

**New species of terrestrial molluscs
(Caenogastropoda, Pupinidae & Pulmonata, Vertiginidae)
of the Hon Chong - Ha Tien limestone hills, Southern Vietnam**

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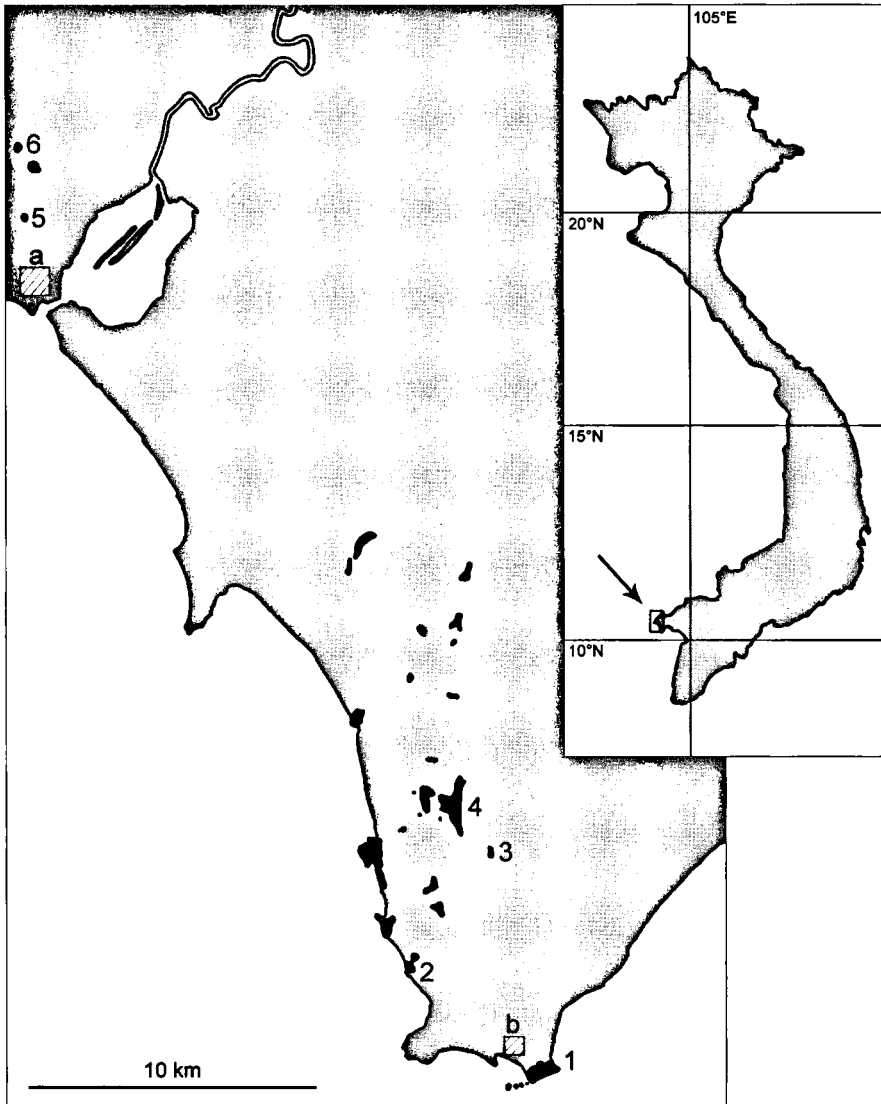
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Small limestone hills between the towns of Hon Chong and Ha Tien (Kien Giang Prov., Southwestern Vietnam) harbour a fauna of 65 species terrestrial molluscs, of which 36 are assumed to be endemic to the hills. Some occur on most hills of the group, others on a few, or even on a single hill only. Eight endemic taxa, new to science, are described here: 3 species of the new genus *Notharinia* (Pupinidae), viz. *N. attenuata*, *N. brevior* and *N. crassilabris*, and 5 taxa of the family Vertiginidae, viz. *Acinolaemus carcharodon*, *Anauchen informis informis*, *Anauchen informis parcedentata*, *Aulacospira conica*, and *Montapiculus pyramidalis*.

Key words: Vietnam, Kien Giang Province, Hon Chong, Ha Tien, Pupinidae, *Notharinia*, Vertiginidae, *Acinolaemus*, *Anauchen*, *Aulacospira*, *Montapiculus*.

INTRODUCTION

The Southwestern part of the Mekong delta (Vietnam, Southwestern part) consists of boundless plains with here and there an isolated rocky hill. A string of small and medium-sized hills stretching along the coast between Hon Chong and Ha Tien consist of limestone; see map 1. The geomorphological history of these hills has determined the nature of the local land snail fauna. The inland hills are now surrounded by agricultural land on clayey soil, only a few of the more seaward ones still have a fringe of mangrove swamps surrounding them. The presence of no fewer than three levels of undercutting at the base of the limestone hills (the upper about 2.5 m, the lowermost and by far deepest about 0.8 m above the present erosion basis, indicates that the hills have been surrounded by water, most likely the sea or, at least, by a coastal facies including mangroves, i.e. an environment definitely inhospitable to most forms of land life, for a considerable period of time in the past. It also shows that the area as a whole has been uplifted with respect to the sea level during its recent geomorphological history, presumably as compensation of ongoing subsidence in the nearby Mekong delta, a major sedimentary basin.



Map 1. Map of the Hon Chong-Ha Tien area, Kien Giang Prov., Southern Vietnam; limestone hills indicated in black; a, Ha Tien; b, Hon Chong; 1, Hon Chong Hill; 2, Ba Tai Hill; 3, Son Cha Hill; 4, Bai Voi Hill; 5, Thach Dong Hill; 6, Da Dung Hill. Upper right: Map of Vietnam, with area under study indicated.

Geographically, the limestone hills are isolated from other limestone hills. In fact they form the south easternmost extension of a small belt of limestone hills in adjacent Kampuchea. The distance between this belt and other limestone hills in Kampuchea is considerable. In Vietnam, the nearest limestone occurs several hundreds of kilometers to the northeast.

Very little, if any, pristine vegetation is left on the limestone hills. The most mature vegetation is found near Hon Chong and Ha Tien village, on hills that are used as places of worship; the temples evidently provide some protection against destructive exploitation of the hill. The environment on the hills, due to both the proximity of the sea as well as to human impact, must always have been dynamic; the word 'pristine' may not applicable here.

Human impact is various: small scale agriculture, silviculture and shrimp farming at the foot of the hills and in at least one of the dolines, firewood collecting, various uses of the caves, invasion of alien species, and last but not least, war damage. Bombing has caused an extensive superficial spalling of the karstified rock surface over a large area surrounding the actual blasts.

At present, most of the limestone hills, those with temples nearby excepted, are sparsely vegetated with evidently secondary herbaceous and low woody growth and grass. Higher and more mature woody vegetation can be found in deep clefts and depressions in the rock and, in particular, in several large dolines.

Isolation determined the nature of the local biodiversity. Geographical isolation, because the nearest limestone hills are miles away, and environmental isolation because they have been, and still are, surrounded by an environment hostile to many forms of land life. Environmental pressure occurred when periods during which the limestone hills were land locked and sheltered from the elements took turns with periods during which the hills were exposed to sea winds, drought and salt spray.

As a result, the terrestrial mollusk fauna of the hills can be characterized as an island fauna: it comprises only 65 species, which is not much when compared to other limestone areas in SE Asia, but the number of species marked as probably endemic to the area is 36, or 55%. This is a very high ratio indeed, and it makes the biodiversity value of the fauna considerable. Some of these endemics have a range restricted to only one or a few hills of the group.

Altogether 30 species (46%) cannot be identified to species level; most of these will prove to be new to science. Investigations into the fauna are ongoing, but we feel that early publication of some of these novelties will highlight the special nature of the local fauna.

The drawings have been made by the first author, with the aid of a Wild M8 stereo microscope with a camera lucida device.

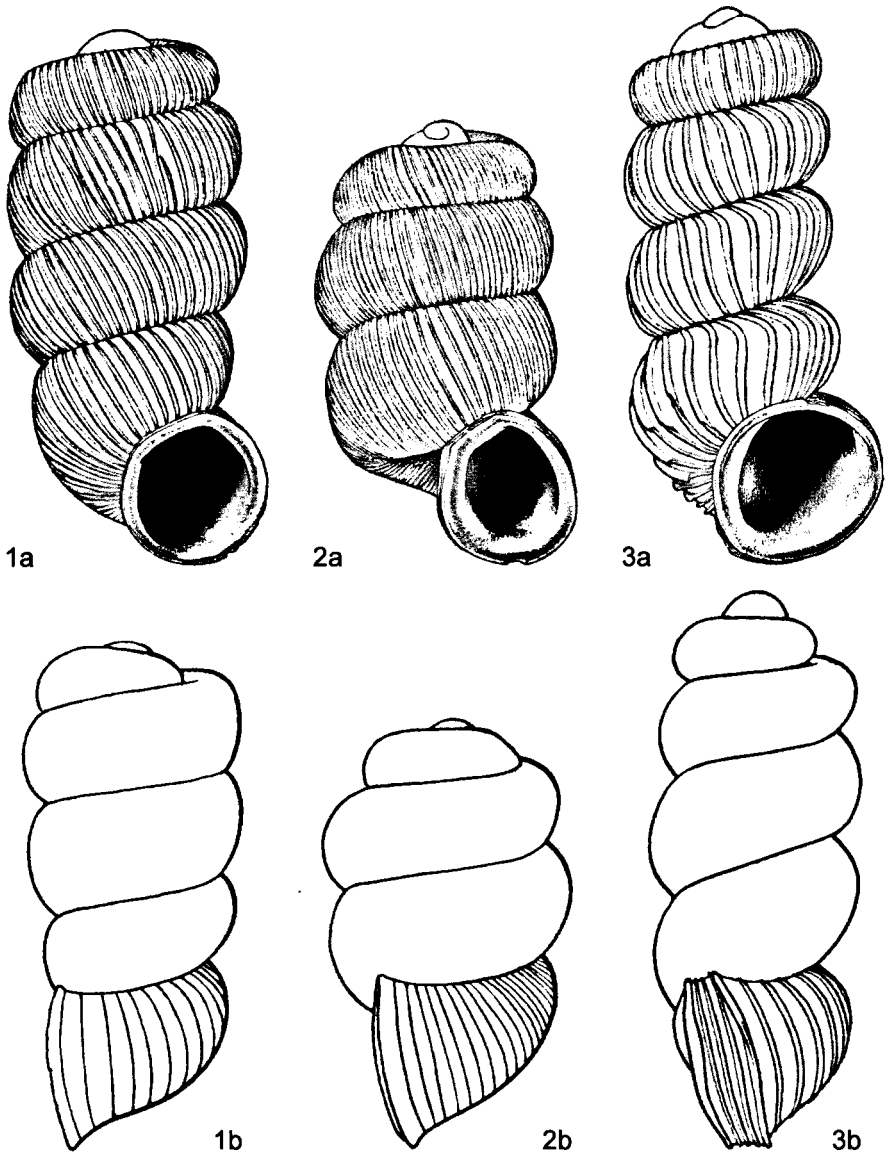
SYSTEMATIC PART

Pupinidae L. Pfeiffer, 1853

Notharinia gen. nov.

Type species: *Notharinia attenuata* spec. nov.

Description. – Shell white, rather thin, about opaque, dextral. Spire about cylindrical. Whorls 4 1/8-5 1/2. Top whorls slightly oblique. Protoconch smooth at 40x magnification. Teleoconch: Radial ribs present, orthocline or slightly prosocline, straight or sinuous, low, with a single crest. Spiral sculpture absent. No internal constriction present in the spire, near the aperture. Umbilicus closed. Plane through aperture about parallel with coiling axis; aperture about circular, without a basal edge, without teeth. Peristome simple or double, not or hardly extended over the previous whorl on the parietal side, without a



Figs 1-3. *Notharinia* spec. 1. *N. attenuata* spec. nov.; a, holotype (shell height 2.0 mm), Vietnam, Hon Chong, Hon Chong Hill (RMNH), frontal view; b, paratype from same locality (V), right lateral view. 2, *N. brevior* spec. nov.; a, holotype (shell height 1.7 mm), Vietnam, Ha Tien, Thach Dong Hill (RMNH), frontal view; b, paratype from same locality (V), right lateral view. 3, *N. crassilabris* spec. nov.; a, holotype (shell height 2.1 mm), Vietnam, Ha Tien, Thach Dong Hill (RMNH), frontal view; b, paratype from same locality (V), right lateral view.

well-demarcated lip on the palatal and basal side. Shell height 1.5-2.05 mm. Operculum not seen.

Distribution. – Endemic to south-western Vietnam, Kien Giang Prov., scattered small limestone hills close to the border with Kampuchea, between Ha Tien and Hon Chong. Three species known.

Ecology. – Small, isolated limestone hills in coastal plains on clay soil, now mainly dry land in use for various purposes but originally at least partly within the tidal zone. The hills where *Notharinia* occurs have a predominantly woody vegetation. The climate is strongly seasonal, with prolonged dry periods. Presumably, the snails are soil dwellers.

Notes. – The generic description is made to set the genus apart from similar genera of the Diplommatinidae as well as the Pupinidae. At first sight, *Notharinia* is of typical diplommatinid appearance; and its species would fit particularly well into the genus *Arinia* H. & A. Adams, 1856. However, all Diplommatinidae have a circular constriction deep inside the ultimate whorl or even in the penultimate whorl, on which rests the small, circular operculum. Such a structure is absent in *Notharinia*, and therefore we prefer to include the genus elsewhere. Although no operculum has been seen, we assume that *Notharinia* is a prosobranch, and we find most similar forms in the Pupinidae, in the genus *Pseudopomatias* Von Moellendorff, 1885. *Notharinia* differs from *Pseudopomatias* in being much smaller (1.5-2.05 mm versus 5.5-14 mm high) and in having a cylindrical shell (rather than conical or fusiform).

Notharinia attenuata spec. nov. (fig. 1)

Material seen. – Vietnam, Kien Giang Prov., Kien Luong, Hon Chong Hill (V 9993/11, incl. holotype RMNH 108981).

Description. – Shell cylindrical but usually somewhat attenuated towards the aperture, top widely rounded to somewhat truncated. Whorls 5-5 3/8, convex. Suture impressed. Radial ribs straight, distinct, rather low and thin, densely placed; but slightly sinuous, particularly at both ends, on the body whorls and particularly on the last whorl, and usually slightly wider spaced on the last whorl. Umbilicus closed, last whorl tightly coiled so that hardly an axial depression is left. Last whorl slightly expanded close to the aperture. Peristome simple, somewhat thickened and somewhat reflexed; parietal side fused to the previous whorl. Height 1.7-1.9 mm; width (excl. last whorl) 0.75-0.85 mm; index (height/width) 2.20-2.26. Height aperture 0.45-0.5 mm; width aperture 0.45-0.5 mm.

Distribution. – Vietnam, SW. part, a single limestone hill near Hon Chong. Proposed IUCN Threat Category Vulnerable VU D2 (IUCN 2001 Categories & Criteria, v. 3.1); some environmental protection is provided by the fact that the place of worship is present on the flank of the hill.

Notharinia brevior spec. nov. (fig. 2)

Material seen. – Vietnam, Kien Giang Prov., Ha Tien, Thach Dong Hill (V 11468/7, incl. holotype RMNH 108983).

Description. – Shell shortly cylindrical, sometimes slightly bulging about half-way its length, top widely rounded to somewhat truncated. Whorls 4 1/8–4 1/2, (moderately) convex. Suture (moderately) impressed. Radial ribs straight, distinct, rather low and thin,

(very) densely placed, usually slightly wider spaced on the last whorl. Umbilicus closed, but last whorl loosely coiled so that an axial depression is present. Last whorl slightly expanded close to the aperture. Peristome double; outer peristome somewhat spreading beyond the inner on the palatal and basal side; inner hardly to moderately protruding from the outer, somewhat thickened and somewhat reflexed; parietal side fused to the previous whorl for a short distance only; traces of densely placed radial lamellae present between the outer and the inner peristome. Height 1.5-1.6 mm; width (excl. last whorl) 0.85-0.9 mm, index (height/width) 0.85-0.95. Height aperture 0.5-0.55 mm; width aperture 0.55-0.65 mm.

Distribution. – Vietnam, SW. part, a single minute limestone hill near Ha Tien. Proposed IUCN Threat Category Vulnerable VU D2 (IUCN 2001 Categories & Criteria, v. 3.1); some environmental protection is provided by the fact that the place of worship is present on the top of the hill.

Notes. – Differs from *N. attenuata* in having a shortly cylindrical spire with fewer whorls, and in the more loosely coiled last whorl that, although it seals off the umbilicus, still leaves a shallow axial depression. The peristome is double, but the inner is barely protruding from the outer in some shells.

Notharinia crassilabris spec. nov. (fig. 3)

Material seen. – Vietnam, Kien Giang Prov., Ha Tien, Thach Dong Hill (V 11467/>10, incl. holotype RMNH 108984); Ha Tien, Da Dung Hill (V 11444/>10).

Description. – Shell cylindrical, rarely with a slightly widened top whorl, top (widely) rounded. Radial ribs about straight, rather low, thin and rather densely placed on the top whorl, increasingly sinuous, somewhat higher and more widely spaced towards the aperture, widely spaced and distinctly sinuous on the last 1/2 whorl. Umbilicus closed, last whorl tightly coiled so that hardly an axial depression is left. Last whorl slightly expanded close to the aperture. Peristome double; outer peristome usually somewhat spreading beyond the inner on the palatal and basal side; inner peristome moderately to distinctly protruding from the outer, somewhat thickened and somewhat reflexed; parietal side fused to the previous whorl; densely placed radial lamellae present between the outer and the inner peristome. Height 1.6-2.05 mm; width (excl. last whorl) 0.65-0.75 mm, index (height/width) 2.46-2.73. Height aperture 0.5-0.6 mm; width aperture 0.5-0.55 mm.

Distribution. – Vietnam, SW. part, two limestone hills near Ha Tien. Proposed IUCN Threat Category Vulnerable VU D2 (IUCN 2001 Categories & Criteria, v. 3.1); some environmental protection is provided by the fact that the place of worship is present on both hills.

Vertiginidae Fitzinger, 1833

Acinolaemus Thompson & Upatham, 1997

Notes. – The species described below does not fully meet the diagnostic set for *Acinolaemus* as given by Thompson and Upatham (1997: 223): it lacks the spiral sculpture of the protoconch, and has a downwards turned last portion of the last whorl. However, its sculpture and the dentition in the aperture are typical for the genus.

Acinolaemus carcharodon spec. nov. (fig. 4)

Material seen. – Vietnam, Kien Giang Prov., Kien Luong, Hon Chong Hill (V 11320/>10, incl. holotype RMNH 108985); near Hon Chong, Ba Tai Hill (V 9966/>10); near Hon Chong, Bai Voi Hill, N and NW flank (V11296/6); do., doline along East flank (V 11260/1); do., Hang Tien cave, shrubland (V 11326/6); do., Hang Tien cave, below doline (V 10024/6).

Description. – Shell white, rather thin, somewhat translucent, dextral. Spire discoid but with the first whorls protruding, conical, and with the last portion of the last whorl abruptly curved obliquely downwards, forming a short, free tube. Whorls 4 1/4-4 3/4, the inner convex, the outer flattened around the periphery, shouldered above, more rounded below, suture deeply impressed. Protoconch dull, without spiral threads. Teleoconch shiny; a radial sculpture of very fine, densely and regularly placed riblets; a spiral sculpture of rather distinct, rather well-spaced spiral threads. Umbilicus open, very wide. Peristome entirely free, general outline triangular with rounded edges, somewhat reflexed, thin. Aperture with 4 lamellae: 1 short and high parietalis deep inside; 1 long angularis starting at the peristome, gradually lower inside but with with an antrorse, needle-sharp tooth at the level of the parietalis; 1 rather long, sigmoid palatalis starting near the peristome and deeply notched about half-way, so that in some shells this lamella is almost divided into two; 1 rather long basalis starting near the peristome as a short, high lamella, separated by a deep and wide notch from an antrorse, needle-sharp tooth further inside. Height 1.2-1.4 mm (0.9-1.05 mm without the downwards pointing part of the last whorl); width 1.5-1.8 mm. Height aperture 0.5-0.6 mm; width aperture 0.55-0.65 mm.

Distribution. – Vietnam, SW. part, two limestone hills near Hon Chong. Proposed IUCN Threat Category Vulnerable VU A4 D2 (IUCN 2001 Categories & Criteria, v. 3.1); Bai Voi Hill is slated for limestone mining; but at Hon Chong Hill some environmental protection is provided by the fact that the place of worship is present on the flank of the hill.

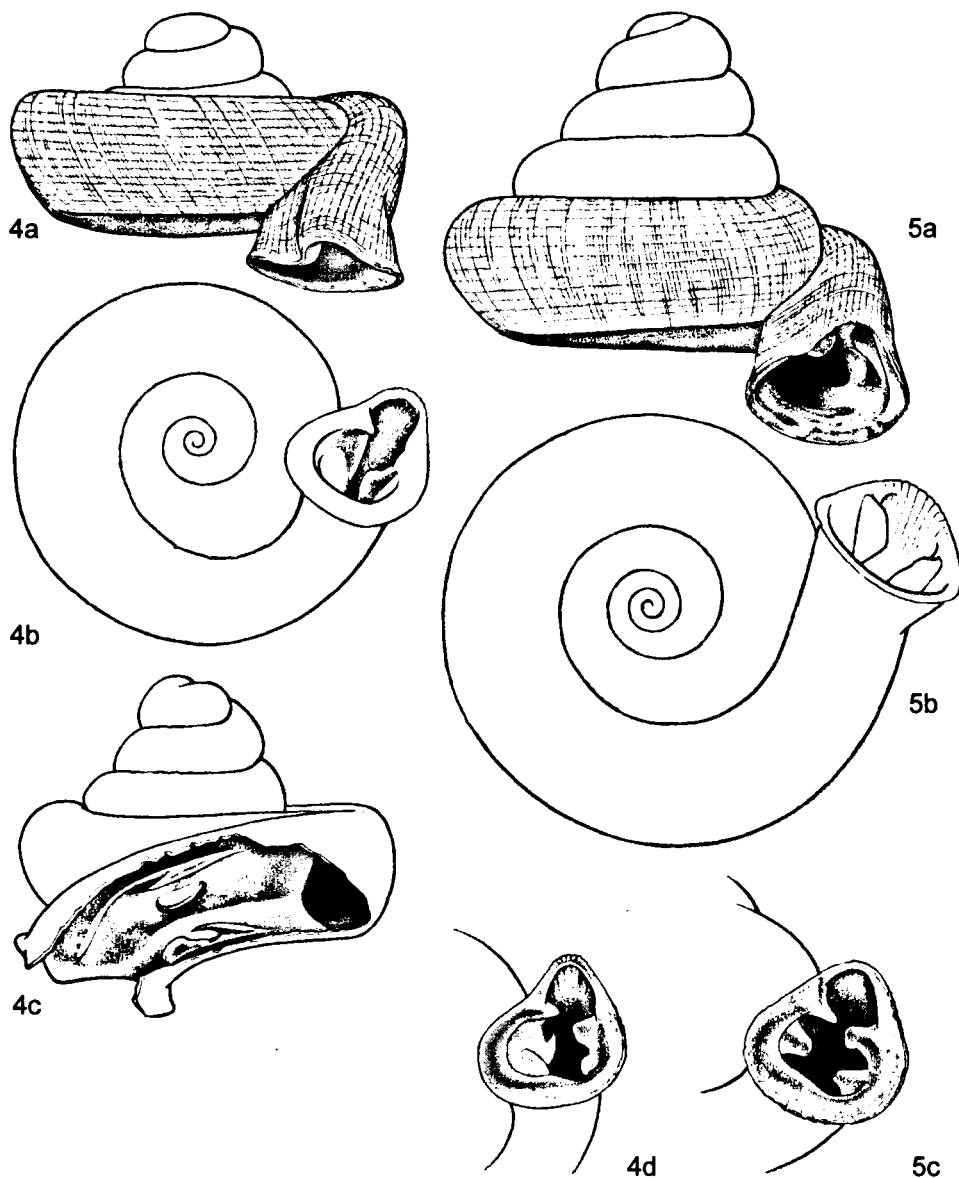
Notes. – The downwards curved free portion of the last whorl suffices to distinguish *A. carcharodon* from other species of the genus.

Anauchen Pilsbry, 1917

Anauchen informis spec. nov. (figs 6, 7)*Anauchen informis informis* subspec. nov. (fig. 6)

Material seen. – Vietnam, Kien Giang Prov., Kien Luong, Hon Chong Hill (V 9999/3); near Hon Chong, Bai Voi Hill (V 9939/>10); do., doline along East flank (V 11258/>10, incl. holotype RMNH 108986); do., North and Northwest flank (V 11295/1); do., Hang Tien cave, below doline (V 10023/3).

Description. – Shell dark reddish brown, rather thin, opaque, dextral. Spire ovoid-conical to conical with slightly convex sides. Whorls 4 3/8-5 3/8, convex, well rounded, suture deeply impressed. Protoconch shiny, with regularly and widely spaced, thin spiral threads. Teleoconch dull; a radial sculpture of irregularly spaced growth lines which may be slightly raised towards the sutures; a spiral sculpture of fine, wavy, irregularly and rather widely spaced threads, particularly present on the lower half of the whorls.



Figs 4-5. 4, *Acinolaemus carcharodon* spec. nov.; a, holotype (shell height 1.15 mm, incl. tuba), Vietnam, Kien Luong, Hon Chong Hill (RMNH), frontal view; b, paratype from same locality (V), umbilical view; c, paratype from same locality (V), right lateral view with shell wall partly removed; d, paratype from same locality (V), frontal view of aperture. 5, *Montapiculus pyramidalis* spec. nov.; a, holotype (shell height 1.7 mm, incl. tuba), Vietnam, Kien Luong, Hon Chong Hill (RMNH), frontal view; b, paratype from same locality (V), umbilical view; c, paratype from same locality (V), frontal view of aperture.

Umbilicus open, narrow, deep. Peristome attached to the previous whorl, general outline about subrectangular but with a rounded lower margin, somewhat expanded on the parietal side, reflexed elsewhere, thin. Aperture with 3-5 lamellae: 1 distinct parietalis, 2 palatales, the upper sometimes missing, with or without 1 basalis, 1 distinct columellaris. Height 3-4 mm; width 2.2-2.7 mm. Height aperture 1.3-1.5 mm; width aperture 1.2-1.5 mm.

Distribution. – Vietnam, SW. part, three limestone hills near Hon Chong. Proposed IUCN Threat Category Vulnerable VU A4 D2 (IUCN 2001 Categories & Criteria, v. 3.1); Bai Voi Hill is slated for limestone mining; but at Hon Chong Hill some environmental protection is provided by the fact that the place of worship is present on the flank of the hill.

Notes. – Among similar genera, *Anauchen* is characterized by the absence of an angular tooth. Most species have a slender, conical spire, often with concave sides, except for *A. anghongense* Burch & Panha, 2000, which approaches *A. informis* in shape. The latter differs in having a peristome of more angular outline, less distinctly flaring and less well-rounded on the parietal and palatal side.

Anauchen informis parcedentata subsp. nov. (fig. 7)

Material seen. – Vietnam. Kien Giang Prov., Kien Luong, Ba Tai Hill (V 9956/>10, incl. Holotype RMNH 108987); do., on shore of surrounding tidal lake (V 9984/3); do., fossil deposit in rock cleft (V 11499/>10).

Description. – Like the nominotypical subspecies, but whorls 5 1/8-5 3/8, aperture with 1-3 lamellae: 1 distinct parietalis, 2 palatales, sometimes the upper or both missing. Height 4-4.6 mm; width 2.7-3 mm. Height aperture 1.6-2.2 mm; width aperture 1.6-1.7 mm.

Distribution. – Vietnam, SW. part, one limestone hill near Hon Chong. Proposed IUCN Threat Category Vulnerable VU D2 (IUCN 2001 Categories & Criteria, v. 3.1); the hill has no protected status at present, but has not yet been earmarked for mining.

Notes. – Somewhat larger than the type subspecies and with fewer and less distinct apertural teeth. Diagnostic is the absence of the columellaris, at most a tiny gibbosity is present in some shells.

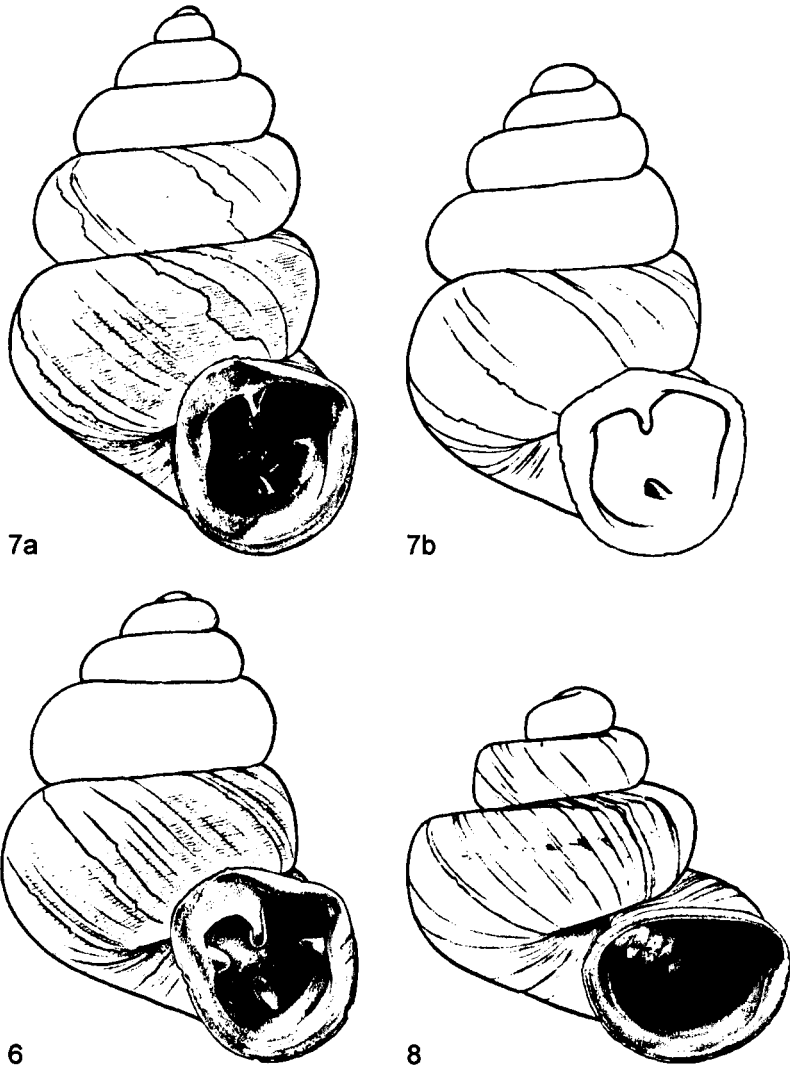
The fossil deposit in which the species was found has not been dated.

Aulacospira Von Moellendorff, 1890

Aulacospira conica spec. nov. (fig. 8)

Material seen. – Vietnam. Kien Giang Prov., Ha Tien, Thach Dong Hill (V 11464/5, incl. Holotype RMNH 108988); Ha Tien, Da Dung Hill (V 11431/7).

Description. – Shell dark reddish brown, rather thin, opaque, dextral. Spire conical with about flat sides. Whorls 3 3/8-3 1/2, distinctly shouldered, concave above the shoulder, flattened below, around the periphery, suture deeply impressed. Protoconch more or less shiny, without any spiral sculpture. Teleoconch dull; a radial sculpture of irregularly spaced growth lines which may be slightly distinctly raised at irregular intervals; no spi-



Figs 6-8. 6, *Anauchen informis informis* subsp. nov., holotype (shell height 3.4 mm), Vietnam, near Hon Chong, Bai Voi Hill (RMNH), frontal view. 7, *Anauchen informis parcedentata* subsp. nov.; a, holotype (shell height 4.5 mm), Vietnam, Kien Luong, Ba Tai Hill (RMNH), frontal view; b, paratype (shell height 3.6 mm) from same locality (V), frontal view. 8, *Aulacospira conica* spec. nov., holotype (shell height 2.5 mm), Vietnam, Ha Tien, Thach Dong Hill (RMNH), frontal view.

ral sculpture present. Umbilicus open, rather narrow. Peristome entirely detached from the previous whorl, general outline about subrectangular but with a rounded lower margin, reflexed on all sides, thin. Aperture without lamellae, but with a slight gibbosity on the upper palatal side. Height 2.4-2.6 mm; width 2.2-2.5 mm. Height aperture 0.9-1 mm; width aperture 1.1-1.2 mm.

Distribution. – Vietnam, SW. part, two limestone hills near Ha Tien. Proposed IUCN Threat Category Vulnerable VU D2 (IUCN 2001 Categories & Criteria, v. 3.1); some environmental protection is provided by the fact that the a place of worship is present on both hills.

Notes. – *Aulacospira mucronata* (Von Moellendorff, 1887) (The Philippines) and "*Systemostoma*" *depressa* Jaekel, 1950 (Vietnam) are the only other species of the genus without lamellae in the aperture. *A. conica* differs in having a higher conical spire and distinctly shouldered whorls.

Montapiculus Panha & Burch, 1999

Montapiculus pyramidalis spec. nov. (fig. 5)

Material seen. – Vietnam. Kien Giang Prov., Kien Luong, Hon Chong Hill (V 11321/>10, incl. Holotype RMNH 108989); near Hon Chong, Son Cha Hill (V7952/2); near Hon Chong, Bai Voi Hill, doline along East flank (V 11261/2); do., Hang Tien cave, shrubland (V 11329/2); do., Hang Tien cave, below doline (V 10028/2); Ha Tien, Da Dung Hill (V 11440/>2).

Description. – Shell white, rather thin, somewhat translucent, dextral. Spire conical with distinctly concave sides, and with the last portion of the last whorl abruptly curved obliquely downwards, forming a short, free tube. Whorls 4 1/4-5 1/4, convex, suture deeply impressed. Protoconch dull, without spiral threads. Teleoconch shiny; a radial sculpture of very fine, densely and regularly placed riblets; a spiral sculpture of rather distinct, rather well-spaced spiral threads. Umbilicus open, very wide. Peristome entirely free, general outline triangular with well-rounded edges, somewhat reflexed, thin, locally with a slightly crenulated margin. Aperture with 4-5 lamellae, all short and rather high except the last mentioned: 1 parietalis deep inside; 1 angularis starting at the peristome, 1 upper palatalis starting near the peristome; 1 lower palatalis deep inside; sometimes with a very inconspicuous columellaris. Height 1.6-1.9 mm (1.2-1.45 mm without the downwards pointing part of the last whorl); width 1.75-2 mm. Height aperture 0.6-0.75 mm; width aperture 0.6-0.65 mm.

Distribution. – Vietnam, SW. part, a few limestone hills near Hon Chong; one limestone hill near Ha Tien. Proposed IUCN Threat Category Vulnerable VU A4 D2 (IUCN 2001 Categories & Criteria, v. 3.1); probably somewhat more widespread than the other species described; Bai Voi Hill, the largest hill where the species has been found, will be mined for limestone, but two other hills enjoy some protection as a place of worship.

Notes. – Differs from the only other known species of the genus, *M. proboscidea* Panha & Burch, 1999, from Thailand, in having a much shorter, more abruptly curved downwards free portion of the last whorl, and in having two more teeth in the aperture.

Material found near Ha Tien (2 shells only) has a slightly higher spire and a very inconspicuous, knob shaped columellaris near the peristome. More material is needed to determinine the taxonomic status of these shells; they are here excluded as paratypes.

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