907.11.21.20). Fig. 5. *Drymaeus* (*Drymaeus*) *protractus* (Pfeiffer), "Meobamba, Eastern Peru"; shell height 29.5 mm; lectotype (BMNH 1975494). Fig. 6. *Drymaeus* (*Drymaeus*) *acervatus* (Pfeiffer), "Brazils"; shell height 41.5 mm; lectotype (BMNH 1975461). Fig. 7. *Drymaeus* (*Drymaeus*) *convexus* (Pfeiffer), "Ecuador"; shell height 38.5 mm; lectotype (BMNH 1975192). Fig. 8. *Drymaeus* (*Drymaeus*) *bogotensis* (Pfeiffer), "Santa Fé de Bogota"; shell height 37.5 mm; lectotype (BMNH 1975191). Fig. 9. *Drymaeus* (*Drymaeus*) *inclinatus* (Pfeiffer), "New Granada"; shell height 33.5 mm; lectotype (BMNH 1975532). Fig. 10. *Drymaeus* (*Drymaeus*) *hepatostomus* (Pfeiffer), "Tepenistlahuaca, Mexico"; shell height 30.5 mm; lectotype (BMNH 1975571). Fig. 11. *Drymaeus* (*Drymaeus*) *quadrifasciatus* (Angas), "Ecuador"; shell height 29.0 mm; lectotype (BMNH 1879.1.21.3).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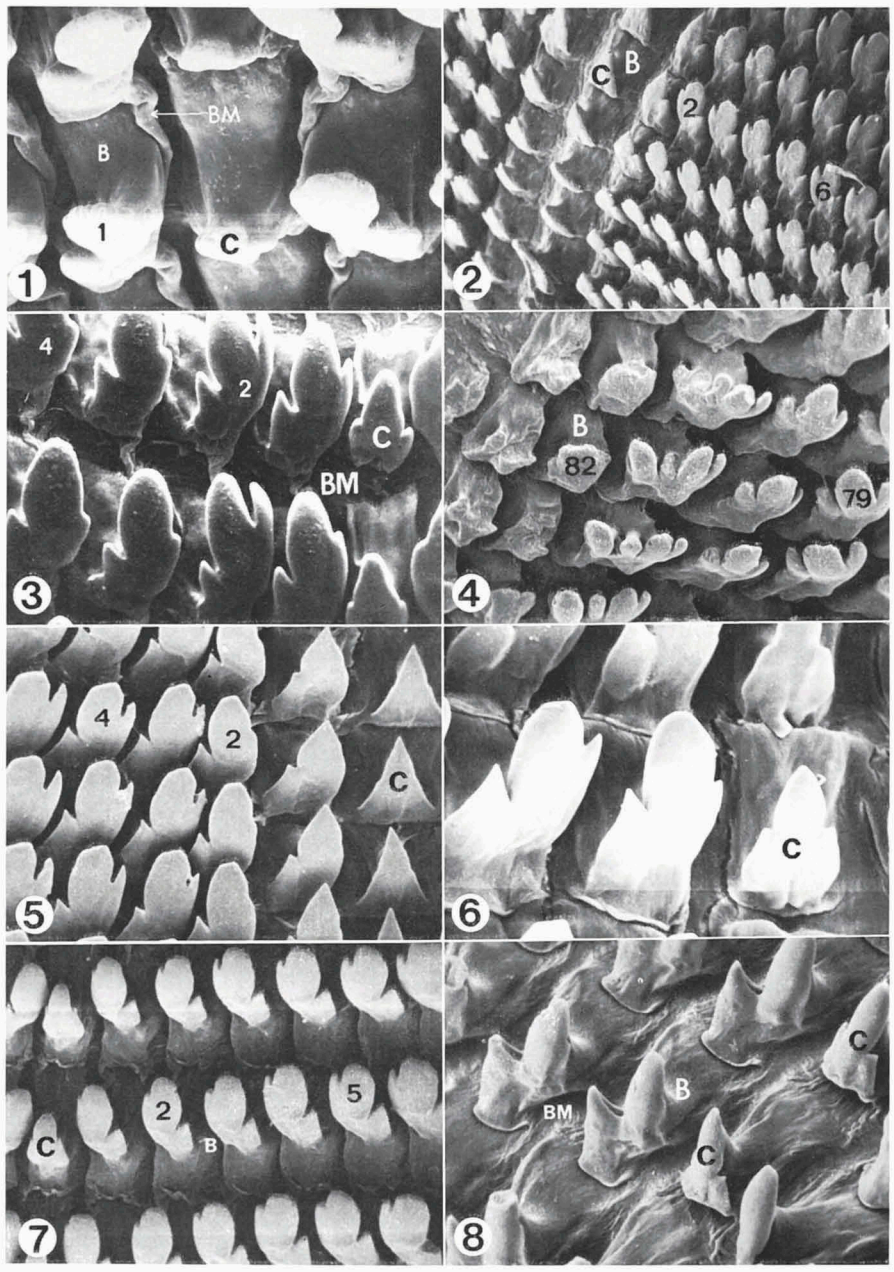
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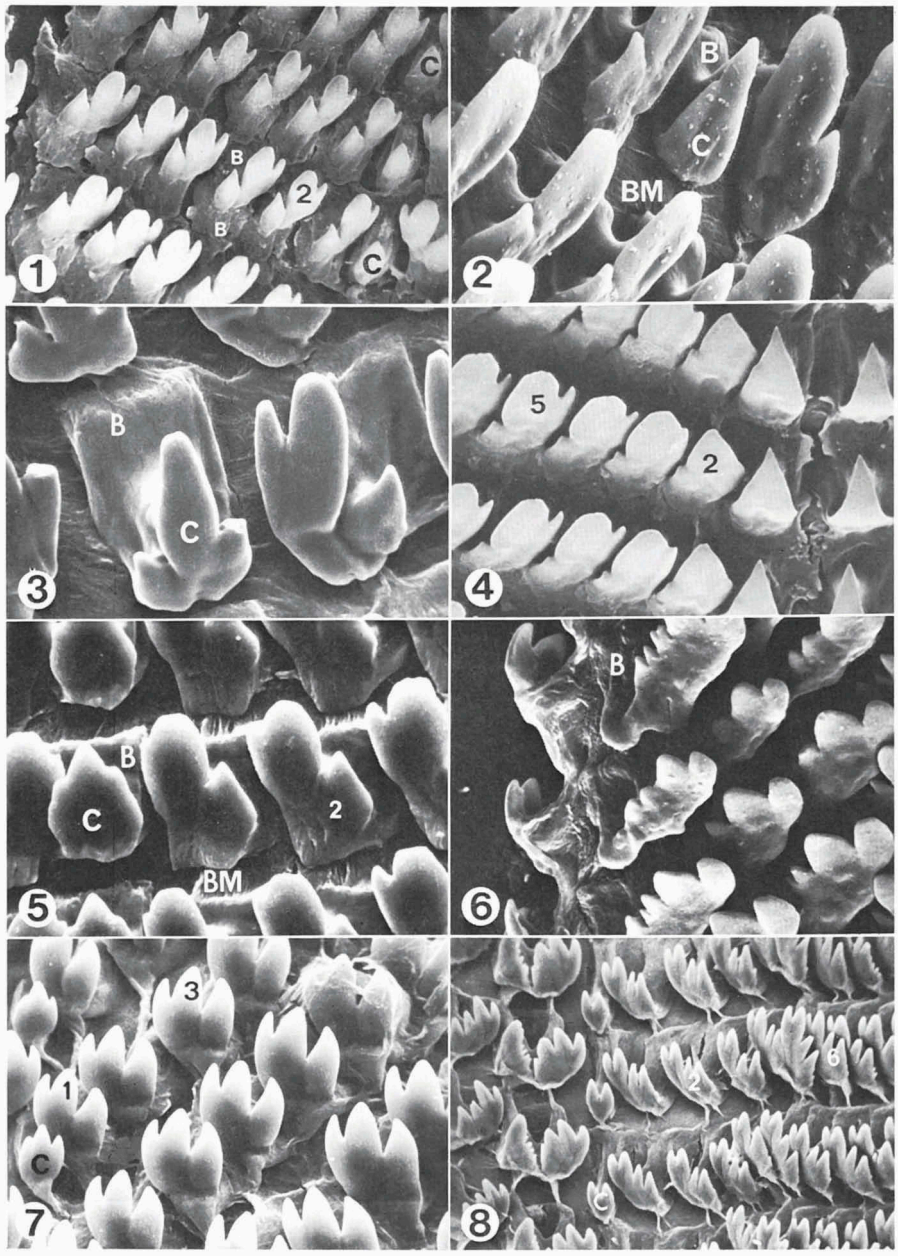
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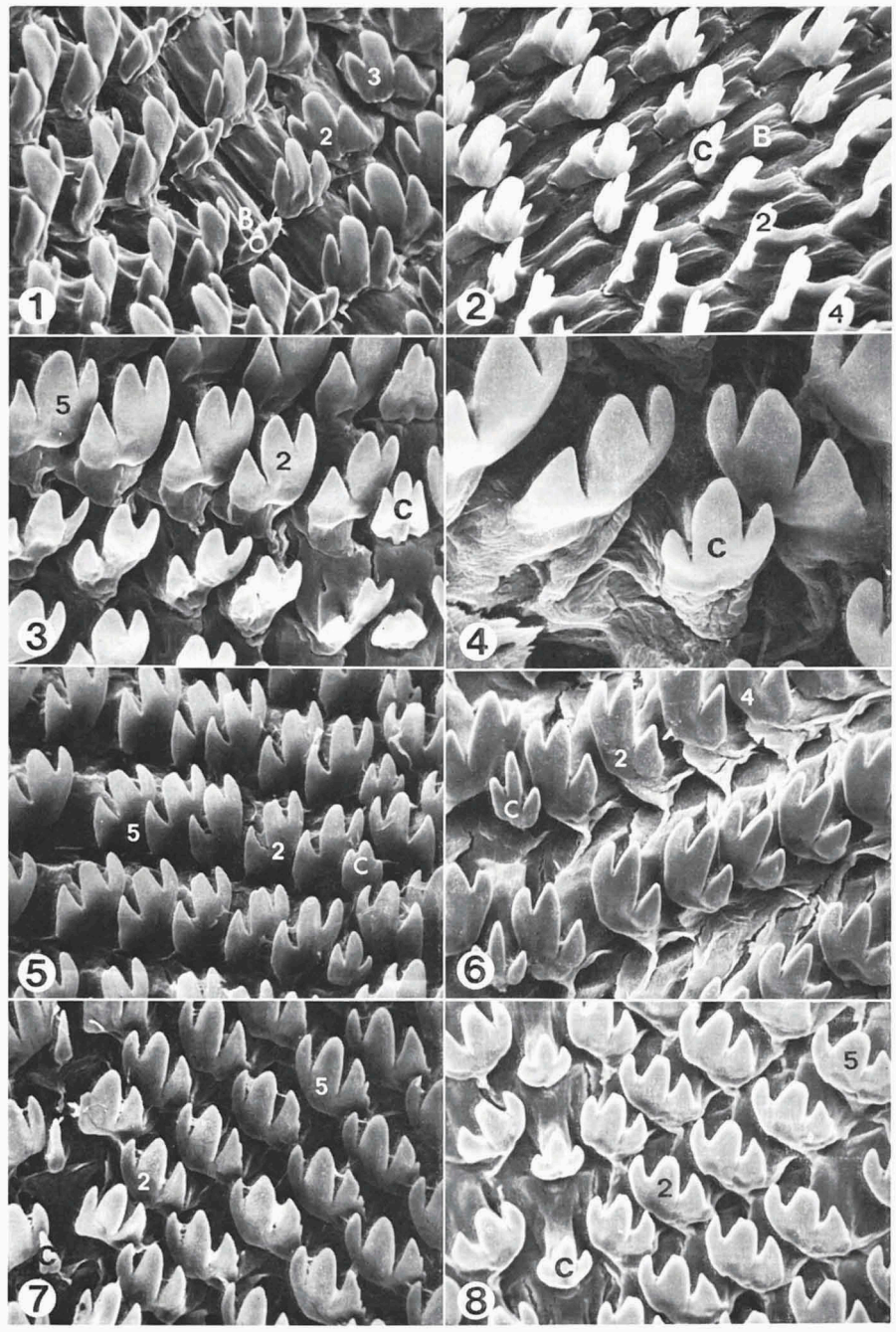
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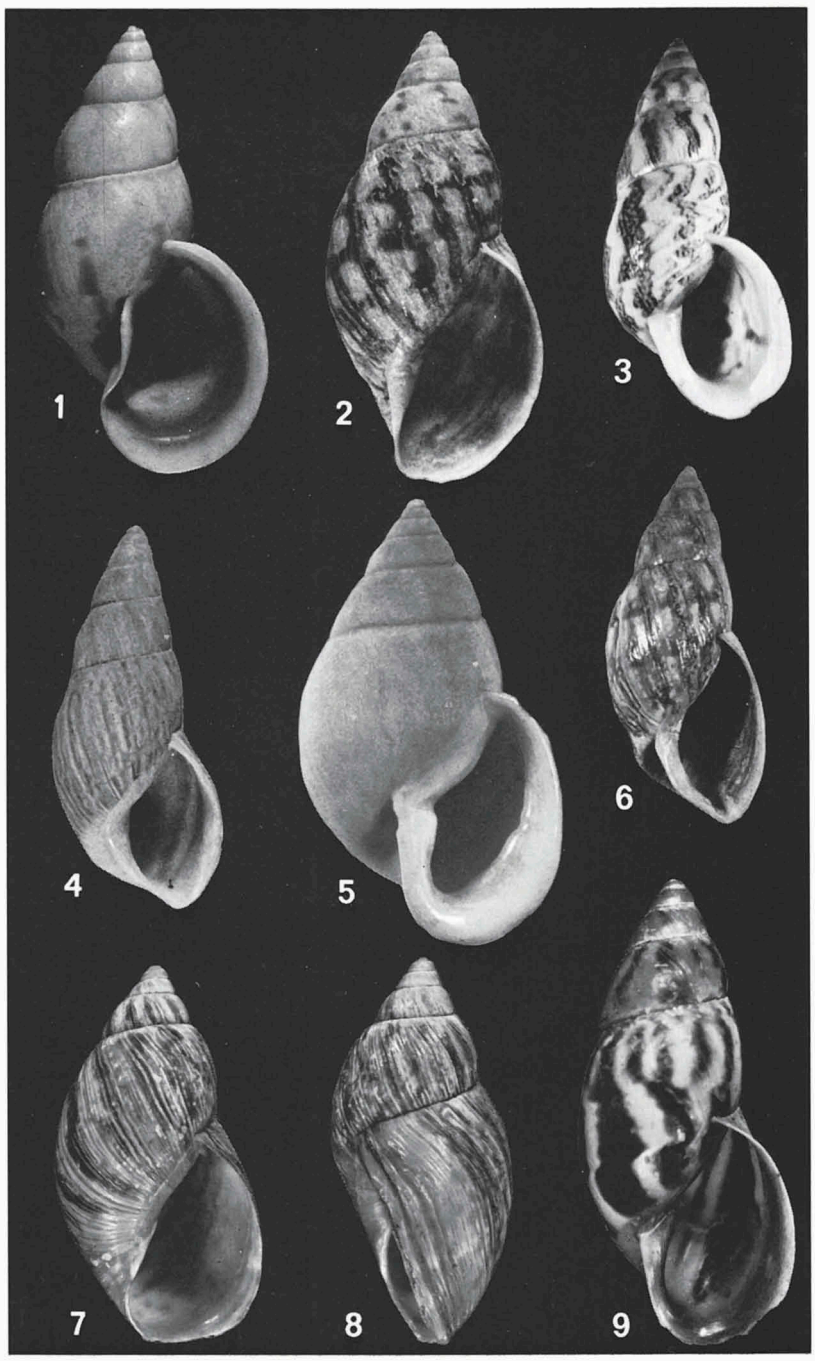
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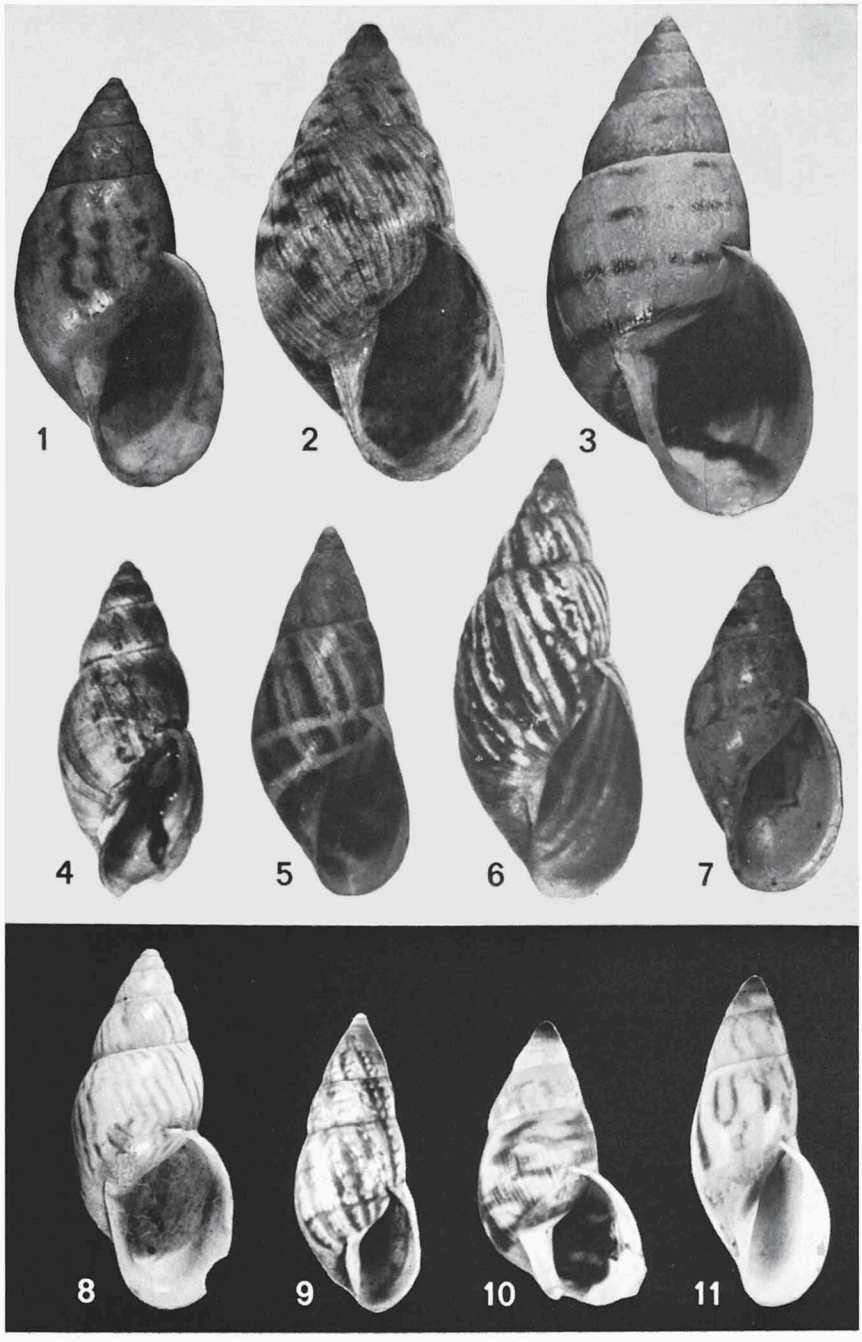
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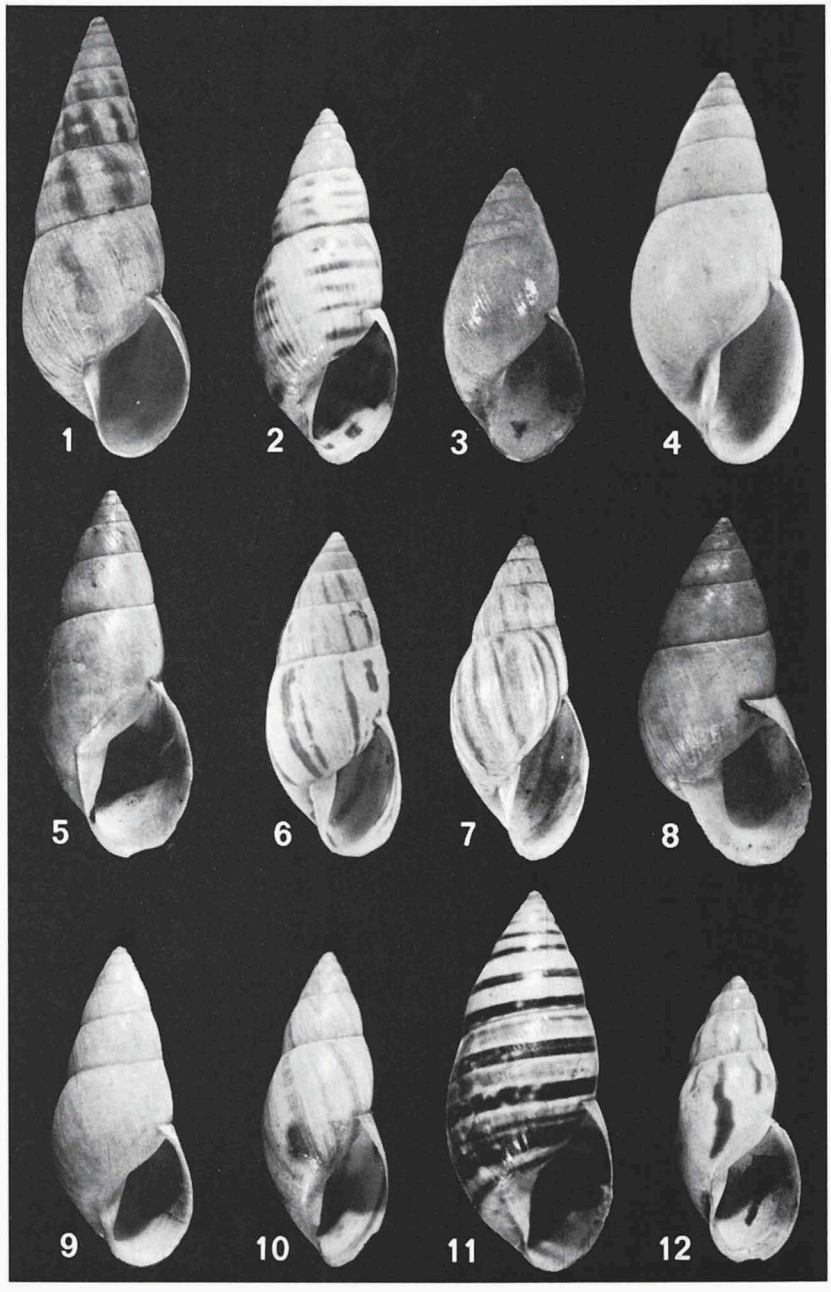
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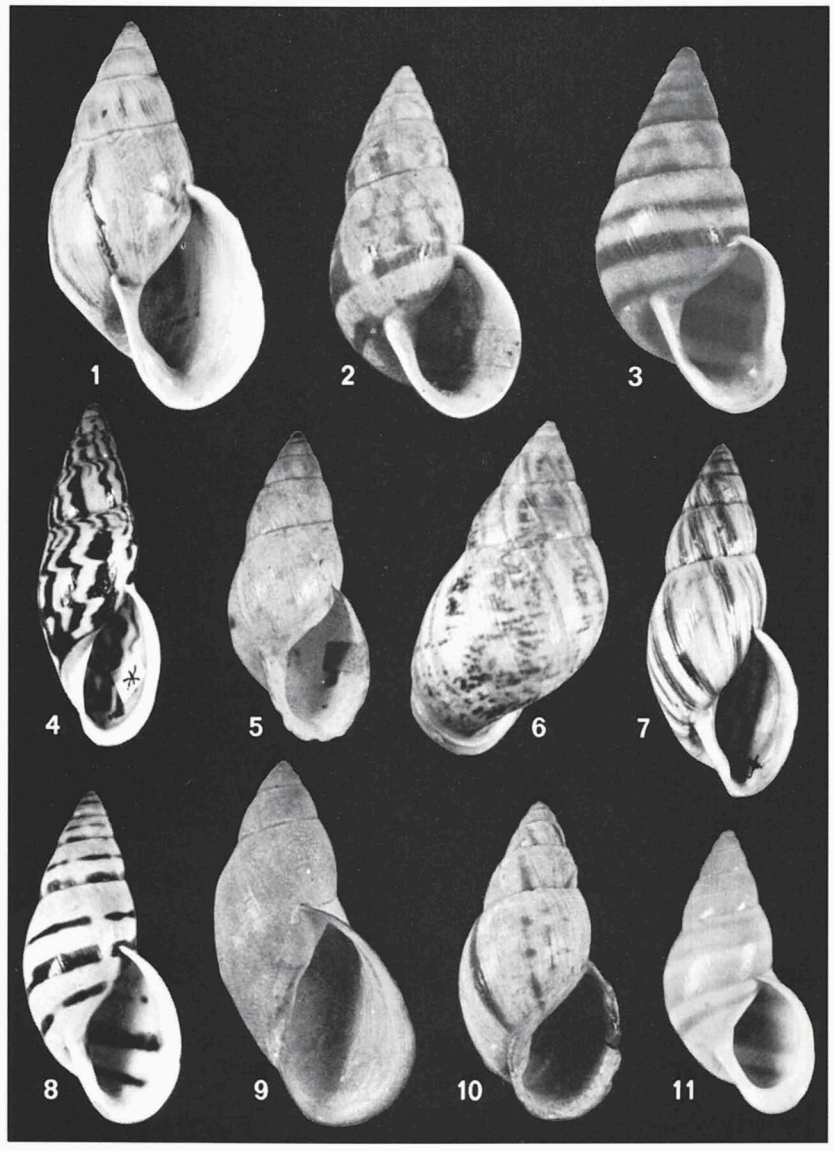
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