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VERTIGINID LAND SNAILS FROM THAILAND (GASTROPODA, PULMONATA, PUPILLOIDEA)

Fred G. Thompson[1] and Suchart Upatham[2]

ABSTRACT

Eight new species of Vertiginidae (Gastropoda, Pulmonata, Pupilloidea) are described from Thailand. *Acinolaemus* (type species: *Acinolaemus ptychochilus* n. sp.) is proposed as a new genus in the subfamily Gastrocoptinae. The genus also includes *A. sphinctinion* n. sp., *A. rhamphodon* n. sp., *A. stenopus* n. sp, *A. colpodon* n. sp., *Hypselostoma dayana* Stoliczka, 1871, *Hypselostoma laidlawi* Collinge, 1902, and *Paraboysidia neglecta* Jutting, 1961. Three other Gastrocoptinae are also described: *Systenostoma conica* n. sp., *S. elevata* n. sp., and *Gyliotrachela adela* n. sp.

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INTRODUCTION

The purpose of this paper is to describe eight new species of pulmonate landsnails of the family Vertiginidae, subfamily Gastrocoptinae, and to provide a brief synopsis of species previously reported from Thailand. The new species are described on the basis of the shell only. Anatomical material of these taxa is not available.

Vertiginidae are a characteristic and important component of the terrestrial snail fauna of southeast Asia. Species are numerous and very localized in their distributions. They have very limited vagility, and local endemism is high. Extensive endemism in *Gyliotrachela*, *Systenostoma* and a new genus described herein occurs among isolated limestone hills and mountain ranges. Species of these genera are sensitive to environmental degradation and are early casualties of deforestation. They are abundant on limestone terrains that are sheltered with a rain forest canopy. Live specimens can be found crawling on cool, damp rocks. Shells can be collected in abundance by sifting through leaf litter gathered from within rock crevices and from along the bases of stone ledges.

Four species of vertiginids have been recorded from Thailand, including *Nesopupa malayana samuiana* (Moellendorff, 1894), *Hypselostoma holimanae* Thompson and Lee, 1988, *Gyliotrachela transitans* (Moellendorff, 1894) and *Gyliotrachela striolata* (Moellendorff, 1894). This is a very small measure of the Thailand fauna, and we estimate that it represents less than five percent of the actual vertiginid fauna based on our field experiences subsequent to 1987.

Most measurements follow standard convention. Departure from normal procedure is necessary in some cases because of striking allometric growth features. Allometric growth is a common feature among vertiginid snails in southeast Asia. In some species the aperture is detached from the preceding whorl and may be deflected upward or downward. Thus, the last whorl may ascend to varying extents or it may project to the side for a considerable distance. Measurements of the aperture and the umbilicus are modified accordingly. The height of the aperture is made in the plane of the aperture, regardless of its orientation. The width of the umbilicus is transverse to the neck of the last whorl. The ratio of umbilical width/shell width is based on the width of the shell before the neck becomes detached from the previous whorl and does not include the width of the aperture. Measurements were made with a calibrated ocular micrometer and converted to mm. Ratios were calculated from micrometer units. The terminology for the aperture barrier is standard and follows Jutting (1950: 7) and earlier authors. The term "teeth" refers to any of the structures that form the internal barrier of the aperture. The primary teeth that occur on the parietal wall and the columella are called lamellae. Those teeth that occur on the palatal and basal walls of the aperture are called plica or folds. Small secondary folds on the parietal and columellar walls are also called plica.

Field work relating to this report was conducted by the senior author in 1987.

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Family VERTIGINIDAE Fitzinger, 1833
Subfamily Nesopupinae Steenberg, 1925
Genus *Nesopupa* Pilsbry, 1900

Nesopupa malayana samuiana (Moellendorff, 1894)

This subspecies is recorded only from Samui Island in the Gulf of Siam (Moellendorff, 1904; Haas, 1937; Zilch, 1982).

Subfamily Gastrocoptinae Pilsbry, 1918
Genus *Hypselostoma* Benson, 1856
Hypselostoma holimanae Thompson and Lee, 1988

Hypselostoma holimanae Thompson and Lee, 1988; Nautilus, 102: 78-81; figs. 1-6.

Type locality.– Thailand, Kanchanaburi Province, a small limestone range on the west border of the Kanchanaburi Agricultural College, ca. 15 km W of Kanchanaburi.

Distribution.– Known only from the type locality.

Remarks.– The taxonomic placement of this species within *Hypselostoma* remains problematic. *Hypselostoma* contains many diverse species groups which have not been critically evaluated with respect to their phylogeny or systematics. No doubt *Hypselostoma* will be divided into additional genera and subgenera as the fauna of southeast Asia becomes better known.

The species described below form a group that is sufficiently distinct from typical *Hypselostoma* and other genera to warrant generic recognition.

Acinolaemus, new genus

Type species: *Acinolaemus ptychochilus*, new species.

Etymology.– The name *Acinolaemus* is from the Classical Greek *ακαινος*, thorn and *λαιμος*, throat, alluding to the thorn-like lamella located deep within the aperture. The name is masculine.

Diagnosis.– The most distinctive feature of *Acinolaemus* is the enlargement of the angular lamella. *It is the most conspicuous tooth in the aperture.* In the closely related southeast Asian genera *Hypselostoma*, *Gyliotrachela*, *Boysidia* and *Paraboysidia* the angular lamella is underdeveloped compared to the parietal

lamella. *The auriculate-shaped aperture has a well-defined bay in the posterior corner formed by the angular lamella and the upper palatal fold.* This is accentuted by a tendency for the species to have a strong tubercle along the margin of the peristome in front of the upper palatal fold at the point where the lip is indented. In closely related genera the bay is not nearly as well differentiated from the rest of the aperture. In *Acinolaemus* one or more of the palatal, basal and columellar teeth are developed as sharp thorns that point toward the aperture, although this feature is repeated in some species of closely related genera. The last whorl is constricted behind the aperture in the region of the internal dentition. The genus also is characterized by having a minute, yellowish, turban-shaped shell with a nearly straight-sided spire, although these feature are not unique to the genus. The last whorl regularly descends or is deflected upward. *The lower whorls are sculptured with raised spiral threads that are crossed by oblique axial threads.* Spiral threads are reported in other genera, but they are not crossed by oblique threads. *The microsculpture of the protoconch consists of a fine mesh of granular reticulations upon which are superimposed evenly spaced continuous raised spiral threads* (Figs. 1-5). Raise spiral threads on the protoconch are not know for the other genera, except in *Systenostoma.*

Six genera of Gastrocoptinae occur in southeast Asia: *Acinolaemus, Hypselostoma* Benson, 1856, *Gyliotrachela* Tomlin, 1930, *Boysidia* Ancey, 1881, *Paraboysidia* Pilsbry, 1917, *Systenostoma* Bavay and Dautzenberg,1909 and *Anauchen* Pilsbry, 1917. The following key will assist in their identifications.

1. Embryonic whorls with raised spiral threads. Posterior corner of aperture forming a distict by bay nearly separated from the main area by the angular lamella and the upper palatal fold. Angular lamella most strongly developed of aperture teeth. Size minute, less than 2 mm high or wide.....2.

1a. Embryonic whorls without spiral sculpture. Posterior corner of aperture without a conspicuous bay formed by angular lamella and upper palatal fold. Parietal lamella most strongly developed of aperture teeth. Size variable, but generally greater than 2 mm.....3.

2. Aperture with teeth on parietal, palatal and columellar walls..... .....*Acinolaemus.*

2a. Teeth absent in aperture or a low fold may be present on parietal wall .....*Systenothoma.*

3. Angular lamella present.....4.

3a. Angular lamella absent.....*Anauchen.*

4. Parietal and angular lamella separated.....5.

4a. Parietal and angular lamella concrescent.....6.

5. Part of last whorl free from preceding whorl.....*Gyliotrachela.*

5a. Last whorl attached to preceding whorl throughout it length.....*Paraboysidia.*

6. Part of last whorl free from preceding whorl.....*Hypselostoma.*

6a. Last whorl attached to preceding whorl throughout it length.....*Boysidia.*

The known species of *Acinolaemus* are from Thailand, Malaysia and Burma. The genus includes *Hypselostoma dayana* Stoliczka, 1871, *Hypselostoma laidlawi* Collinge, 1902, and *Paraboysidia neglecta* Jutting, 1961, as well as the five species described below.

Acinolaemus ptychochilus, new species
(Figs. 7-11)

Description.– Shell minute, 1.43-1.55 mm long and 1.30-1.36 mm wide. Turban-shaped, 1.11-1.15 times as high as wide (Figs. 7, 10); last whorl not ascending in contrast to two previous species. Spire nearly straight sided with last whorl slightly expanding. Umbilicus open and funnel shaped, about 0.26-0.30 times width of shell (Fig. 9). Periostracum light yellowish brown in fresh specimens. Shell with 4.3-4.5 whorls. Protoconch containing 1.5-1.6 protruding whorls; microsculpture consisting of a mesh of fine reticulating granules superimposed on which are distinct evenly spaced spiral threads (Fig. 1). Teleoconch sculptured with raised spiral threads which are crossed with oblique growth threads; sculpture most distinctly developed on last whorl; irregularly developed or poorly developed in whorls of spire. Peristome auriculate in shape due to strong indentation on parietal wall and middle of palatal wall (Figs. 8, 11). Aperture with a complex arrangement of plica and lamella. Posterior corner of aperture with a bay demarcated by a large angular lamella and the upper palatal fold. Angular lamella relatively high, flat and moderately long (Fig. 8, A); upper palatal fold short and stout, confined to margin of peristome. Face of parietal, columellar and basal margins of peristome with nine short low plica. Deep-set within aperture are five small denticles within the bay and nine other denticles that are aligned with the plica; usually denticles along basal wall and bay wall are modified into forward pointing hooks, the largest of which is the basal plica (Fig.11, B). Parietal lamella very long and almost as high as angular lamella but narrower (Fig. 8, P); usually separated from plica by a moderate gap, but in two individuals the two are continuous. Subparietal lamella low, but nearly as long as parietal lamella. Columellar lamella stout and long (Fig. 11, C).

Measurements in mm of the holotype and two paratypes (UF 113503) selected to show variation are as follow.

Specimen	height	width	aper.h.	aper.w.	umbil.	whorls
Holotype	1.45	1.30	0.62	0.60	0.37	4.4
Paratype	1.45	1.30	0.59	0.56	0.34	4.3
Paratype	1.55	1.36	0.68	0.60	0.40	4.5

Type locality.– Thailand, Chiang Mae Province, Doi Pha San Sao (Mountain), 3 km west of Ban Prang Ma-O; 500 m altitude (19°26.0' N, 99°03.5' E). HOLOTYPE: UF 113502 (gold plated); collected 29 June, 1987 by Fred G. Thompson. PARATYPES: UF 113503 (4 specimens), Mahidol University (4 specimens); same data as the holotype. UF 113504 (3 specimens); Doi Pha San

Sao (Mountain), 1 km west of Ban Prang Ma-O; 500 m alt. (99°04'26"E, 19°25'41"N); collected June 19, 1987 by Fred G. Thompson.

The specimens from both stations were recovered from leaf-litter samples gathered at the bases of limestone ledges in densely shaded thickets.

Remarks.– *Acinolaemus ptychochilus* is most closely related to the following two species. It is immediately recognized from other known species by its complex aperture dentition. In addition the last whorl does not ascend behind the aperture and the shell is narrower than high. The postembryonic sculpture is also less well developed than in closely related species.

Etymology.– The specific name *ptychochilus* is taken from the Classical Greek πτυκος, folded and χειλος, lip, referring to the plicate peristome around the aperture.

Acinolaemus sphinctinion, new species
(Figs. 16-19)

Description.– Shell minute, turbiniform, wider than high, about 0.8 times as high as wide (Fig. 16). Spire straight sided. Last whorl projecting forward as a short neck (Fig. 17). Shell containing 3.9 whorls. Suture deeply impressed. Umbilicus large, greater than half width of shell. Protoconch protruding, with 1.5 whorls; strongly demarcated from teleoconch; dense microsculpture consisting of raised reticulating granules and threads (Fig. 5). Teleoconch sculpture cancellated with strong widely spaced spiral threads and weaker, less regular vertical threads (Fig. 19, subperipheral area on last whorl in front of aperture); sculpture continuing undiminished into umbilicus. Last whorl shouldered, with a blunt peripheral angle, flattened below periphery, and with a narrow basal crest around umbilicus; umbilical wall of last whorl flattened; last whorl weakly ascending, constricted behind aperture (Fig. 17). Peristome weakly reflected, heart-shaped with the posterior corner weakly impressed in areas of parietal lamella and upper palatal fold. Interior of aperture with four deeply immersed folds (Fig. 18). Parietal lamella discontinuous, consisting of a large high blade deeply set within aperture and extending nearly to edge of peristome with two small knobs. Palatal wall with two short folds, which are moderately high and are separated from parietal lamella by a distance about equal to their own height. Lower palatal fold higher than upper palatal fold and extended slightly deeper into throat. Columella lamella about the same size as lower palatal fold. Exterior surface of neck weakly indented over parietal and upper palatal lamella.
(The posterior wall of the holotype was punctured when it was removed from the SEM stub).

Measurements for the unique holotype are: height, 1.41 mm; width, 1.71 mm; aperture height, 0.70 mm; aperture width, 0.70 mm; umbilicus, 0.92 mm.

Type locality.– Thailand, Prachuap Khiri Khan Province, Khao Sam Roi Yot National Park, limestone knoll on east side of brackish marsh 3 km south of

park entrance; (12°12.5' N, 99°59.6' E). HOLOTYPE: UF 113507 (gold plated), collected May 31, 1987 by Fred G. Thompson. The unique holotype was recovered from a dried leaf-litter sample that was gathered at the base of the knoll.

Remarks.-- This species is distinguished by its forward projecting aperture, the constricted neck behind the aperture, The indentations overlying the parietal lamella and the upper palatal fold, the number and arrangement of its aperture lamella, the peripheral angle and the basal angle on the last whorl and the flattened subperiphery of the last whorl. It is most similar in appearance to the following species where differences between the two are discussed.

Etymology.-- The species name *sphinctinion* is from the Classical Greek, *σφιγγος*, to bind, and *ιγιον*, a neck. The name refers to the constricted neck of the last whorl behind the aperture.

Acinolaemus rhamphodon, new species
(Figs. 20-25)

Description.-- Shell small, about 1.36-1.38 mm high and 1.46-1.52 mm wide. Turban-shaped, wider than high being about 0.92-0.93 times as high as wide (Figs. 22,24). Spire straight sided. Periostracum yellowish brown. Umbilicus broad, funnel-shaped, about 0.36-0.39 times as wide as shell (Fig. 21). Shell with 4.7-4.9 rounded whorls. Last whorl weakly ascending behind the aperture (Fig. 20). Protoconch consisting of 1.5 whorls. Microsculpture of protoconch consisting of minute granules upon which is superimposed raised granular spiral threads (Fig. 4). Teleoconch sculptured with regularly spaced spiral threads that are crossed by more widely spaced oblique axial threads; spiral threads becoming stronger on base and in umbilicus; axial threads less distinct on last quarter of last whorl, on base and in umbilicus. Last whorl behind aperture with a vertical impression overlying area of palatal lamella. Peristome complete but adnate to the preceding whorl; moderately reflected except along posterior corner. Aperture tri-lobed; parietal and palatal margins of peristome indented; palatal margin of peristome with a conspicuous tubercle that lies opposite the outer end of the parietal lamella to form a bay in the posterior corner of the aperture. Interior of aperture with 4-5 deeply immersed lamella (Figs. 23, 25). Parietal lamella long and blade-like, extending outward to edge of peristome. Mesad and deeper within the aperture is a shorter and lower subparietal lamella. Palatal wall with two short flat infrapalatal folds opposite subparietal lamella. Columellar lamella a large sharp hook pointing forward to opening of aperture. Columellar lamella present in the two paratypes (Fig. 25); holotype with a weakly developed low elongate lamella that has not yet completed development into a hook.

Measurements in mm of the holotype and the two paratypes are as follow:

Specimen	height	width	aper.h.	aper.w.	umbil.	whorls
Holotype	1.36	1.46	0.68	0.68	0.53	4.7
Paratype UF	1.36	1.47	0.68	0.71	0.50	4.8
Paratype MU	1.38	1.52	0.65	0.68	0.53	4.9

Type locality.– Thailand, Chachaengsao Prov. Khao Tam Raet, 5 km ENE Ban Nan Khok, 100 m altitude (13°26.1' N, 101°44.2' E). HOLOTYPE: UF 113505 (gold plated); collected May 11, 1987. PARATYPES: UF 113506 (1 specimen), Mahidol University (1 specimen, gold plated); same data as the holotype.

The type locality is a long narrow limestone hill that is honeycombed by numerous caves, and is the sight of a major Buddhist temple. The specimens constituting the type lot were recovered from a dried leaf-litter sample that was collected on top of the hill in a densely shaded grove of small trees.

Remarks.– This species is similar in appearance to *A. sphinctinion*, but it differs by several characteristics that warrant specific separation. The shell has one whorl more, the aperture is adnate to the preceding whorl, the palatal margin or the peristome has a well developed tubercle, a subparietal lamella is present and the columellar lamella is developed into a forward projecting hook-like spine. Superficially the umbilicus is narrower, but it is difficult to make this comparison. In *A. sphinctinion* the umbilical wall tapers to the basal angle, giving the appearance of a wider opening, whereas it is about the same in relative size as in *A. rhamphodon* if one ignores the tapered appearance.

Etymology.– The species name *rhamphodon* is from the Classical Greek *ραμφος*, a hook and *οδους*, a tooth, and alludes to the hook-like columellar tooth that characterizes this species.

Acinolaemus stenopus, new species
(Figs. 2, 12-15)

Description.– Shell 1.46-1.61 mm high and 1.55-1.71 mm wide. Turban-shaped, about as wide as long; spire relatively long and narrow, with the last whorl noticeably expanded; shell 0.87-1.04 times as high as wide (Figs. 12, 13). Color of fresh specimens grayish-white. Umbilicus funnel-shaped, 0.40-0.46 times width of the shell. Whorls 4.9-5.4. Protoconch consisting of 1.4-1.6 whorls; sculptured with a dense mesh of reticulating granules upon which is superimposed 12-13 evenly spaced fimbriated spiral threads (Fig. 2). Teleoconch sculptured with evenly spaced spiral threads and less regularly spaced and less well developed oblique axial threads. Sculpture equally developed over the surface of the shell and in the umbilicus. Aperture attached to preceding whorls; slightly oblique; heart shaped with a strong indentation over the parietal margin and a weak indentation along the palatal margin. Peristome moderately expanded along parietal, columellar, basal and lower palatal margins. Interior of aperture with five deeply recessed teeth and a strong tubercle on palatal margin just below indentation (Figs. 12, 14). Angular lamella (Fig. 15, A and upper palatal fold (Fig. 15, P) greatly developed and forming a nearly completely closed bay in posterior corner; the two teeth are separated only by a very narrow passage. Angular lamella long and high, extending to edge of peristome; tapered posteriorly (Fig. 15,A). Parietal lamella

low and short; confined to zone near posterior end of angular lamella (Fig. 15, F). Columellar lamella situated low on columella, short and developed into a forward projecting spine; a second columellar spine occurs posterior to the columellar lamella in some specimens. Upper palatal fold originating behind palatal tubercle and extending into aperture as far as angular lamella (Fig. 15, F). Lower palatal fold low and short and lying opposite parietal lamella.

Measurements in mm. of the holotype and three paratypes (UF 113531) are as follow.

Specimen	height	width	aper.h.	aper.w.	umbil.	whorls
Holotype	1.61	1.55	0.68	0.68	0.62	5.4
Paratype	1.49	1.64	0.68	0.68	0.56	4.9
Paratype	1.49	1.71	0.65	0.68	0.59	5.4
Paratype	1.55	1.64	0.65	0.65	0.68	5.2

Type locality.– Thailand, Chantaburi Province, limestone ridge 3 km w N Yai Ham; 25 m altitude (12°44.3' N ,101°52.9' E). HOLOTYPE: UF 113530; collected April 25, 1987 by Fred G. Thompson. PARAYPES: UF 113531 (4 specimens), Mahidol University (4 specimens); same data as the holotype.

The type locality lies about 48 km west of Chantaburi, and is on a limestone ridge that was about 500 m long and 100 m wide. The ridge has been cleared of most of its forest cover and only small patches of vegetation remain. The ridge is being mined on all sides for limestone, and in a few more years it will be completely removed from the landscape! Snails were recovered from a leaf-litter sample that was gathered at the base of a low ledge within a small grove of vines and shrubs.

Remarks.– This snail can be recognized from other known species by the elaborate development of the angular lamella and the upper palatal fold, which are separated by only a narrow sinus. In other respects the shell is somewhat like that of the following two species, although the sculpture is not as well developed. Unfortunately, this species will soon be extinct because its total habitat will be removed by mining!

Etymology.– The name *stenopus* is from the Classical Greek *stenopos* στενοπος, meaning a narrow passage and alludes to the very narrow gap between the angular lamella and the upper palatal fold that characterizes this species.

Acinolaemus colpodon, new species
(Figs. 26-31)

Description.– Shell small, about 1.74-1.92 mm wide and about 0.90-1.02 mm high; about 0.50-0.57 times as high as wide. Depressed turban-shaped with an aperture that projects vertically on a long neck above the tip of the spire (Fig. 26). Color of fresh shells grayish white. Umbilicus broad, about 0.48-0.50 times width of shell (Fig. 29). Whorls 4.2-4.5. Protoconch consisting of 1.7 whorls; microsculpture typical for subgenus. Teleoconch sculptures with fine fimbriated spiral threads on top of weaker irregularly spaced oblique growth threads;

sculpture equally developed over surface of whorls. Neck of last whorl expanding toward aperture; strongly furrowed over angular lamella and with weaker indentations over upper palatal fold and columellar lamella. Aperture auriculate; posterior corner forming a bay separated by angular lamella and palatal tubercle (Figs. 27, 28). Peristome broadly reflected around parietal, columellar and basal margins. Interior of aperture with four teeth, the angular lamella, columellar lamella, upper palatal fold and lower palatal fold. Face of peristome with a low palatal tubercle opposite angular lamella. Angular lamella high, thick and long; extending from edge of peristome to base of neck; bi-lobed, posterior half forming a thick forward pointing spine (Fig. 30, A). Columellar lamella deep-set, low and narrow, with a bay-like gap in center of tooth (Fig. 30, C). Palatal folds very small and tubercle-like, deeply set within aperture opposite columellar lamella; upper palatal fold behind palatal tubercle, occasionally absent (Fig. 31, F); lower palatal fold slightly larger and a little posterior to upper palatal fold.

The measurements given below for the holotype and two paratypes (UF 113529) are not standard because of the deflected neck of the last whorl. The height of the shell is measured from the base of the last whorl to the apex of the spire. The figure in parenthesis is the height of the shell to the top of the aperture. The height/width ratio given above is based on the height of the spire. The aperture is measured across the same respective points as in the preceding species.

Specimen	height	width	aper.h.	aper.w.	umbil.	whorls
Holotype	1.02 (1.09)	1.92	0.65	0.65	0.68	4.5
Paratype	0.99 (1.05)	1.74	0.62	0.59	0.65	4.3
Paratype	0.87 (1.05)	1.74	0.62	0.62	0.74	4.2

Type locality.– Thailand, Rayong Province, Khao Bot, about 6 km north and 2 km west of Ban Syaek Batan; 150 m altitude (13°02.8' N, 101°38.5' E). HOLOTYPE: UF 113528; collected 25 April, 1987 by Fred G. Thompson. PARATYPES: UF 113529 (5 specimens), Mahidol University (5 specimens). The type specimens were recovered from a leaf-litter sample that was gathered at the base of a limestone ledge in a dense thicket of vines and shrubs. The locality is immediately behind a Buddhist temple.

Remarks.– This species is immediately distinguished from its congeners by its shape and its aperture dentition. Superficially it resembles some species of *Gyliotrachela* because of its shape and extended aperture, but it is readily distinguished from members of that genus by the absence of a parietal lamella and by the enlargement of the angular lamella.

Etymology.– The species name *colpodon* is from the Classical Greek, *κολπος*, a bay, and *οδους*, a tooth, in reference to the bay-like gap in the columellar lamella.

Systenostoma Bavay and Dautzenberg, 1909

The microsculpture of the teleoconch is similar to that of other Indo-Asian genera although it is weaker. It consists of a dense mesh of very fine granular

reticulatiion superimposed upon which are fine spiral threads. Spiral sculpture may be present or absent on the protoconch.

This genus is described by previous authors as lacking teeth within the aperture (Bavay and Dautzenberg, 1909, Pilsbry, 1917, Zilch, 1059). A new species described below has a low rounded lamella on the parietal wall which occupies the same relative position as the angular lamella in *Acinolaemus*, and the upper palatal margin of the peristome has a slight tubercular thickening that occupies the same position as the upper palatal tubercle in *Acinolaemus*. In addition the last whorl is deflected in its growth. A close relationship between *Systenostoma* and *Acinolaemus* is hypothesized based on these similarities.

Systenostoma contains five species. Three occur in Vietnam, *S. pauperimma* (Bavay and Dautzenberg, 1908), *S. defixa* Bavay and Dautzenberg, 1912, and *S. pulveria* (Bavay and Dautzenberg, 1908). Two others described below occur in Thailand.

Systenostoma concava, new species
(Figs. 32-38)

Description.– Shell minute, 1.02-1.21 mm high. Color grayish white. Conical with a blunt apex and a deflected body whorl which rises slightly along the periphery of the penultimate whorl on the left side of the shell and then descends onto the base near the umbilicus (Figs. 32-34). Spire concave in outline due to deflection of last whorl. Shell 0.87-1.09 times as wide as high. Umbilicus broad and funnel shaped; about 0.28-0.31 times width of shell (Fig. 36). Whorls 4.6-5.3; rounded, strongly shouldered; periphery above middle of whorl; subperipheral area weakly convex. Protoconch with 1.6 whorls; microsculpture consisting of very fine reticulating granules (Fig. 37); very weak spiral threads occasionally present. Teleoconch with microsculpture similar to protoconch, but spiral threads more apparent (Figs. 36); superimposed on microsculpture are irregularly spaced growth wrinkles. Aperture slightly free from preceding whorl; oblique, lying at an angle of about 46-48° to shell axis; slightly higher than wide, being about 1.1 times as high as wide; broadly kidney-shaped in outline with a weak parietal indentation and a sinuous outer lip (Figs. 35). Parietal wall arched forward near middle and with a low ridge-like angular lamella. Palatal lip sinuous in lateral profile; margin with a slight tubercular thickening.

Measurements in mm for the holotype and three paratypes (UF 113542) are as follow.

Specimen	height	width	aper.h	aper.w	umbil.	whorls
Holotype	1.12	1.09	0.43	0.40	0.34	5.0
Paratype	1.15	1.09	0.43	0.37	0.34	5.1
Paratype	1.21	1.05	0.43	0.40	0.31	5.1
Paratype	1.02	1.12	0.43	0.40	0.34	4.6

Type locality.– Thailand, Nakhon Ratchasima Province, limestone hill 3.4 km west of Ban Mu Si, 380 m altitude (14°32.0'N, 101°22.5'E). HOLOTYPE: UF

113541; collected 5 May, 1987. PARATYPES: UF 113542 (9 specimens), Mahidol University (9 specimens); same data as holotype. Specimens were found in a leaf-litter sample that was gathered at the base of a limestone ledge.

Remarks.– This species differs from other known *Systenostoma* by its deflected last whorl, its concave spire and its angular lamella within the aperture. The upper palatal tubercle also is more pronounced than in other known species.

Etymology.– The species name *concava* is from the Latin, in reference to the concave outline of the spire.

Systenostoma elevata, new species
(Figs. 39-43)

Description.– Shell minute, 0.92-0.99 mm high. Conical with a blunt apex and a narrow spire, whorls regularly descending; shell 1.15-1.27 times as high as wide, (Figs. 39-40). Fresh shells light gray in color. Umbilicus 0.20-0.26 times width of shell (Fig. 41). Whorls 4.2-4.3, evenly rounded, with a strong shoulder. Protoconch with 1.5 whorls; microsculpture consisting of minute, low anastomosing granules; no indication of spiral threads observed in the specimens examined (Fig. 43). Teleoconch with similar but finer microgranules and fine raised spiral threads that are crossed by irregularly spaced oblique axial threads; base and umbilicus lacking spiral threads. Aperture ovate in shape, about 0.87-0.92 times as wide as high; very slightly free from preceding whorl along parietal margin (Fig. 39); oblique, lying at an angle of about 45° to shell axis in lateral profile (Fig. 40); parietal margin extending forward as a slight tongue-like projection along columellar curvature. Aperture lacking any indication of dentition.

Measurements in mm for the holotype and four paratypes are as follow.

Specimen	length	width	aper.h	aper.w	umbil.	whorls
Holotype	0.92	0.80	0.37	0.34	0.17	4.2
Paratype	0.99	0.81	0.38	0.35	0.20	4.3
Paratype	0.92	0.81	0.35	0.31	0.21	4.2
Paratype	0.99	0.78	0.38	0.34	0.18	4.3
Paratype	0.98	0.83	0.38	0.34	0.17	4.3

Type locality.– Thailand, Chiang Mae Province, Doi Chiang Dao (Mountain), 7 km west of Chiang Dao; 600 m altitude (19°24.3'N, 98°54.2'E). HOLOTYPE: UF 113544; collected June 18, 1987 by Fred G. Thompson. PARATYPES: UF 113545 (3 specimens), Mahidol University (2 specimens); same data as the holotype.

Doi Chiang Dao is a high dome-shaped limestone mountain that rises to over 2000 m in elevation, and is surrounded on all sides by nearly vertical cliffs. Snails were collected near a Buddhist monastery along the north base of the mountain among huge karsted boulders. The area around the boulders and tallus was shaded by a dense over-story of trees and shrubs and the ground was covered by a thick damp layer of leaf litter. *Sytenostoma elevata* was recovered from leaf-litter gathered around the bases of limestone cliffs and in solution pockets in the rock.

Remarks.-- This species is distinguished from it congeners by its minute size, narrow high spire and narrow umbilicus. The tongue-like extension of the parietal wall of the aperture is unique. It differs from *S. convexa* by lacking any indication of dentition within the aperture. In this respect it is similar to other species in the genus.

Etymology.-- The name *elevata* is from the Latin, and refers to the narrow, raised spire that characterizes this species.

Gyliotrachela Tomlin, 1930
Group of *Gyliotrachela crossei* (Morlet, 1885)

This is a small group of species known from Vietnam, Thailand and Perak (Pilsbry, 1917: 211-217). Two species have been recorded from Thailand. The group is characterized by having a rounded peripheral keel with a concavity above it, the surface is minutely granulose, and there is an external concavity between the palatal plicae.

Gyliotrachela transitans transitans (Moellendorff, 1894)

Hypselostoma transitans Moellendorff, 1994; Proceedings of the Zoological Society of London, 1894: 16: figs. 12-13.
Gyliauchen transitans (Moellendorff). Pilsbry, 1917; Manual of Conchology, Ser. II, 24: 214-215; pl. 36, figs. 5-8.
Gyliotrachela transitans transitans (Moellendorff). Jutting, Bulletin Raffles Museum, (24): 28.
Type locality.-- Samui Island, Gulf of Siam, Thailand.
Distribution.-- Known only from the type locality.

Gyliotrachela striolata (Moellendorff, 1895)

Hypselostoma striolatus Moellendorff, 1895; Proceedings Zoological Society of London, 1895: 152; [unfigured].
Gyliauchen striolatus (Moellendorff). Pilsbry, 1917; Manual of Conchology, Ser. II, 24: 215.
Gyliotrachela striolata (Moellendorff). Jutting, Bulletin Raffles Museum, (24): 46.
Type locality.-- Samui Island, Gulf of Siam, Thailand.
Distribution.-- Known only from the type locality.

Group of *Gyliotrachela adela*, new species

This group from Thailand is characterized a depressed turban-shaped shell with a widely expanded last whorl, a low spire and distinct raised spiral threads on the teleoconch. The microsculpture of the protoconch consists of a dense mesh of

granular reticulations and lacks spiral sculpture (Fig. 6). The following is the only species assigned to this group at present.

Gyliotrachela adela, new species
(Figs. 6, 44-47)

Description.– Shell small, about 1.30-1.46 mm high and about 1.55-1.80 mm wide. Depressed turban-shaped with a forward projecting aperture that descends along the last quarter turn (Figs. 44, 46). Spire low and slightly oblique to plane of last whorl. Shell about 0.76-0.90 times as high as wide. Color of fresh specimens yellowish-white. Umbilicus broad, about 0.43-0.47 times width of shell posterior to aperture (Fig. 47). Whorls 3.7-3.9. Last whorl strongly shouldered; weakly convex along periphery; neck weakly constricted behind aperture around area of teeth. Protoconch with 1.4 strongly protruding whorls; microsculpture consisting of a dense mesh of granular reticulations that lack any apparent spiral component (Fig. 6). Teleoconch sculptured with uniformly spaced spiral threads that are equally developed across the whorl and into the umbilicus. Occasional incremental growth striations are present underlying spiral threads. Aperture free from and slightly forward of preceding whorl; auriculate in shape with a weak constriction over parietal margin and palatal margin. Peristome broadly expanded along palatal, basal and parietal margins (Fig. 45). Interior of aperture with six teeth. Angular lamella and upper palatal fold forming a shallow bay in posterior corner. Angular lamella low and short, lying mostly anterior to outer end of parietal lamella and other teeth. Upper palatal fold, lower palatal ford and columellar lamella about equal in size, moderately long and about as high as their distances from the parietal lamella. Basal fold small and tubercular. Parietal lamella slightly higher, longer, and thicker than other teeth and arched toward columellar lamella. Exterior surface of shell without any apparent indentations over teeth.

Measurements in mm of the holotype and three paratypes (UF 113509) are as follow.

Specimen	height	width	aper.h.	aper.w.	umbil.	whorls
Holotype	1.36	1.80	0.78	0.74	0.81	3.9
Paratype	1.30	1.58	0.71	0.71	0.71	3.8
Paratype	1.40	1.55	0.71	0.68	0.65	3.7
Paratype	1.46	1.71	0.74	0.71	0.74	3.9

Type locality.– Thailand, Surat Thani Province, box canyon in limestone range 6 km south of Na San; 100 m altitude (08°39.6'N, 99°23.9'E). HOLOTYPE: UF 113508; collected 3 June, 1987 by Fred G. Thompson. PARATYPES: UF 113509, Mahidol University; same data as the holotype.

The type locality is in a box canyon that is about two hectares in area and is surrounded on all sides by vertical limestone cliffs. Access to the canyon is through a narrow pass, outside of which is a small municipal park. The area is cut over and planted with various fruit trees. Natural shrubbery, vines and herbaceous

vegetation grow along the base and faces of the cliffs. Snails were recovered from a leaf-litter sample that was gathered at several places along the base of the cliff. The specimens were unnoticed in the field, so their ecological station was not determined.

Remarks.-- This and the following species are alike and differ from other known species of *Gyliotrachela* by having well defined spiral sculpture on the teleoconch. The following four species may belong in the *adela* species-group, but information concerning their microsculpture is insufficient at present to make this allocation. None are described or illustrated as having raised spiral threads, but early descriptions frequently were deficient in making the distinction between *incised* striations and *raised* threads. Thus, the descriptive term striation frequently referred to either. *Gyliotrachela salpinx* Jutting, 1961, is described as having fine spiral lines [threads or striations?] below the periphery of the last whorl (Jutting, 1961: 38). *Gyliotrachela fruhstorferi* (Moellendorff, 1897), *G. everetti* (E. A. Smith, 1896), and *G. dohertyi* (Fulton, 1899) also have spiral striations [threads?] over portions of the last whorl (Pilsbry, 1917: 217-220).

Gyliotrachelus adela is most similar to *Gyliotrachela salpinx* Jutting, 1961 in the general shape of the shell, although they differ in various details. In *G. salpinx* the aperture is deflected upward, not downward, the umbilicus is not as wide as it is in *G. adela*, the shell bears spiral sculpture below the periphery, and the aperture has numerous secondary tubercles between the major teeth, in contrast to the simplified and basic tooth pattern described above for *G. adela* (see Fig. 45).

Etymology.-- The species name *adela* is from the Classical Greek, αδελος, meaning unseen or obscure in reference to the fact that the snail was unnoticed at the time it was collected.

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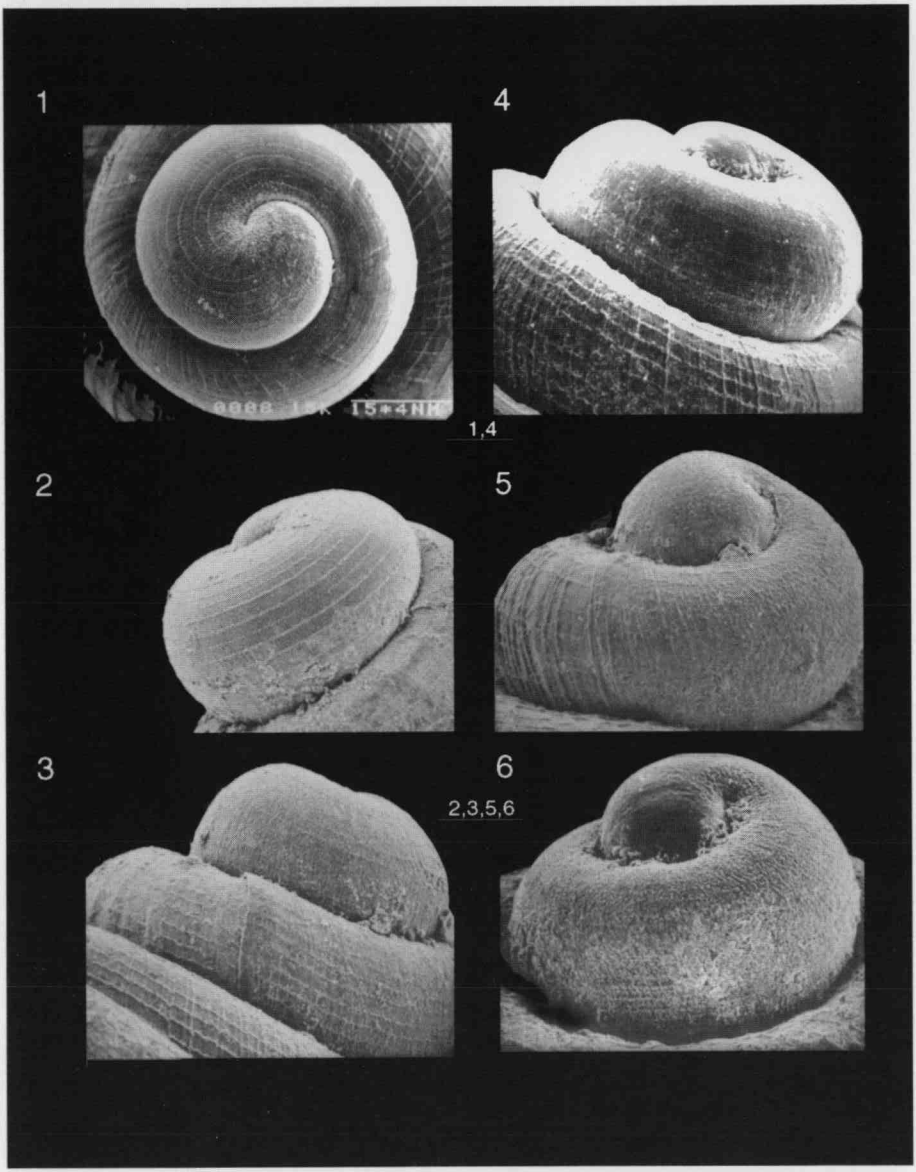
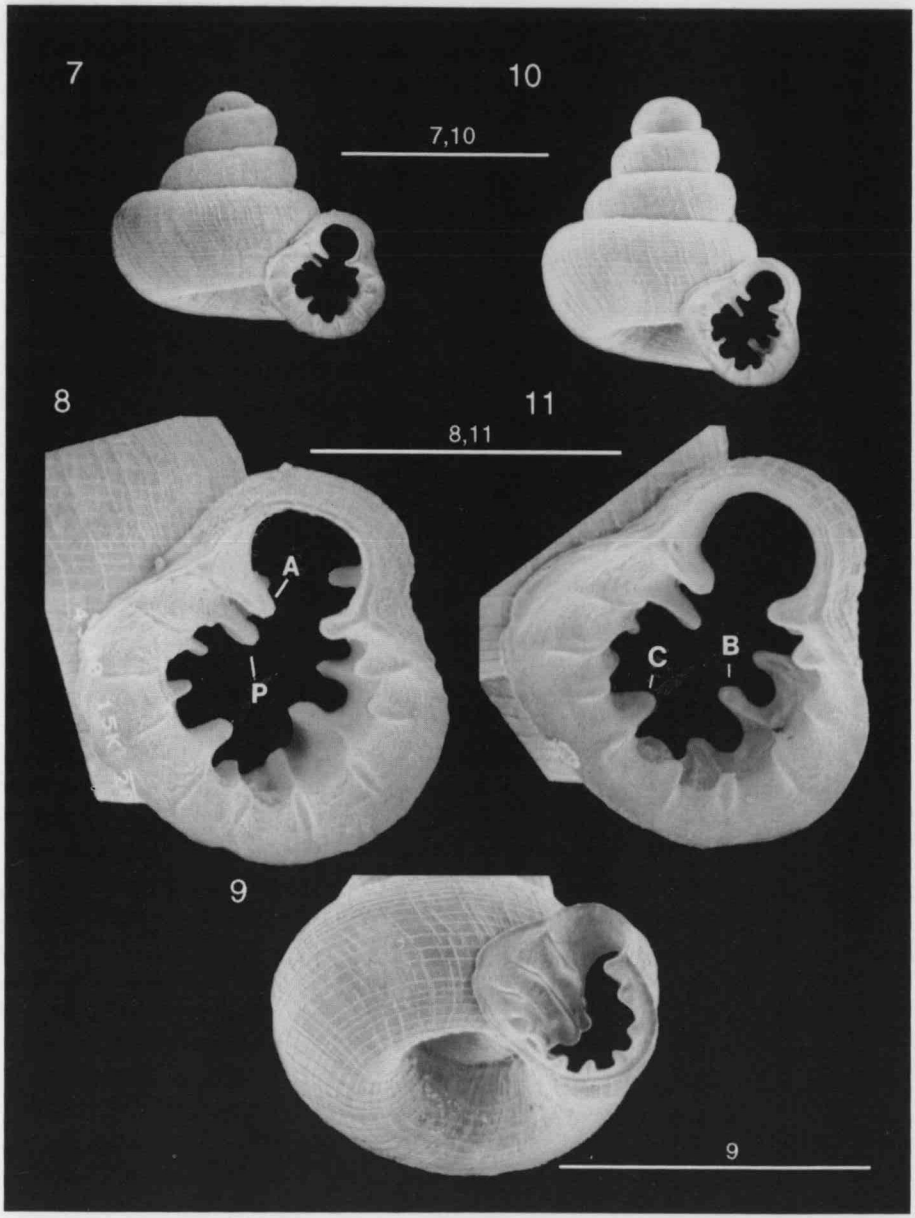
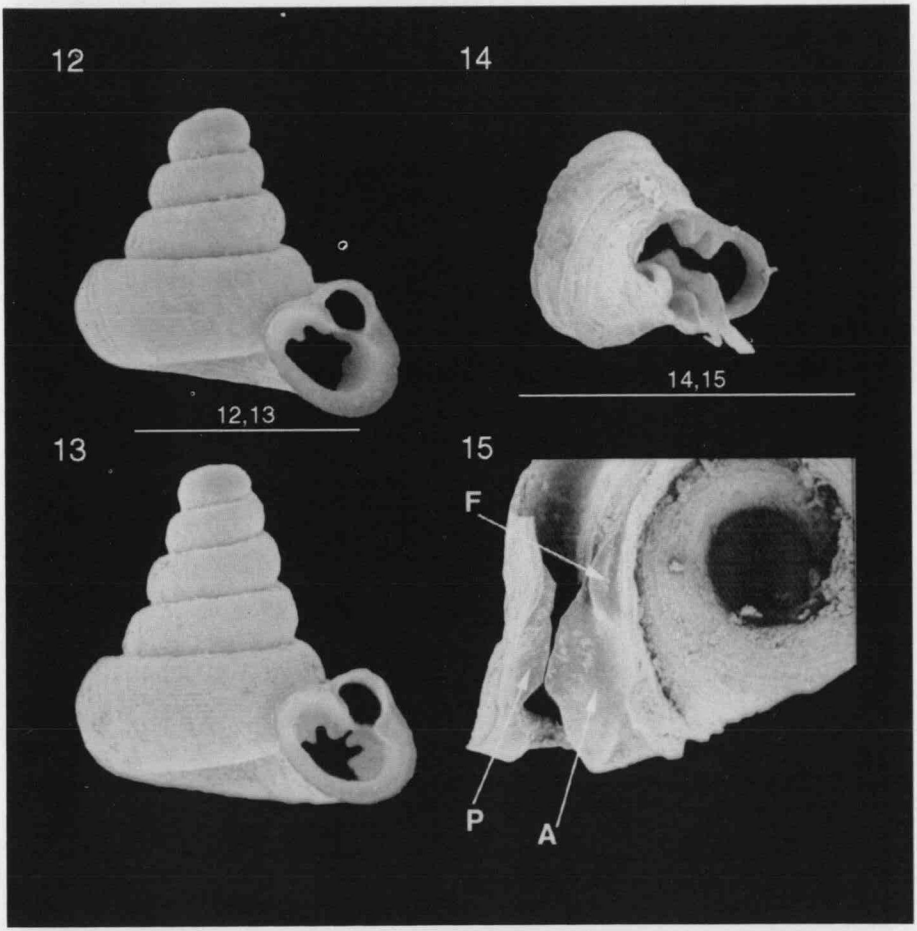


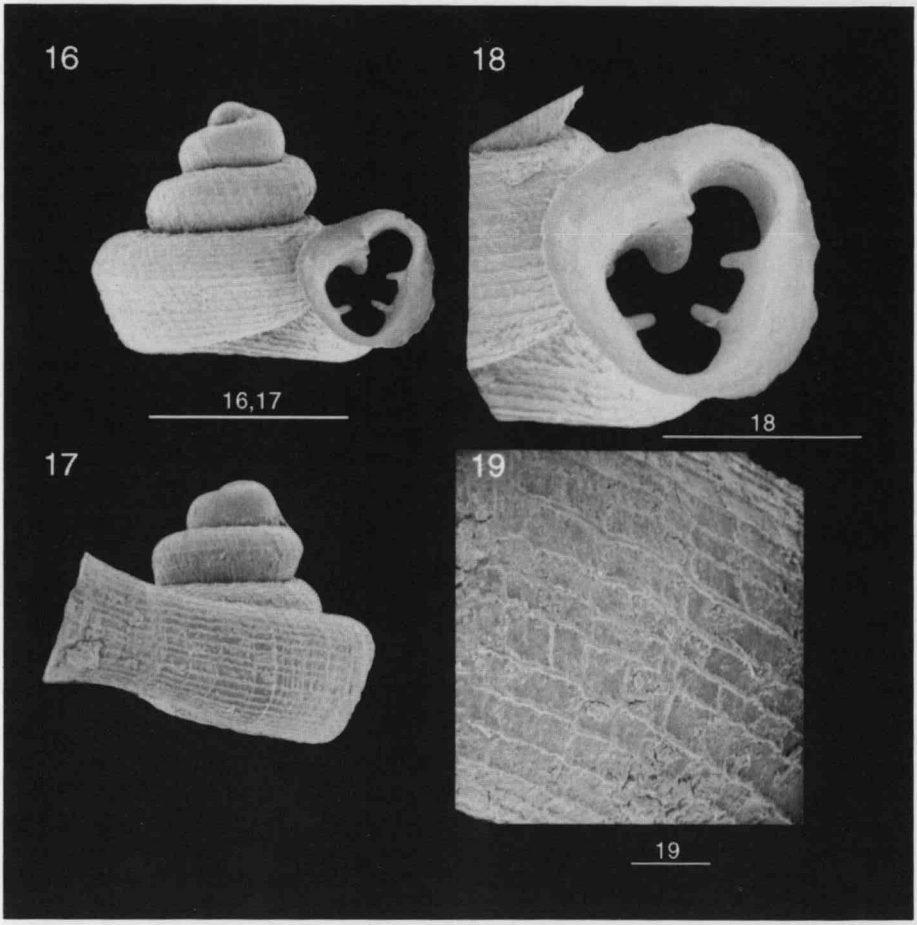
Figures 1-6.– Apical whorls of Thailand Vertiginidae. Fig. 1.- *Acinolaemus ptychochilus* n. sp., HOLOTYPE (UF 113502). Fig. 2.- *Acinolaemus stenopus* n. sp., PARATYPE (UF 113531). Fig. 3- *Acinolaemus colpodon* n. sp.; PARATYPE (UF 113529). Fig. 4.- *Acinolaemus rhamphodon* n. sp., HOLOTYPE (UF 113505). Fig. 5.- *Acinolaemus sphinctinion* n. sp. , HOLOTYPE (UF 113507). Fig. 6.– *Gyliotrachela adela* n. sp., HOLOTYPE (UF 113508). Scale bars = 100 µ.



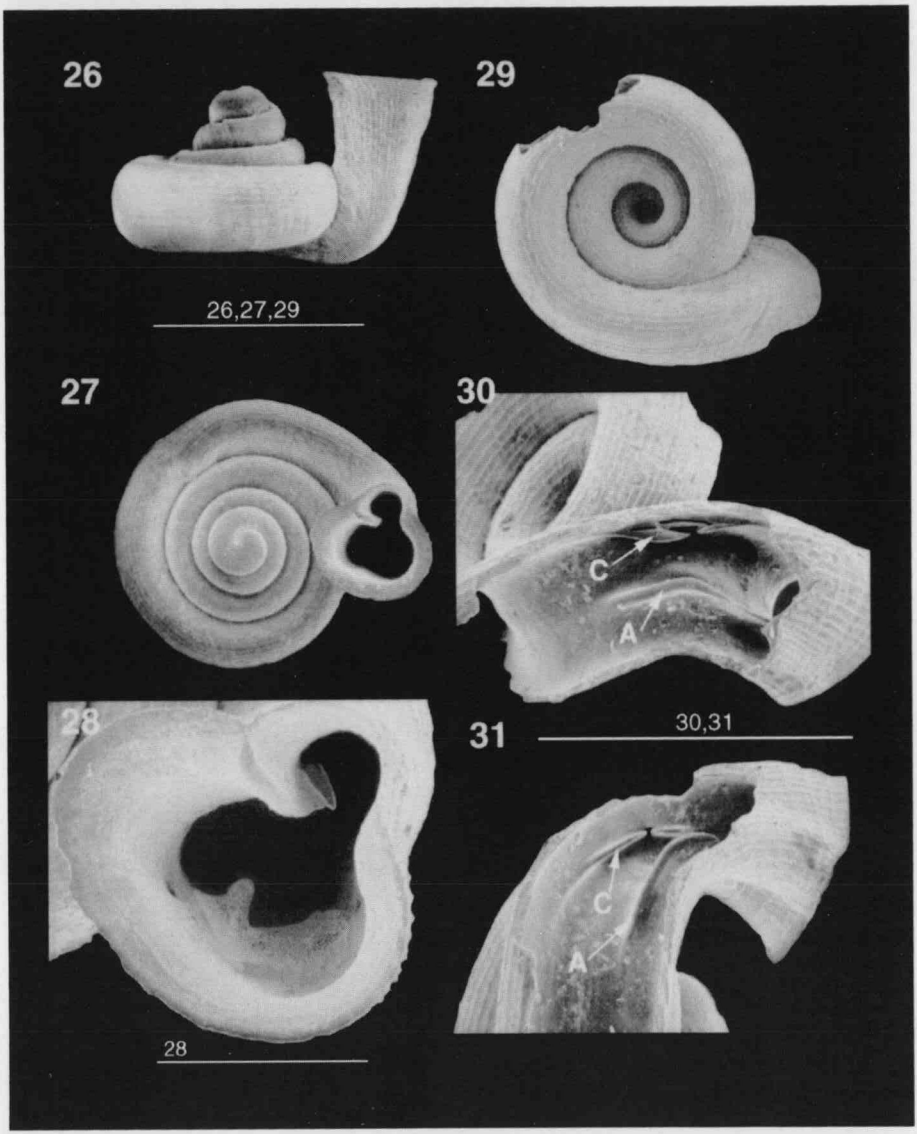
Figures 7-11.- *Acinolaemus ptychochilus* n. sp. Figs. 7-8.- PARATYPE (UF 113504). Figs. 9-11.– HOLOTYPE (UF 113502). Scale bars = 1 mm..



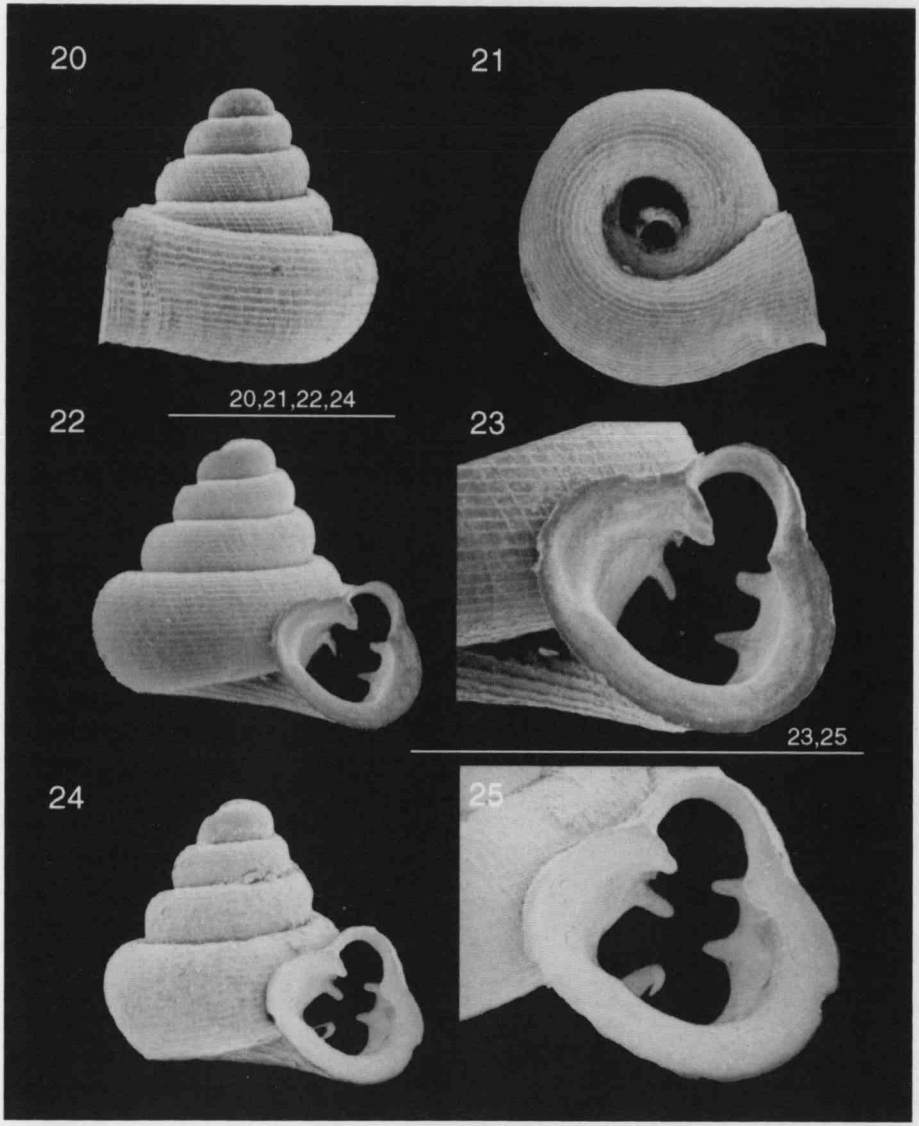
Figures 12-15.- *Acinolaemus stenopus* n. sp., PARATYPES (UF 113531). Figure 14 is a posterior view within the aperture showing the forward projecting hook-like columella lamella. Figure 15 shows the short receded parietal lamella (F) and the narrow gap between the angular lamella (A) and the palatal fold (P). Scale bars = 1 mm..



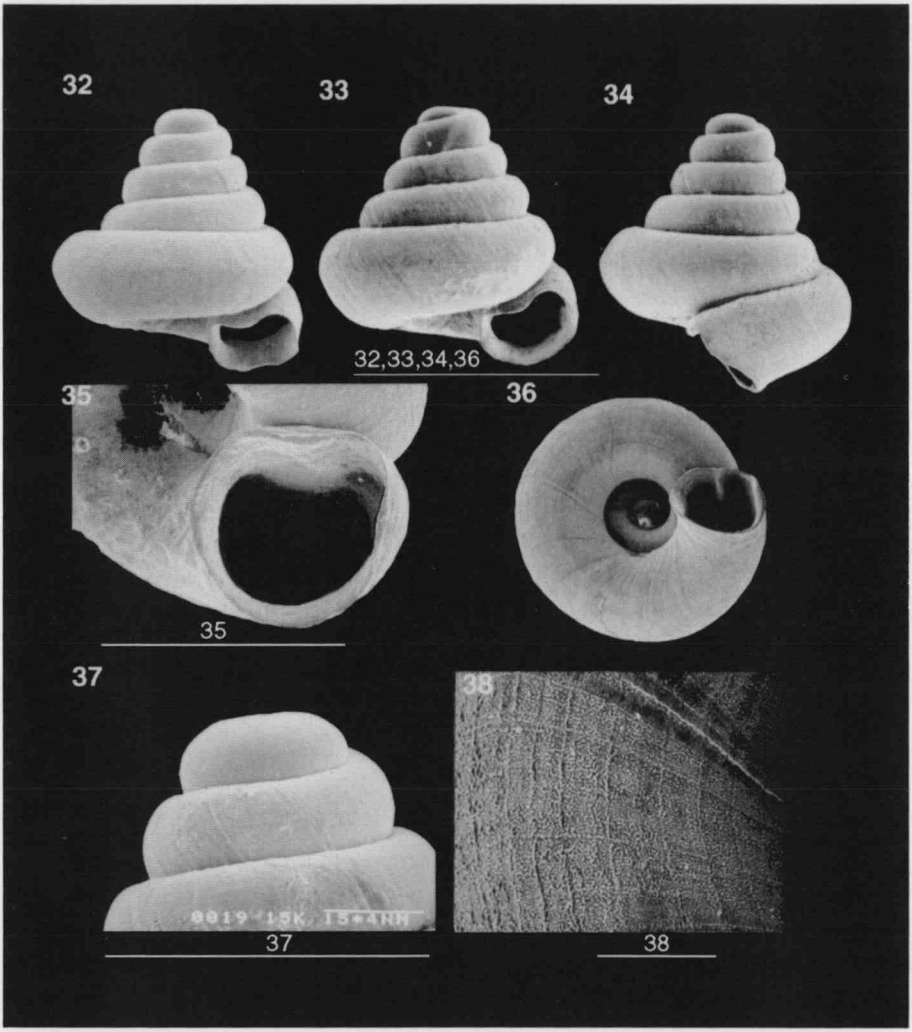
Figures 16-19.- *Acinolaemus sphinctinion* n. sp., HOLOTYPE (UF 113507). Scale bars for Figs. 16, 17 18 = 1 mm. Scale bar for Fig. 19 = 100μ..



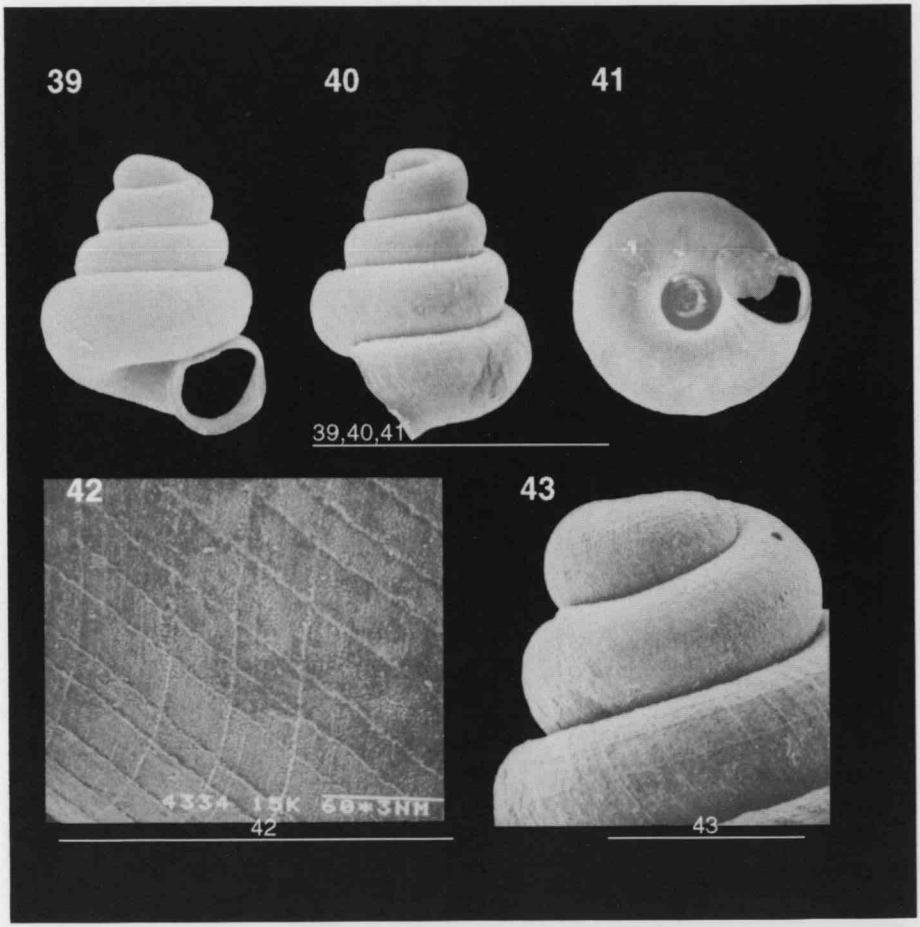
Figures 20-25.- *Acinolaemus rhamphodon* n. sp. Figs. 20-23.– HOLOTYPE (UF 113505). Figs.. 24-25.– PARATYPE (Mahidol Univ.). Scale bars = 1 mm.



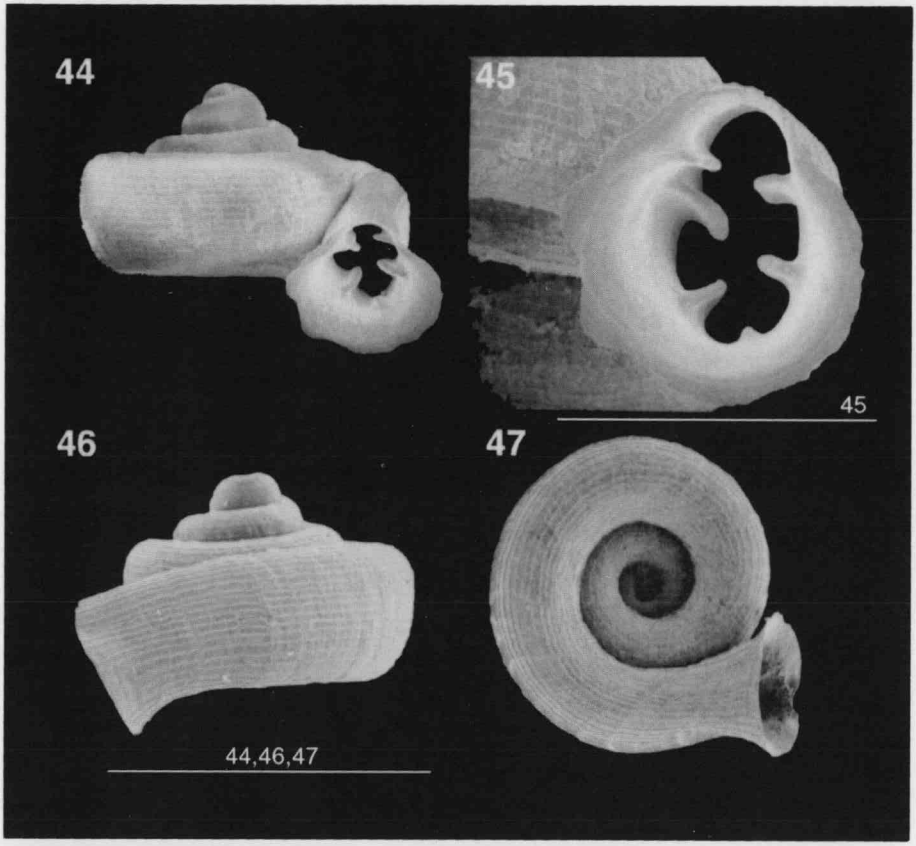
Figures 26-31.- *Acinolaemus colpodon* n. sp. PARATYPES (UF 113529). Scale bars for Figs. 26, 27, 29-31 = 1 mm.. Scale bar for Fig. 28 = 0.5 mm.



Figs. 32-38. *Systenostoma concava* n. sp., PARATYPES (UF 113542). Scale bars for Figs. 32-34, 36 = 1 mm.. Scale bars for Figs. 35, 37 = 0.5 mm. Scale bar for Fig. 38 = 100 μ..



Figures 39-43.-- *Systenostoma elevata* n. sp., PARATYPES (UF 113455). Fig. 42.-- Base of fig. 41. Scale bar for Figs. 39-41 = 1 mm. Scale bars for Figs. 42-43 = 100μ.



Figures 44-47. *Gyliotrachela adela* n. sp. Figs. 44-45.– HOLOTYPE (UF 113508). Figs. 46-47.– PARATYPE (UF 113509). Scale bar for Figs. 44-46 = 1 mm.. Scale bar for Fig. 45 = 0.5 mm.

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