

New Pupillid Species from Thailand (Pulmonata: Pupillidae)

SOMSAK PANHA^{1*}, PIYOROS TONGKERD¹, CHIRASAK SUTCHARIT¹
AND JOHN B. BURCH^{2,3,4}

¹ Department of Biology, Faculty of Science, Chulalongkorn University, Bangkok 10330, THAILAND

² Museum of Zoology ³ Department of Biology, College of Literature, Science and the Arts, and ⁴ School of Natural Resources and Environment, University of Michigan, Ann Arbor, Michigan 48109, U.S.A.

ABSTRACT.—Fifteen new species of pupillid micro land snails from limestone areas of various parts of Thailand are described. They are *Anauchen banmiensis*, *Anauchen smokon*, *Anauchen srakeoensis*, *Aulacospira pluangtong*, *Gyliotrachela khaowongkot*, *Gyliotrachela muangon*, *Gyliotrachela srirachaensis*, *Gyliotrachela tridentatus*, *Hypselostoma utongensis*, *Hypselostoma pattalungensis*, *Hypselostoma satulensis*, *Krobylos kangkoy*, *Krobylos veruwan*, *Krobylos takensis*, *Krobylos tampla*.

Key words: *Anauchen*; *Aulacospira*; *Gyliotrachela*; *Hypselostoma*; *Krobylos*; Pupillidae; Pulmonata; Stylommatophora; Thailand

INTRODUCTION

The recent publication on the Pupillidae of Thailand by Burch et al. (2002) provided the first detailed description which later all nine described species were used in molecular phylogenetic analysis based on nuclear (28S rDNA) and mitochondrial (16S rDNA) ribosomal gene fragments (Tongkerd et al., 2004). The results showed the unquestioned use of apertural dentition characteristics as diagnostic generic characters, imply that ecological transitions can lead to morphological change, and suggest that a comprehensive sampling of both rock and leaf-litter lineages is required to fully flesh out phylogenetic relationships among regional pupillid microsnails. We then have sorted out

the former collected materials and identified. With the current paper we are reporting fifteen more species for Thailand. Each of these species except, *Krobylos takensis*, is known only from its type locality (approximate locations of type localities are shown Fig. 1).

MATERIALS AND METHODS

The descriptions of the shells were made using of an Olympus M5 stereoscopic light microscope, augmented by scanning electron microscope (SEM) pictures. The processes to get shell apertures and the included barriers followed Burch et al. (2002). The species identifications were based mainly on the following papers; Panha (1997a,b); Panha and Burch (1999a,b; 2002) and Burch and Panha (2000); Burch et al. (2002). The decision for species identification in the present paper was also used the recent molecular analytical paper by Tongkerd et al. (2004).

* Corresponding author.

Tel: (662) 218-5273

Fax: (662) 218-5273

E-mail: somsak_panha@yahoo.com

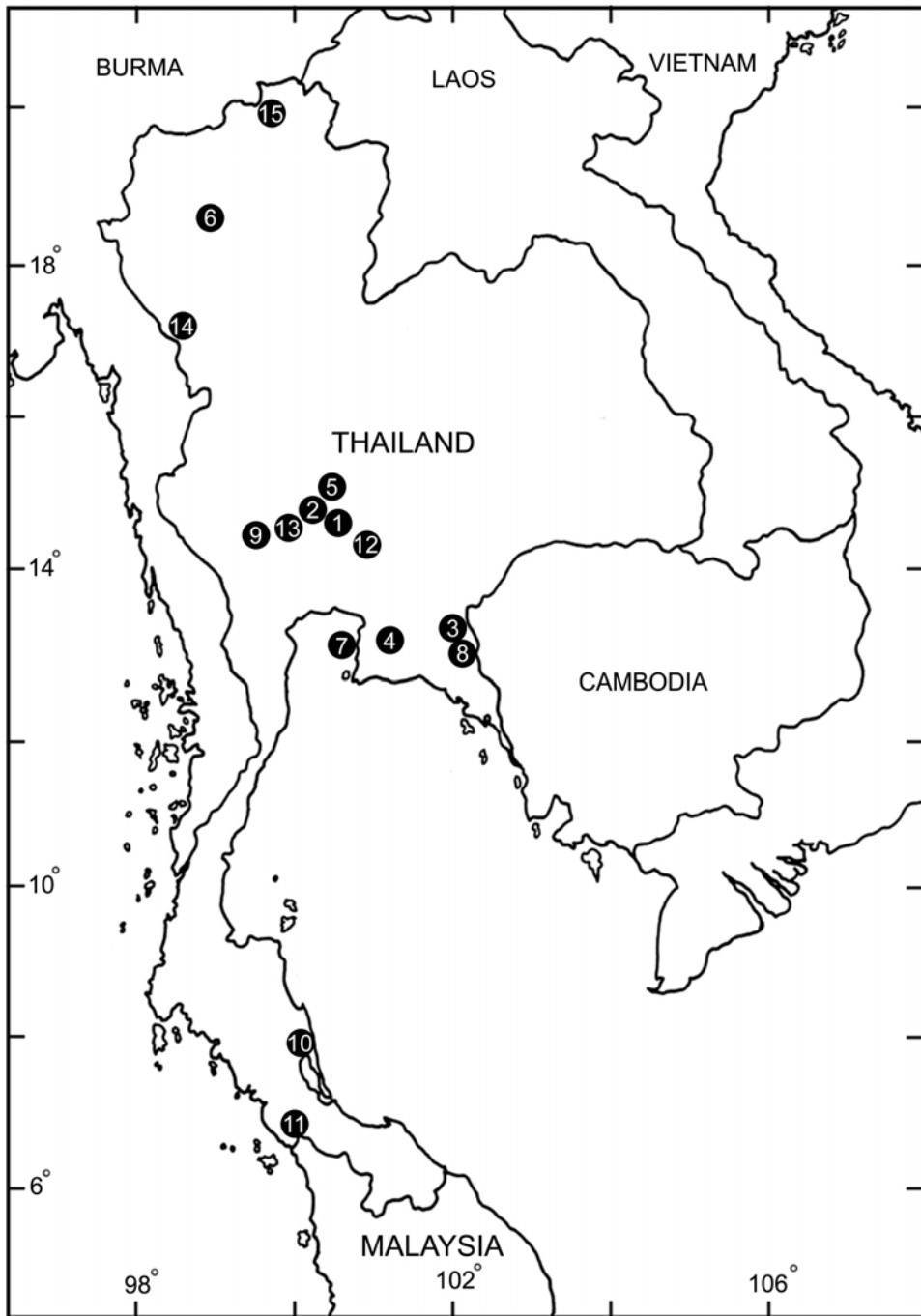


FIGURE 1. Map showing the locations of the type localities of the fifteen pupillid micro land snails described in this paper. 1. *Anauchen banmiensis*; 2. *A. smokon*; 3. *A. srakeoensis*; 4. *Aulacospira pluangtong*; 5. *Gylotrachela khaowongkot*; 6. *G. muangon*; 7. *G. srirachaensis*; 8. *G. tridentatus*; 9. *Hypselostoma utongensis*; 10. *H. pattalungensis*; 11. *H. satulensis*; 12. *Krobylos kangkoy*; 13. *K. veruwan*; 14. *K. takensis*; 15. *K. tampla*.

***Anauchen banmiensis* Panha & Burch n. sp.**

Description of Holotype – The shell (Fig. 2) is small (2.1×2.3 mm; see Table 1), with

4¾ whorls and the entire last whorl is attached to the preceding whorls. The shell is deeply umbilicate. The sutures are well impressed. The peristome is complete, expanded, weakly

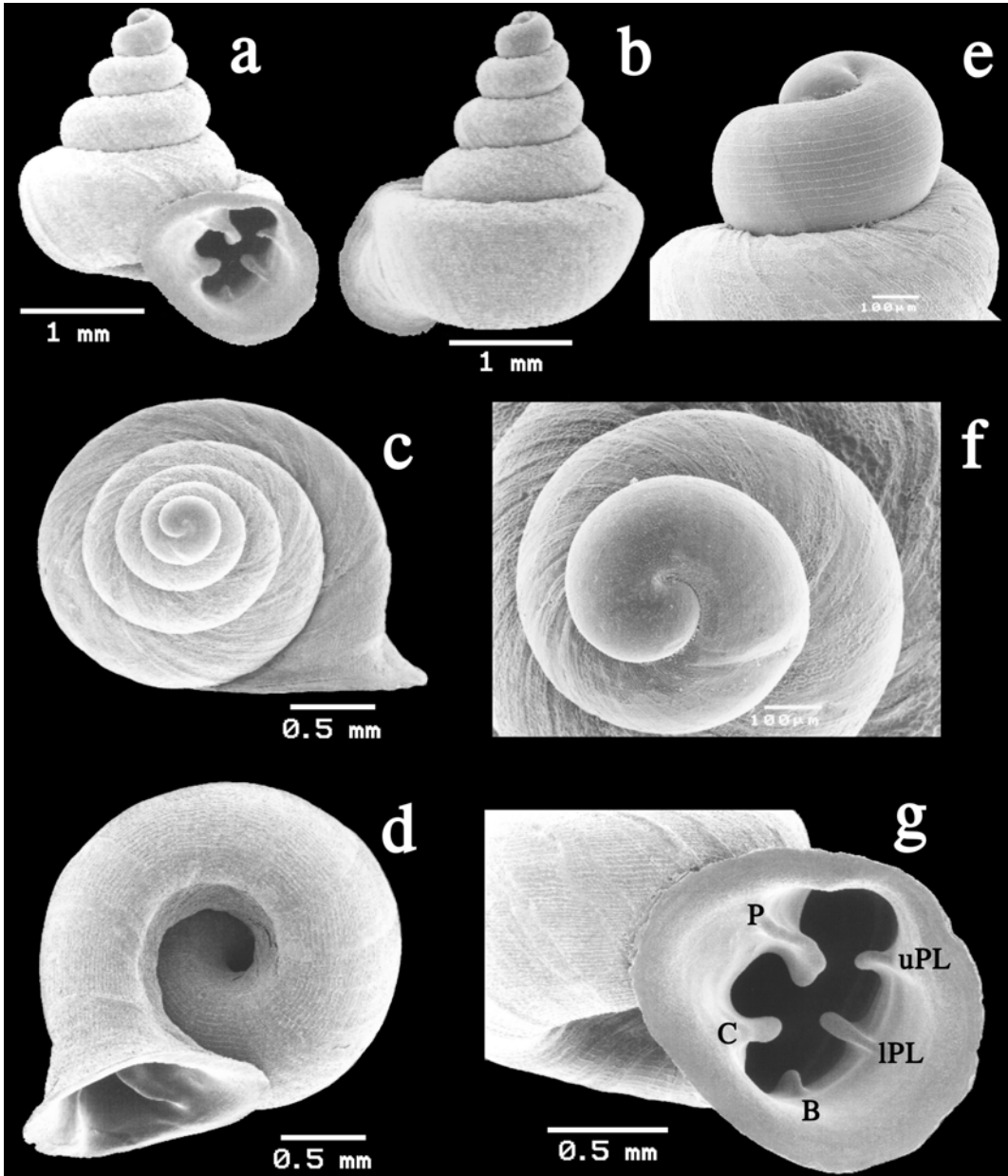


FIGURE 2. *Anauchen banmiensis* n. sp., holotype. **a**, apertural view; **b**, abapertural view; **c**, top view; **d**, ventral view; **e**, vertical position of apical whorls; **f**, horizontal position of apical whorls; **g**, aperture enlarged, lamellae and plicae: B = basal; C = columellar; P = parietal; IPL = lower palatal; uPL = upper palatal.

adnate. The body whorl near the aperture bends slightly downward. The teleconch is quite smooth with indistinct spiral striae. Some indented spiral striae can be seen on the last whorl and the whorls of the umbilicus. The apertural barriers are five, well developed, set back in the aperture from the peristome. The bone-shaped parietal lamella is the most prominent of the barriers. An angular lamella is absent. The columellar lamella enters the aperture perpendicularly (horizontally). The palatal plicae are well developed, about the same height as the parietal and columellar lamella. The basal plica is the smallest of the barriers, but nevertheless well developed.

Type locality – Chang Peuag Cave Mountain, Banmi District, Lopburi Province, 14° 54' 10" N 100° 30' 8" E, 15 meters elevation. *Cryptozona siamensis* (Pfeiffer, 1850) was also found in this habitat.

Type material – The holotype (CUMZ, Ver 44025), leg. S. Panha, is deposited in the Chulalongkorn University Zoological Museum, together with 10 paratype specimens (CUMZ, Ver 44026). Other 6 paratype specimens (CUMZ, Ver 44027) were deposited in the Museum of Zoology, University of Michigan, Ann Arbor, Michigan, U.S.A.

Etymology – The specific epithet *banmiensis* is from the name of Banmi District, the locality of the new species.

Diagnosis – *Anauchen banmiensis* n. sp. looks very close relation to *A. huaykhakang* Panha, 2002, but the shell characteristics of the new species is lower. The bone-shaped parietal lamella is different the club-shaped of *A. huaykhakang*. And the spiral striae of the new species distinctly appeared on the last whorl and the whorls of the umbilicus, while there is no striation appeared in *A. huaykhakang*.

TABLE 1. Shell dimensions (in mm) of *Anauchen banmiensis* n. sp.

Types	Height	Width
Holotype	2.3	2.1
Paratype		
1	2.3	2.1
2	2.3	2.1
3	2.3	2.1
4	2.4	2.1
5	2.4	2.1
6	2.4	2.1
7	2.4	2.1
8	2.4	2.1
9	2.4	2.1
10	2.4	2.1

Anauchen smokon Panha & Burch n. sp.

Description of Holotype – The shell (Fig. 3) is small (2.2×2.5 mm; see Table 2), with 6½ whorls and the last whorl is attached to the preceding whorls but the peristome and a small attached portion are free. The shell is deeply umbilicate. The sutures are well impressed. The peristome is complete, expanded, not adnate. The teleconch is sculptured. The apertural barriers are four, well developed, set back in the aperture from the peristome except the most prominent sharp tip parietal lamella. An angular lamella is absent. The columellar lamella enters the aperture perpendicularly (horizontally). The palatal plicae are well developed in the aperture, about the same height as the parietal and columellar lamella.

Type locality – Smokon Mountain, Banmi District, Lopburi Province, 14° 54' 54" N 100° 29' 45" E, 30 meters elevation. *Cryptozona*

siamensis (Pfeiffer, 1850) was also found in this habitat.

Type material – The holotype (CUMZ, Ver 44043), leg. S. Panha, is deposited in the Chulalongkorn University Zoological Museum,

together with 7 paratype specimens (CUMZ, Ver 44044). Other 6 paratype specimens (CUMZ, Ver 44045) were deposited in the Museum of Zoology, University of Michigan, Ann Arbor, Michigan, U.S.A.

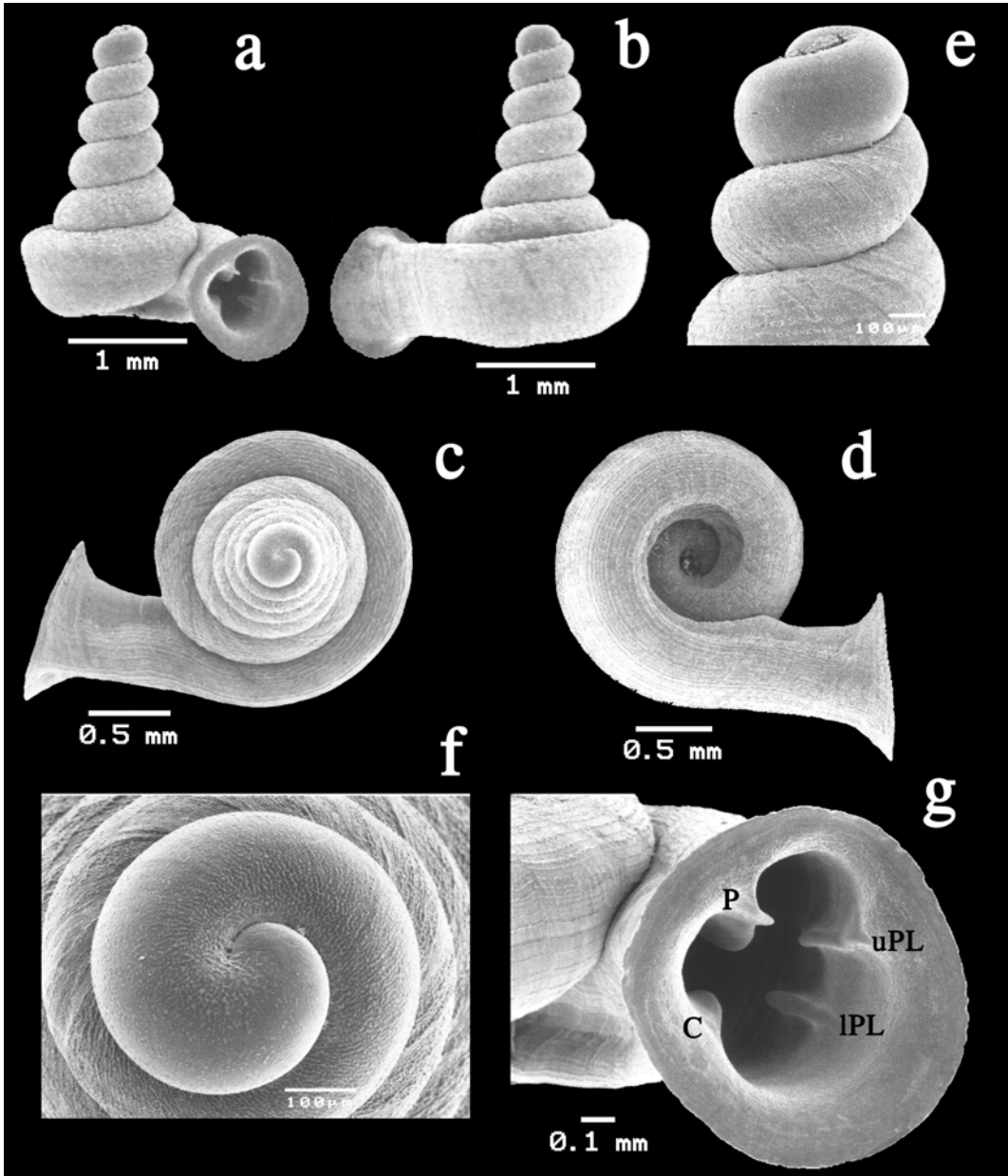


FIGURE 3. *Anauchen smokon* n. sp., holotype. a, apertural view; b, abapertural view; c, top view; d, ventral view; e, vertical position of apical whorls; f, horizontal position of apical whorls; g, aperture enlarged, lamellae and plicae: C = columellar; P = parietal; IPL = lower palatal; uPL = upper palatal.

Etymology – The specific epithet *smokon* is from the name of Smokon Mountain, the place that the new species was collected.

Diagnosis – *Anauchen smokon* n. sp. looks very close relation to *A. chedi* (Panha, 1997), but the shell characteristics of the new species is lower, the tuba is not adnated to the last whorl. The sharp tip parietal lamella is different the club-shaped of *A. chedi*. And the basal plica is absent is the new species.

TABLE 2. Shell dimensions (in mm) of *Anauchen smokon* n.sp.

Types	Height	Width
Holotype	2.2	2.5
Paratype		
1	2.2	2.5
2	2.2	2.5
3	2.2	2.5
4	2.2	2.5
5	2.2	2.5
6	2.2	2.5
7	2.3	2.5

Anauchen srakeoensis Panha & Burch n. sp.

Description of Holotype – The shell (Fig. 4) is small to medium (2.3×3.1 mm; see Table 3), with 3¼ whorls. The free trumpet-shaped of last whorl projecting downward. The shell is deeply umbilicate. The sutures are well impressed. The peristome is complete, expanded, weakly adnate. There is no spiral striation. The apertural barriers are four, well developed, set back in the aperture from the peristome. The parietal lamella is the most prominent of the barriers. The angular lamella is absent. The columellar lamella enters the aperture perpendicularly (horizontally). The palatal plicae are well developed, about the same height as the angular and columellar

lamellae. A tiny parietal plica, one supracolumellar and one subcolumellar are observed, with an interpalatal and three tiny infrapalatal plicae.

Type locality – Plubpluengtong limestone hills, Srakeo Province, 13° 48' 02" N 102° 12' 49" E, 110 meters elevation. *Cryptozonia siamensis* (Pfeiffer, 1850) was also found in this habitat.

Type material – The holotype (CUMZ, Ver 44037), leg. S. Panha, is deposited in the Chulalongkorn University Zoological Museum, together with 9 paratype specimens (CUMZ, Ver 44038). Other 7 paratype specimens (CUMZ, Ver 44039) were deposited in the Museum of Zoology, University of Michigan, Ann Arbor, Michigan, U.S.A.

Etymology – The specific epithet *srakeoensis* is from the name of Srakeo Province, the locality of the new species.

Diagnosis – *Anauchen srakeoensis* n. sp. has similar apertural barriers characteristic as other nominated *Anauchen* species but basal plica is absent. The most prominent character is the trumpet-shaped of last whorl projecting downward.

TABLE 3. Shell dimensions (in mm) of *Anauchen srakeoensis* n. sp.

Types	Height	Width
Holotype	3.1	2.3
Paratype		
1	2.8	2.1
2	2.8	2.1
3	2.9	2.1
4	2.9	2.1
5	2.9	2.1
6	2.9	2.1
7	2.9	2.1
8	3.0	2.2
9	3.1	2.3

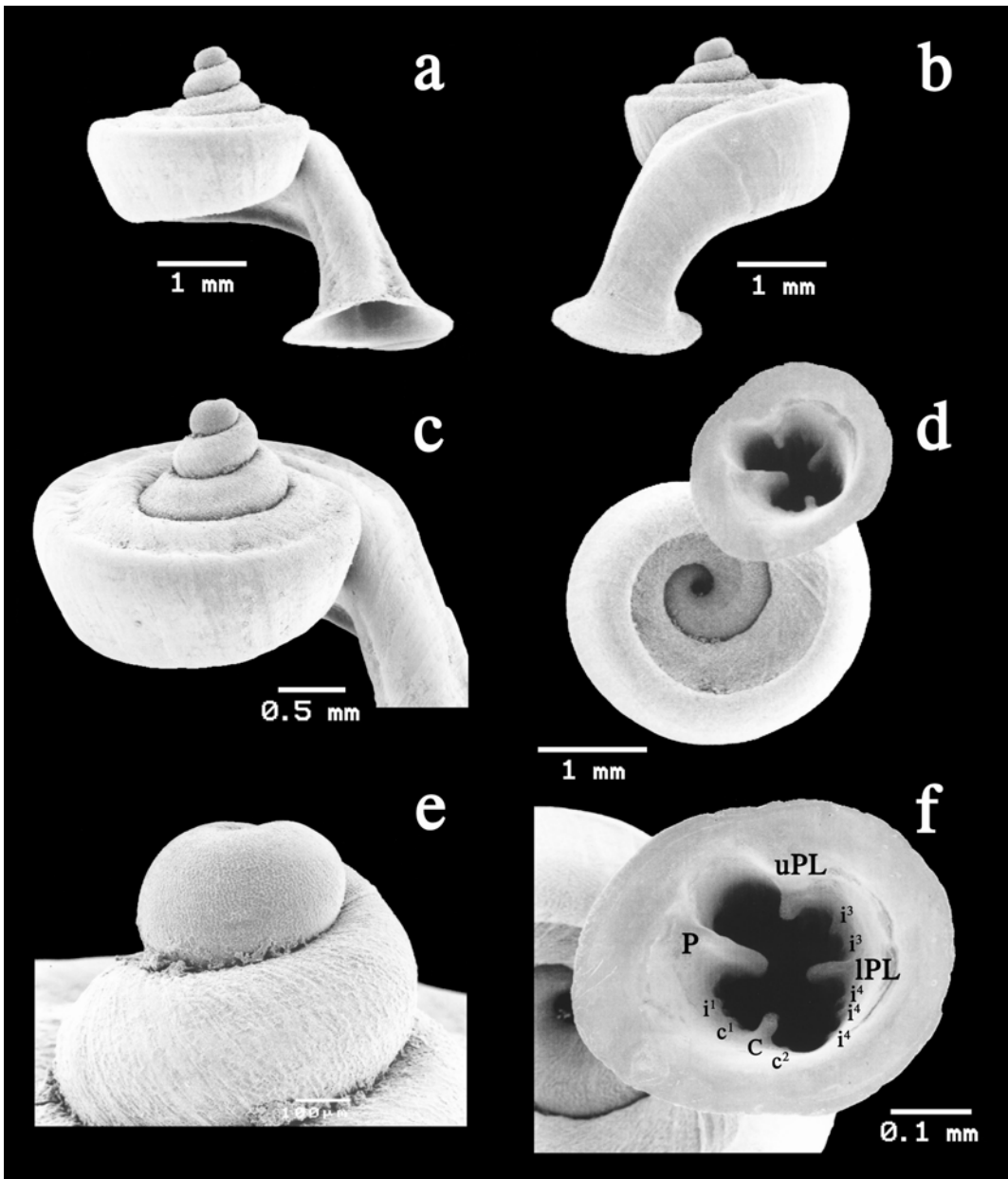


FIGURE 4. *Anauchen srakeoensis* n. sp., holotype. a, apertural view; b, front view; c, apical view; d, ventral view; e, vertical position of apical whorls; f, aperture enlarged, lamellae and plicae: C = columellar; P = parietal; IPL = lower palatal; uPL = upper palatal; c¹ = supracolumellar; c² = subcolumellar; i¹ = infraparietal; i³ = interpalatal; i⁴ = infrapalatal.

***Aulacospira pluangtong* Panha & Burch n. sp.**

Description of Holotype – The shell (Fig. 5) is small (1.8×1.9 mm; see Table 4), with

4¼ whorls and a free apertural a bit projecting downwards. The shell is narrowly umbilicate. The aperture is round, and contains three main distinct apertural barriers, parietal, columellar

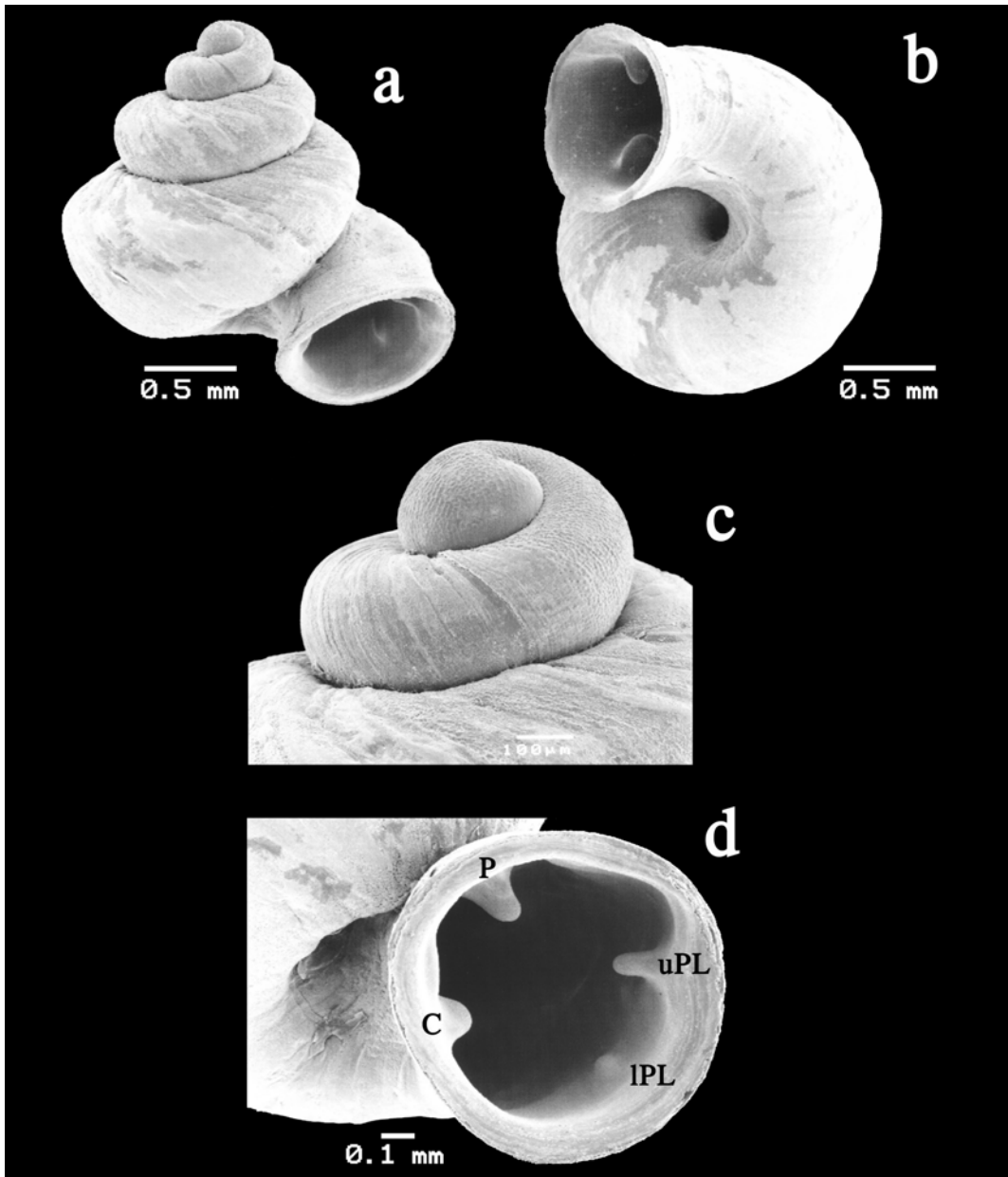


FIGURE 5. *Aulacospira pluangtong* n. sp., holotype. a, apertural view; b, ventral view; c, horizontal position of apical whorls; g, aperture enlarged, lamellae and plicae: C = columellar lamella; P = parietal lamella; IPL = lower palatal; uPL = upper palatal plica.

lamellae and upper palatal plica. There is a small lower palatal plica. All whorls are round with $1\frac{1}{4}$ embryonic whorls.

Type locality – Pluangtong Mountain, Botong District, Chonburi Province, $13^{\circ} 11' 59''$ N $101^{\circ} 34' 49''$ E, 80 meters elevation. *Amphidromus inversus* (Müller, 1774) and *Cryptozona siamensis* (Pfeiffer, 1850) were also found in this habitat.

Type material – The holotype (CUMZ, Ver 44013), leg. S. Panha, is deposited in the Chulalongkorn University Zoological Museum, together with 4 paratype specimens (CUMZ, Ver 44014). Other 3 paratype specimens (CUMZ, Ver 44015) were deposited in the Museum of Zoology, University of Michigan, Ann Arbor, Michigan, U.S.A.

Etymology – The specific epithet *pluangtong* is from the name of Pluangtong Mountain, the locality of the new species.

Diagnosis – *Aulacospira pluangtong* n. sp. looks very close relation to *A. smaesarnensis* Panha and Burch, 1999, but the shell characteristics of the new species is round while of *A. smaesarnensis* has a broad low spiral sulcus above the obtuse peripheral angle begins on the penultimate whorl and become stronger on the ultimate whorl. Aperture has three distinct barriers and a small plica. The peristome is not expanded.

TABLE 4. Shell dimensions (in mm) of *Aulacospira pluangtong* n.sp.

Types	Height	Width
Holotype	1.8	1.9
Paratype		
1	1.8	1.9
2	1.7	1.8
3	1.7	1.8
4	1.7	1.8
5	1.7	1.8
6	1.7	1.8
7	1.7	1.8

Gyliotrachela khaowongkot
Panha & Burch n. sp.

Description of Holotype – The shell (Fig. 6) is small (0.7×2.2 mm; see Table 5), planiturbinate, base flattened, body whorl with a long tuba, ascending, widely umbilicate, with $3\frac{3}{4}$ whorls. The last whorl is remarkably enlarged and exceeded beyond apex. Apex is concave with about 1 whorl embryonic shell. There is spiral sulcus running along ultimate whorl. Peristome continuous thickened, expanded. Apertural dentition performed *Gyliotrachela* characteristic. There are 13 apertural barriers in this specimen. The noticeably larger barriers are angular, parietal, upper and lower palatal and columellar lamellae. On the parietal wall are two additional small barriers-infraparietal lamellae. On the palatal wall are seven barriers-upper and lower palatal plicae, three suprapalatals, one interpalatal, and one infrapalatal. The three suprapalatals and an infrapalatal are situated deeper within the aperture. The largest palatal plicae is the lower palatal plica. One supracolumellar and one subcolumellar lamellae are also observed.

Type locality – Khaowongkot, Ban Mee District, Lopburi Province, $15^{\circ} 1' 13''$ N $100^{\circ} 32' 44''$ E, 60 meters elevation. *Hypselostoma khaowongensis* Panha, 1997 was also found in this habitat.

Type material – The holotype (CUMZ, Ver 44031), leg. S. Panha, is deposited in the Chulalongkorn University Zoological Museum, together with 14 paratype specimens (CUMZ, Ver 44032). Other 10 paratype specimens (CUMZ, Ver 44033) were deposited in the Museum of Zoology, University of Michigan, Ann Arbor, Michigan, U.S.A.

Etymology – The specific epithet *khaowongkot* is from the name of Khaowongkot (Wongkot Mountain), the locality of the new species.

Diagnosis – Shell in general looks superficially very similar to of *Antroapiculus pendulus* Panha

and Burch, 1999 but aperture dentition is of *Gyliotrachela* character. The new species found a very low isolated limestone hills. The sulcus on

ultimate whorl are dominant, large round shape. Trumpet raise up about ninety degree.

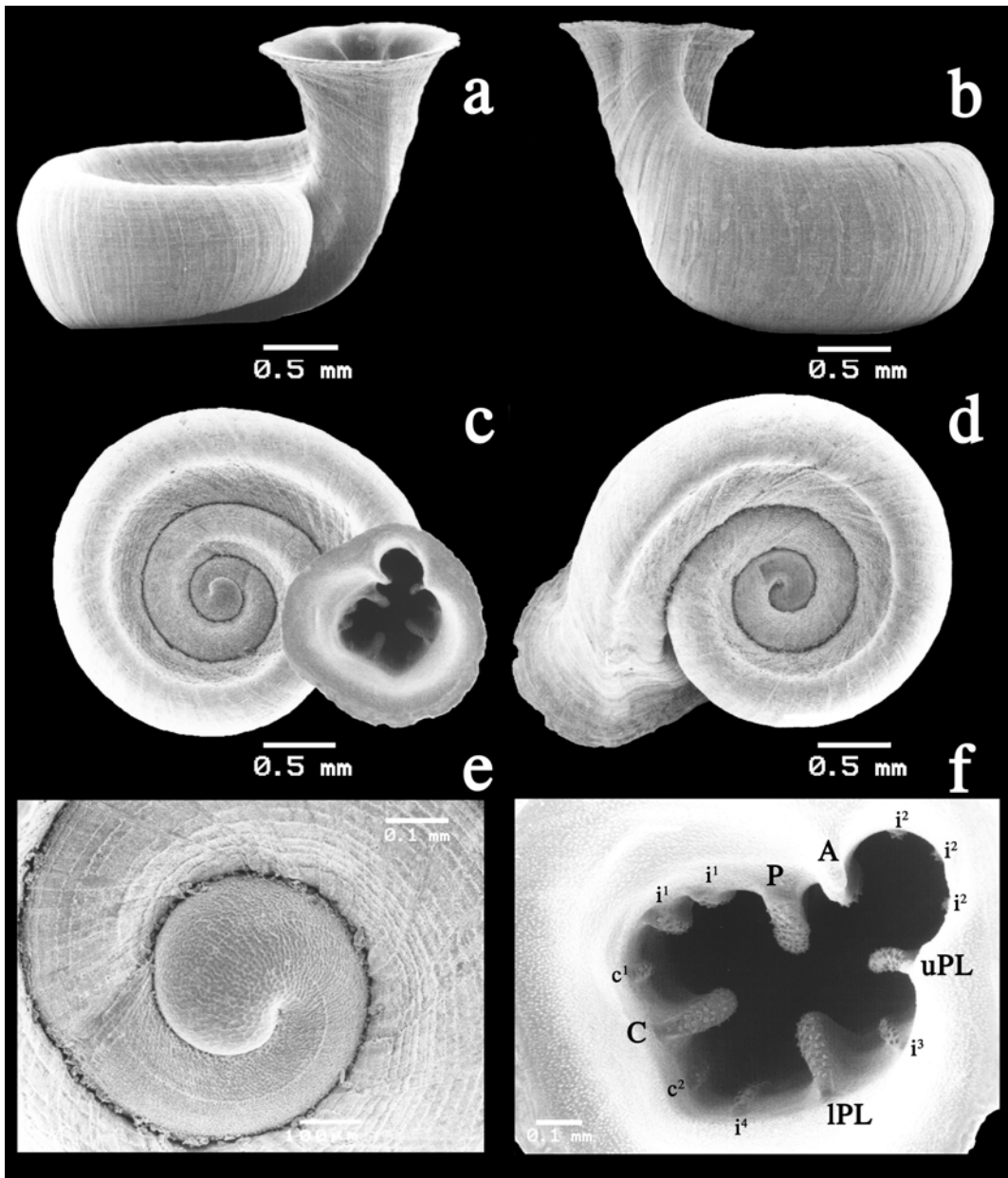


FIGURE 6. *Gyliotrachela khaowongkot* n. sp., holotype. **a**, apertural view; **b**, abapertural view; **c**, top view; **d**, ventral view; **e**, horizontal position of apical whorls; **f**, aperture enlarged, lamellae and plicae: A = angular; C = columellar; P = parietal; IPL = lower palatal plica; uPL = upper palatal; i¹ = supracolumellar; i² = subcolumellar; i¹ = infraparietal; i² = suprapalatal; i³ = interpalatal; i⁴ = infrapalatal.

TABLE 5. Shell dimensions (in mm) of *Gyliotrachela khaowongkot* n.sp.

Types	Height	Width
Holotype	0.7	2.2
Paratype		
1	0.7	2.2
2	0.7	2.2
3	0.7	2.2
4	0.7	2.2
5	0.7	2.2
6	0.7	2.2
7	0.7	2.2
8	0.7	2.2
9	0.7	2.2
10	0.7	2.2
11	0.7	2.2
12	0.6	2.1
13	0.6	2.1
14	0.6	2.1

***Gyliotrachela muangon* Panha & Burch n. sp.**

Description of Holotype – The shell (Fig. 7) is small (1.8×1.3 mm; see Table 6), conical spire, with 3¾ whorls, shape looks close to *Boysidia* or *Paraboysidia* however as from criteria of Burch et al., 2002, this species should be classified in *Gyliotrachela* species. The umbilicus is wide. Shell has radial ribs except at one and half whorls of embryonic shell area of fine granulated and distinct spiral sulcus.

There are two distinct parietal and angular lamella located almost at the peristome edge however the arrangement of both two teeth show character of *Gyliotrachela*. There are also many teeth located a bit inside peristome, exist almost encircled of aperture; one inside angular, parietal and columellar lamellae are observed. There are two tiny infraparietal lamellae on the parietal wall and one small suprapalatal located inside angulo-upper palatal bay. Upper, inter, lower and two infrapalatal plicae are observed.

Type locality – Muangon Cave, San Kam Pang District, Chiangmai Province, 18° 47' 11" N 99° 14' 16" E, 280 meters elevation. *Hypselostoma khaowongensis* Panha, 1997 was also found in this habitat.

Type material – The holotype (CUMZ, Ver 44019), leg. S. Panha, is deposited in the Chulalongkorn University Zoological Museum, together with 5 paratype specimens (CUMZ, Ver 44020). Other 5 paratype specimens (CUMZ, Ver 44021) were deposited in the Museum of Zoology, University of Michigan, Ann Arbor, Michigan, U.S.A.

Etymology – The specific epithet *muangon* is from the name of Muangon Cave, San Kam Pang District, Chiangmai Province, the locality of the new species.

Diagnosis – The new species looks similar to *Acinolaemus ptychochilus* Thompson and Upatham, 1997 but differs clearly by apertural dentitions. Most of *A. ptychochilus* teeth appeared almost at the apertural edge while of the new species most of them located inside aperture except angular lamella and upper palatal plica.

TABLE 6. Shell dimensions (in mm) of *Gyliotrachela muangon* n. sp.

Types	Height	Width
Holotype	1.8	1.3
Paratype		
1	1.9	1.3
2	1.9	1.3
3	1.9	1.3
4	1.8	1.3
5	1.8	1.3
6	1.7	1.2
7	1.7	1.2
8	1.7	1.2
9	1.7	1.2
10	1.7	1.2

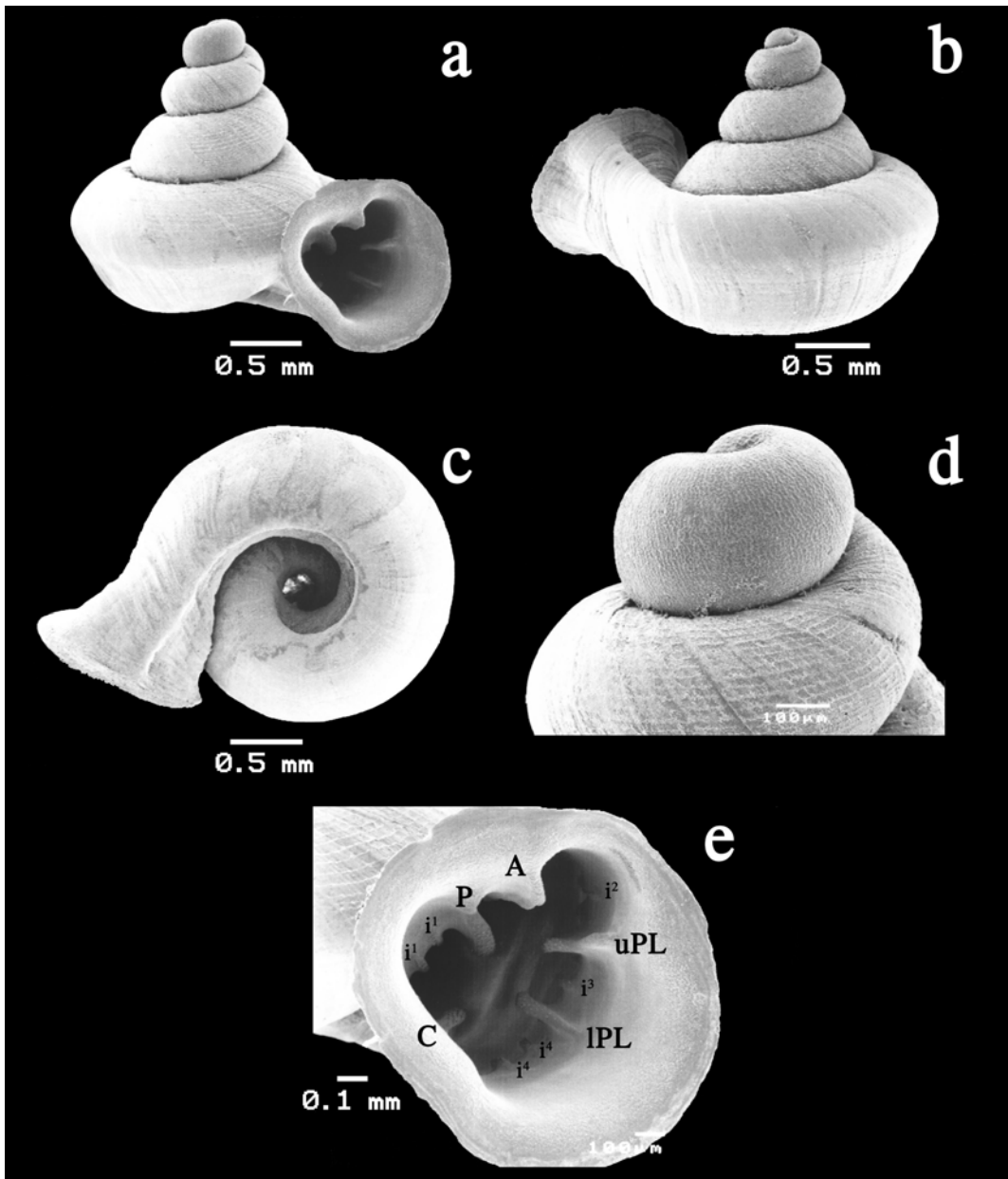


FIGURE 7. *Gylotrachela muangon* n. sp., holotype. a, apertural view; b, abapertural view; c, ventral view; d, horizontal position of apical whorls; e, aperture enlarged, lamellae and plicae: A = angular; C = columellar; P = parietal; IPL = lower palatal; uPL = upper palatal; i¹ = infraparietal; i² = suprapalatal; i³ = interpalatal; i⁴ = infrapalatal.

Gyliotrachela srirachaensis
Panha & Burch n. sp.

Description of Holotype – The shell (Fig. 8) is small (1.7×2.3 mm; see Table 7), conical spire, widely umbilicate, with $6\frac{1}{4}$ whorls. The last whorl is remarkably enlarged with spiral ridges along the whorls except at one and half of embryonic whorl: Peristome continuous thickened expanded. Aperture is oval shape and never adnate to the surface of the last whorl.

There is a character of genus *Gyliotrachela* as described by Burch et al., in 2002, the posterior corner of aperture forming a distinct by bay nearly separated from the main area by

the angular lamella and the upper palatal fold. The new species has other unique apertural barriers which differs from the species described before. There are parietal, angular, infraparietal and columellar lamella, basal plica, lower and upper palatal plica and also small interpalatal plica deeper within aperture.

Type locality – Sichang Island, Sriracha, Chonburi Province, $13^{\circ} 20' 05''$ N $100^{\circ} 55' 24''$ E, 70 meters elevation. *Hypselostoma khaowongensis* Panha, 1997 was also found in this habitat.

Type material – The holotype (CUMZ, Ver 44007), leg. S. Panha, is deposited in the Chulalongkorn University Zoological Museum,

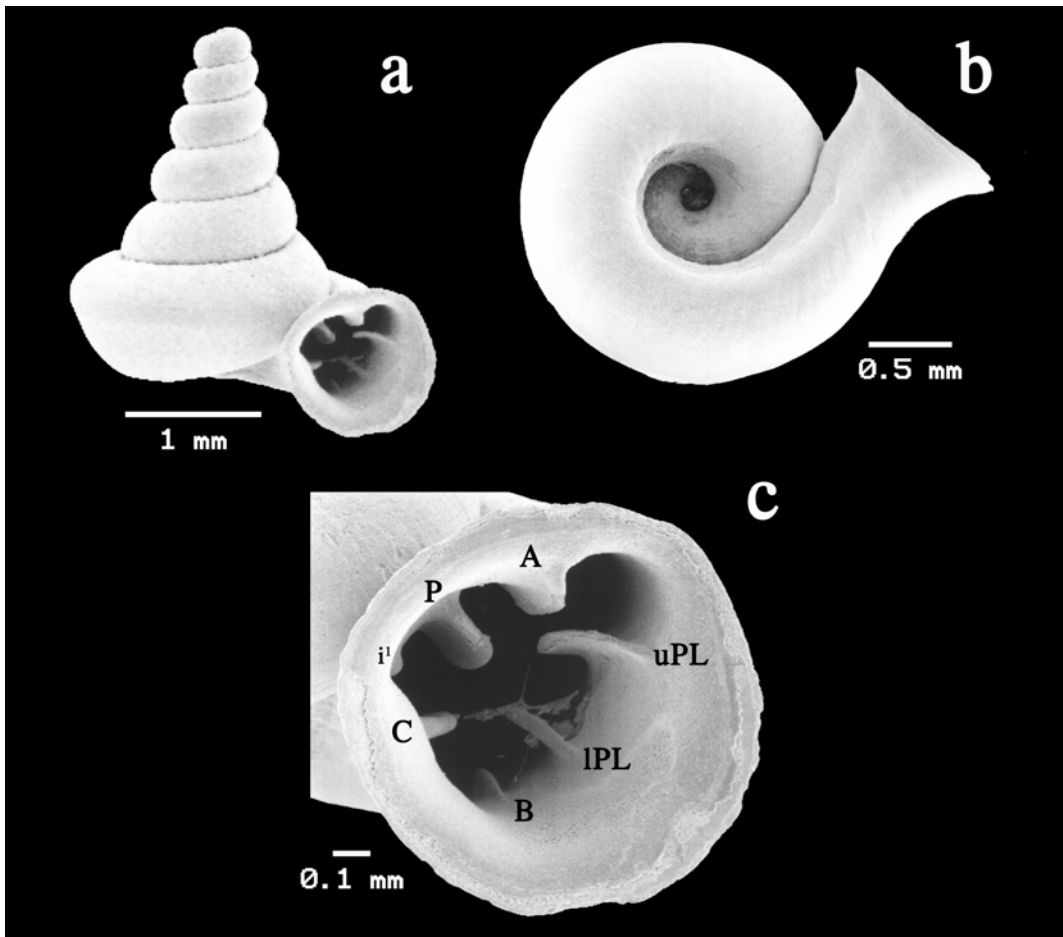


FIGURE 8. *Gyliotrachela srirachaensis* n. sp., holotype. a, apertural view; b, ventral view; c, aperture enlarged, lamellae and plicae: A = angular; B = basal; C = columellar; P = parietal; IPL = lower palatal; uPL = upper palatal; i¹ = infraparietal.

together with 5 paratype specimens (CUMZ, Ver 44008). Other paratype, four specimens (CUMZ, Ver 44009) were deposited in the Museum of Zoology, University of Michigan, Ann Arbor, Michigan, U.S.A.

Etymology – The specific epithet *srirachaensis* is from the name of Sriracha District, the location of Sichang Island, the place that we found the new species.

Diagnosis – The new species looks similar to *Hypselostoma khaowongensis* Panha, 1997 in general shell characteristics but different in body whorl shape of the new species is not round and the apertural dentitions are totally different.

TABLE 7. Shell dimensions (in mm) of *Gyliotrachela srirachaensis* n. sp.

Types	Height	Width
Holotype	1.7	2.3
Paratype		
1	1.7	2.3
2	1.7	2.3
3	1.6	2.3
4	1.6	2.3
5	1.6	2.3
6	1.6	2.3
7	1.6	2.3
8	1.6	2.3
9	1.6	2.3

***Gyliotrachela tridentatus*
Panha & Burch n. sp.**

Description of Holotype – The shell (Fig. 9) is small (2.2×0.9 mm; see Table 8), planiturbinate, base flattened, body whorl with a long tuba, ascending, widely umbilicate, with 3½ whorls. The last whorl is remarkably enlarged and exceeded beyond apex. Apex is concave with about half whorl embryonic shell. There is spiral sulcus running along ultimate

whorl. Peristome continuous thickened, expanded. Apertural dentition performed *Gyliotrachela* characteristic. There are four dominant and one small apertural barriers in this specimen. The noticeably larger barriers are angular, parietal, upper palatal and columellar lamellae. There is one distinct subcolumellar plica.

Type locality – Plubpluengtong limestone hills, Srakeo Province, 13° 27' 07" N 102° 12' 49" E, 80 meters elevation. *Cryptozona siamensis* (Pfeiffer 1850) was also found in this habitat.

Type material – The holotype (CUMZ, Ver 44040), leg. S. Panha, is deposited in the Chulalongkorn University Zoological Museum, together with 8 paratype specimens (CUMZ, Ver 44041). Other 6 paratype specimens (CUMZ, Ver 44042) were deposited in the Museum of Zoology, University of Michigan, Ann Arbor, Michigan, U.S.A.

Etymology – The specific epithet *tridentatus* is from the Greek meaning of three dominant barriers of the new species.

Diagnosis – Shell in general looks superficially very similar to of *Gyliotrachela khaowongkot* n. sp., but totally different in apertural barrier characteristics.

TABLE 8. Shell dimensions (in mm) of *Gyliotrachela tridentatus* n. sp.

Types	Height	Width
Holotype	0.9	2.2
Paratype		
1	0.9	2.2
2	0.9	2.2
3	0.9	2.2
4	0.9	2.2
5	0.9	2.2
6	1.0	2.2
7	1.0	2.2
8	1.0	2.2

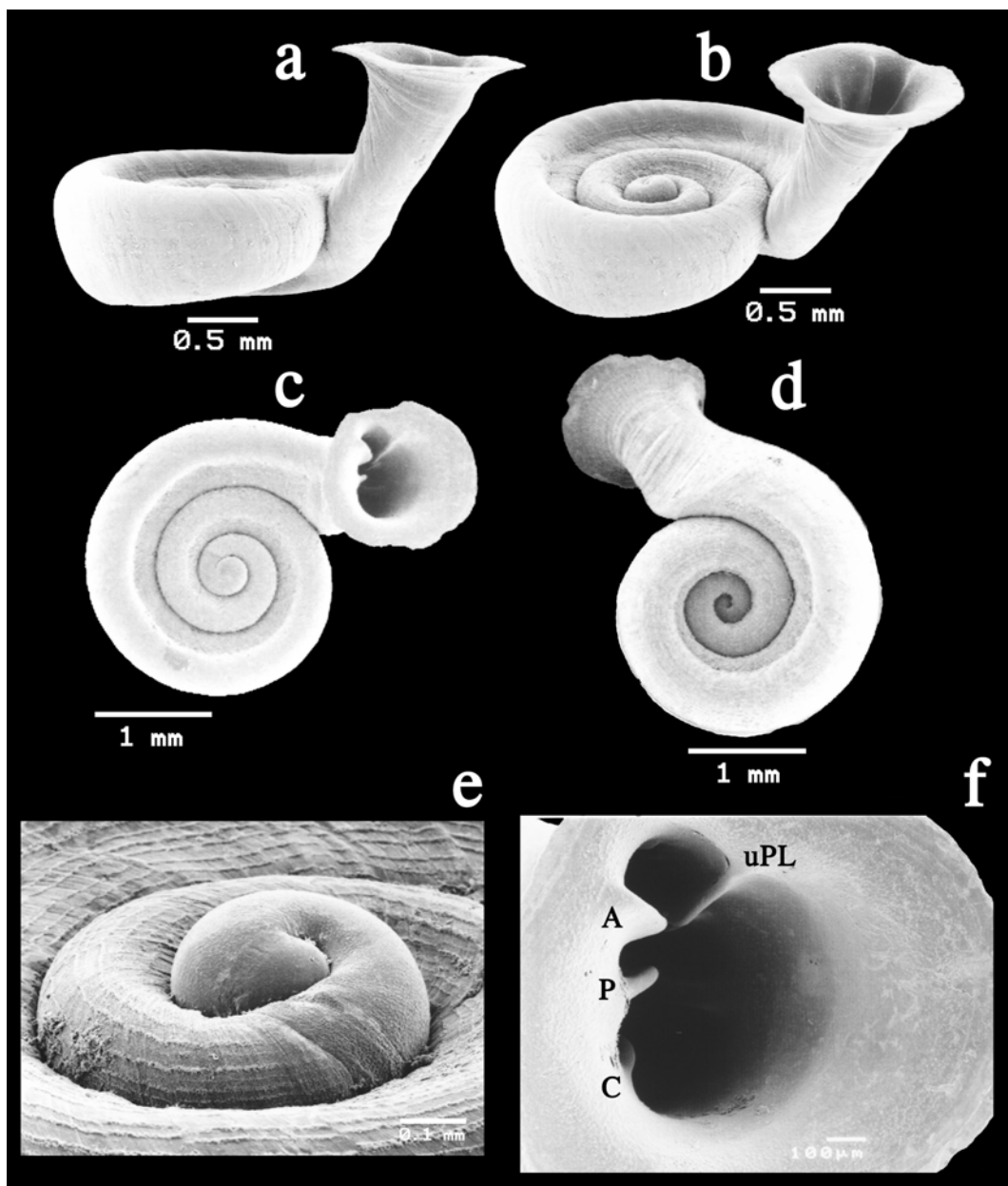


FIGURE 9. *Gylotrachela tridentatus* n. sp., holotype. **a**, apertural view; **b**, apertural view showing apical whorls; **c**, top view; **d**, ventral view; **e**, horizontal position of apical whorls; **f**, aperture enlarged, lamellae and plicae: A = angular; C = columellar; P = parietal; uPL = upper palatal.

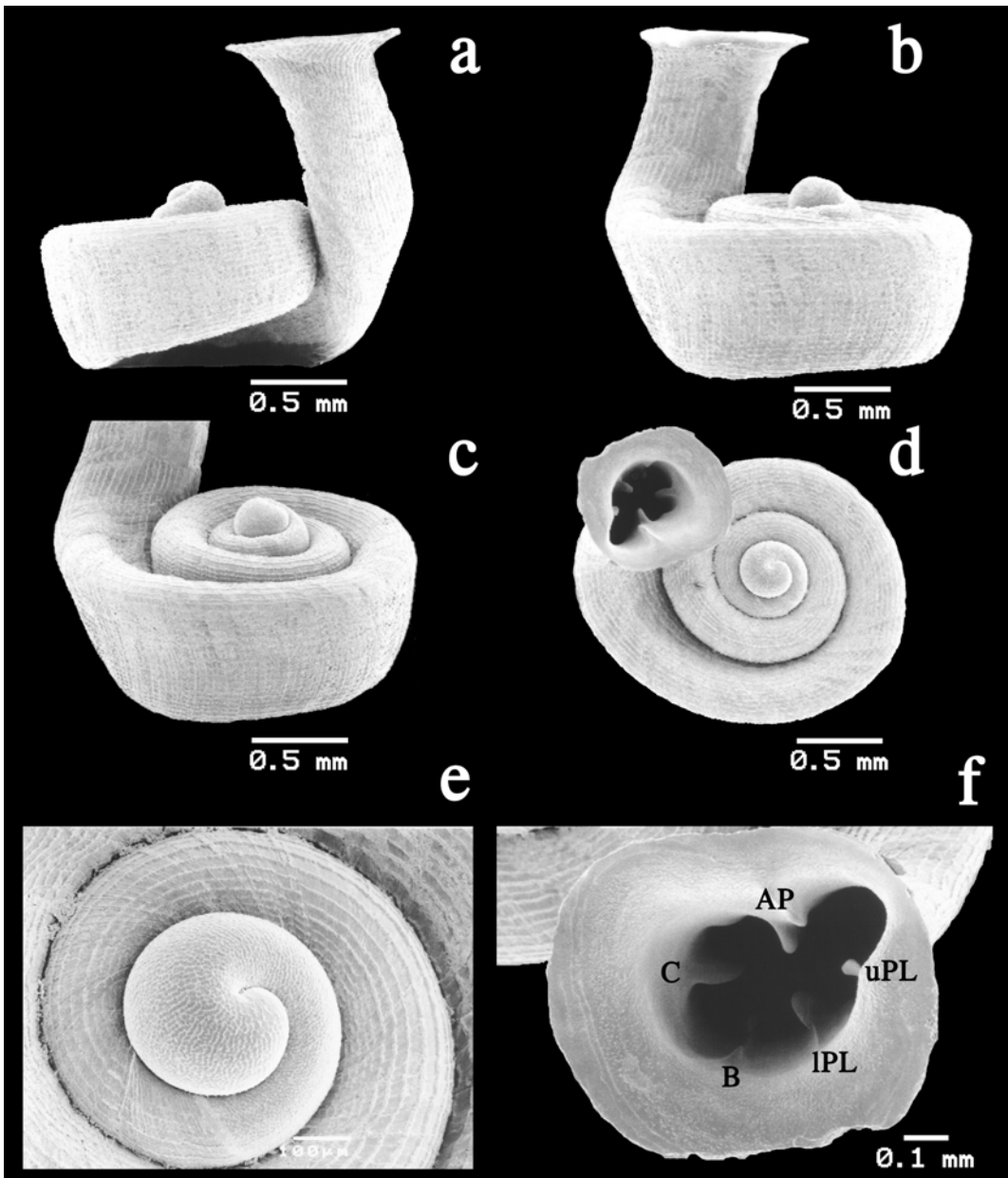


FIGURE 10. *Hypselostoma utongensis* n. sp., holotype. **a**, apertural view; **b**, abapertural view; **c**, abapertural view focusing apex to the body whorl; **d**, top view; **e**, horizontal position of apical whorls; **f**, aperture enlarged, lamellae and plicae: A = angular; B = basal; C = columellar; P = parietal; IPL = lower palatal; uPL = upper palatal.

Hypselostoma utongensis
Panha & Burch n. sp.

Description of Holotype – The shell (Fig. 10) is small (1.0×1.8 mm; see Table 9), after embryonic shell, whorls increase horizontally never progress upwards. Embryonic shell sculpture is about one and half whorls. The next whorl sculpture arrangement has spiral ridges running along until last whorl. Last whorl ascends perpendicularly 1 mm over apex. Peristome continuous thickened expanded. There are six major teeth in the shell aperture. The parietal and angular lamellae are not separated. The angular is smaller than parietal lamella. There are one upper palatal and one lower palatal folds, one basal fold and one columellar lamella. All teeth are smooth.

Type locality – Tam Sua Hill, Utong District, Supanburi Province, $14^{\circ} 34' 27''$ N $99^{\circ} 46' 26''$ E, 80 meters elevation. *Anauchen chatnareeae* Panha and Burch, 2002 was also found in this habitat.

Type material – The holotype (CUMZ, Ver 44004), leg. S. Panha, is deposited in the Chulalongkorn University Zoological Museum, together with 4 paratype specimens (CUMZ, Ver 44005). Other paratype, four specimens (CUMZ, Ver 44006) were deposited in the Museum of Zoology, University of Michigan, Ann Arbor, Michigan, U.S.A.

Etymology – The specific epithet *utongensis* is from the name of Utong District, the locality of the new species.

Diagnosis – Shell with spiral ridges sculpture except at one and half embryonic shell area. The shell is look similar to *Gylotrachela erawan* Panha & Burch, 2002 in general. However apertural dentitions are distinctly different with lower number in the new species. The columellar lamella, upper and lower palatal plica and a basal lamella are dominant in the new species.

TABLE 9. Shell dimensions (in mm) of *Hypselostoma utongensis* n. sp.

Types	Height	Width
Holotype	1.0	1.8
Paratype		
1	1.0	1.8
2	1.0	1.8
3	1.0	1.8
4	1.0	1.7
5	1.0	1.7
6	1.0	1.7
7	1.0	1.7
8	1.0	1.7

Hypselostoma pattalungensis
Panha & Burch n. sp.

Description of Holotype – The shell (Fig. 11) is small (1.7×1.7 mm; see Table 10), conical spire, widely umbilicate, with $3\frac{3}{4}$ whorls. Last whorl has two times larger than penultimate whorl, and divided into larger upper part and smaller lower part. Tuba is almost half of last whorl length. Umbilicus is widely opened. There are six major apertural barriers, the angulo-parietal lamellae are concrescent, columellar, basal, lower palatal and upper palatal lamellae. A tiny infraparietal are also observed deeper within aperture.

Type locality – Ko Si Ko Ha (Ko Na Thewada), Limestone Hill, Pattalung Province.

Type material – The holotype (CUMZ, Ver 44034), leg. S. Panha, is deposited in the Chulalongkorn University Zoological Museum, together with 6 paratype specimens (CUMZ, Ver 44035). Other 3 paratype specimens (CUMZ, Ver 44036) were deposited in the Museum of Zoology, University of Michigan, Ann Arbor, Michigan, U.S.A.

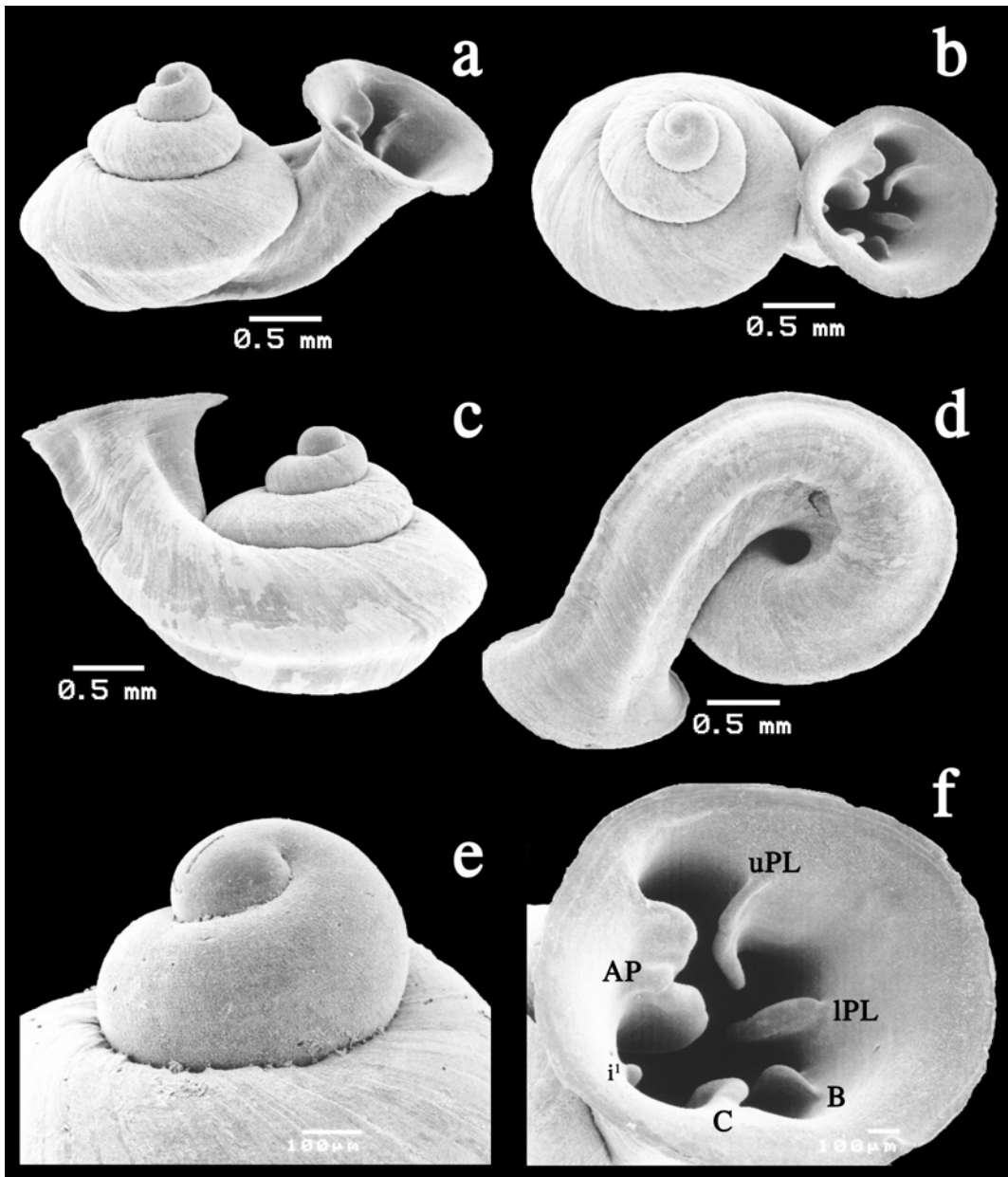


FIGURE 11. *Hypselostoma pattalungensis* n. sp., holotype. **a**, apertural view; **b**, top view; **c**, abapertural view; **d**, ventral view; **e**, vertical position of apical whorls; **f**, aperture enlarged, lamellae and plicae: AP = angulo-pareital; B = basal; C = columellar; IPL = lower palatal; uPL = upper palatal; i^1 = infraparietal.

Etymology – The specific epithet *pattalungensis* is from the name of Pattalung Province, the locality of the new species.

Diagnosis – Shell of the new species looks very close *Gyliotrachela surakiti* Panha and

Burch, 2002. In comparison, the new species has tuba ascending 45 degree up to the same level of apex, and aperture is oblique at also about 45 degree. Aperture is almost rounded, expanded.

TABLE 10. Shell dimensions (in mm) of *Hypselostoma pattalungensis* n. sp.

Types	Height	Width
Holotype	1.7	1.7
Paratype		
1	1.7	1.7
2	1.7	1.7
3	1.7	1.7
4	1.7	1.7
5	1.8	1.7
6	1.8	1.7

Hypselostoma satulensis
Panha & Burch n. sp.

Description of Holotype – The shell (Fig. 12) is small (3.2×2.4 mm; see Table 11), conical spire, widely umbilicate, with 4¾ whorls, gradually increase size. Ultimate whorl is the largest. Peristome continuous thickened expanded, tilted a little bit downwards. Aperture is not adnate to the surface of the last whorl. There are five major apertural barriers. Parietal and angular lamellae are connected and perform clearly the character of *Hypselostoma*. One lower palatal, an upper palatal plicae, and

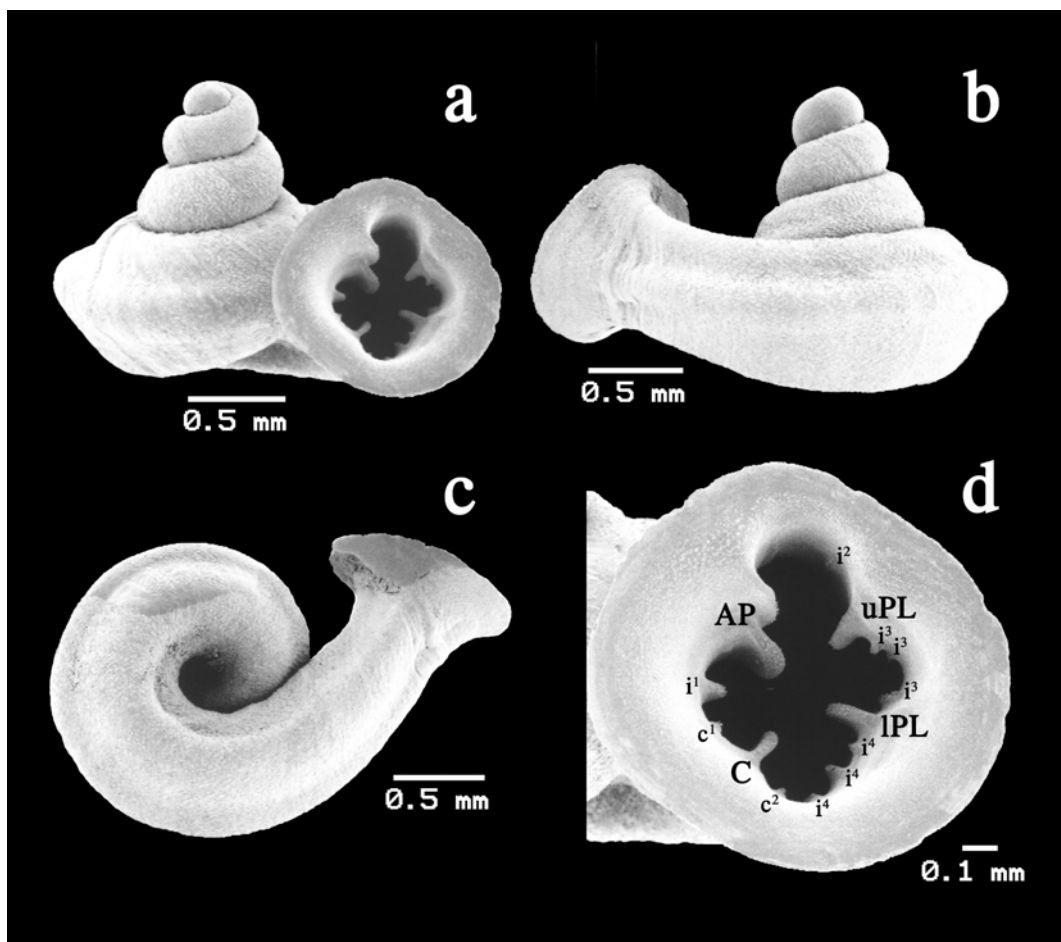


FIGURE 12. *Hypselostoma satulensis* n. sp., holotype. **a**, apertural view; **b**, abapertural view; **c**, ventral view; **d**, aperture enlarged, lamellae and plicae: AP = angulo-pareital; C = columellar; IPL = lower palatal plica; uPL = upper palatal; c¹ = supracolumellar; c² = subcolumellar; i¹ = infraparietal; i² = suprapalatal; i³ = interpalatal; i⁴ = infrapalatal.

columellar lamella are appeared. Infraparietal, supracolumellar and subcolumellar are presented. Small supra, inter and infra palatal folds are also observed.

Type locality – Kuankalong Limestone Hill, Satul Province, 6° 52' 59" N 100° 07' 38" E, 110 meters elevation. *Gyliotrachela khaochongensis* Panha, 1997 was also found in this habitat.

Type material – The holotype (CUMZ, Ver 44028), leg. S. Panha, is deposited in the Chulalongkorn University Zoological Museum, together with 3 paratype specimens (CUMZ, Ver 44029). Other 3 paratype specimens (CUMZ, Ver 44030) were deposited in the Museum of Zoology, University of Michigan, Ann Arbor, Michigan, U.S.A.

Etymology – The specific epithet *satulensis* is from the name of Satul Province, the locality of the new species.

Diagnosis – Shell of the new species looks very close *Anauchen* spp. but the apertural dentitions are the character of *Hypselostoma*. The pattern looks alike of *Acinolaemus ptychochilus* Thompson and Upatham, 1997, however angular and parietal lamellae are not separated and very prominent. Upper and lower palatal fold and columellar fold are also great prominent.

TABLE 11. Shell dimensions (in mm) of *Hypselostoma satulensis* n. sp.

Types	Height	Width
Holotype	3.2	2.4
Paratype		
1	3.2	2.4
2	3.2	2.4
3	3.2	2.4
4	3.2	2.4
5	3.2	2.4
6	3.2	2.4

Krobylos kangkoy Panha & Burch n. sp.

Description of Holotype – The shell (Fig. 13) is small (2.3×2.8 mm; see Table 12), with 3¾ whorls. The whorls expand rapidly, with the last whorl being especially large and inflated. The last two whorls are weakly angular. The sutures are well defined and deep. The peristome is oval in shape, sharp, not expanded or thickened and not reflected, except at the columellar margin which almost covers the umbilicus. The aperture lacks barrier.

Type locality – An isolated limestone Hill, Kangkoy District, Saraburi Province, 14° 41' 25" N 101° 05' 30" E, 10 meters elevation. *Gyliotrachela khaowongensis* Panha, 1997 was also found in this habitat.

Type material – The holotype (CUMZ, Ver 44046), leg. S. Panha, is deposited in the Chulalongkorn University Zoological Museum, together with 3 paratype specimens (CUMZ, Ver 44047). Other 3 paratype specimens (CUMZ, Ver 44048) were deposited in the Museum of Zoology, University of Michigan, Ann Arbor, Michigan, U.S.A.

Etymology – The specific epithet *kangkoy* is from the name of Kang Koy District, the locality of the new species.

Diagnosis – Shell of the new species looks very close to *Krobylos pomjuk* Panha and Burch, 2002, but the new species has more flatter shell, and smaller whorl numbers.

TABLE 12. Shell dimensions (in mm) of *Krobylos kangkoy* n. sp.

Types	Height	Width
Holotype	1.8	2.1
Paratype		
1	1.8	2.1
2	1.8	2.1
3	1.8	2.1

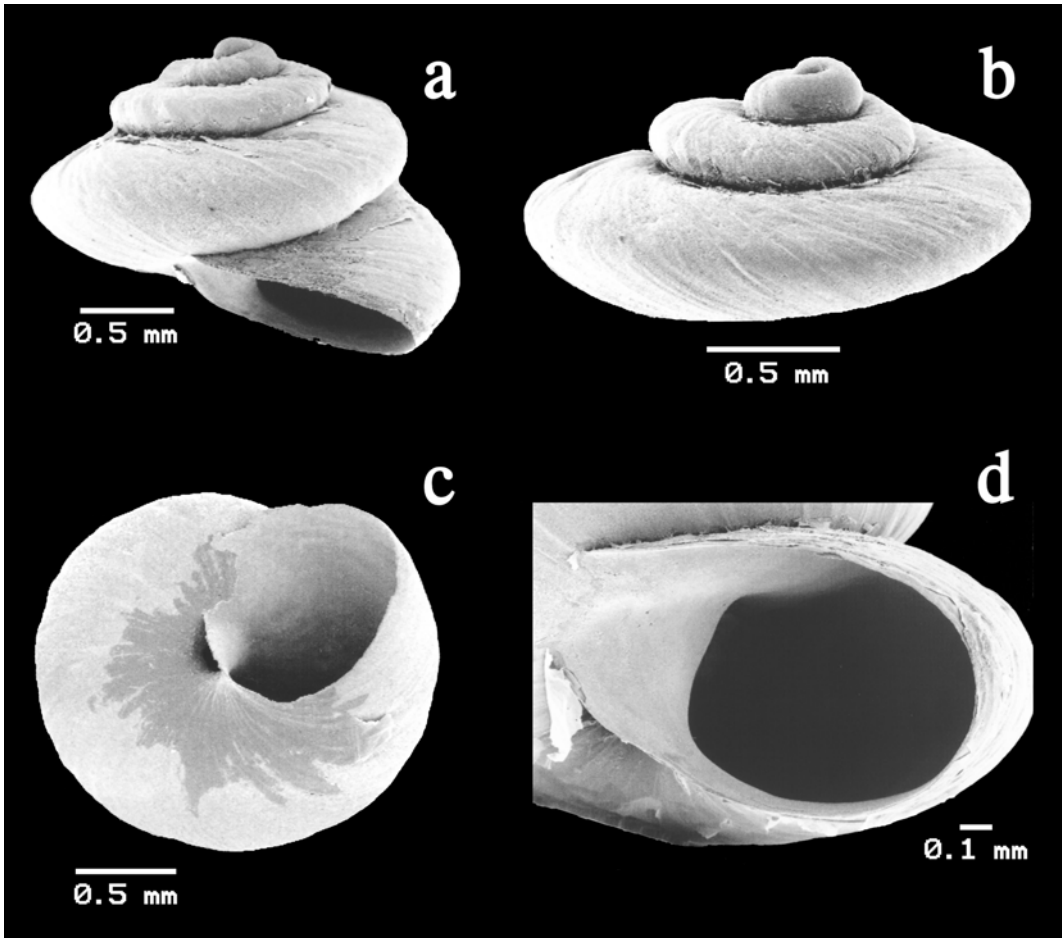


FIGURE 13. *Krobylos kangkoy* n. sp., holotype. a, apertural view; b, abapertural view; c, ventral view; d, aperture enlarged.

***Krobylos veruwan* Panha & Burch n. sp.**

Description of Holotype – The shell (Fig. 14) is small (1.2×1.5 mm; see Table 13), with 4¼ whorls. The whorls gradually expanded. The last three whorls have a pronounced peripheral angulation. The sutures are well defined and deep. The peristome is more or less round shape, sharp, not expanded or thickened and not reflected, except at the columellar margin which almost covers the umbilicus. The aperture lacks barrier.

Type locality – Veruwan Cave, Danchang District, Suphanburi Province, 14° 57' 08" N 100° 15' 30" E, 30 meters elevation. .

Type material – The holotype (CUMZ, Ver 44049), leg. S. Panha, is deposited in the Chulalongkorn University Zoological Museum, together with 5 paratype specimens (CUMZ, Ver 44050). Other 3 paratype specimens (CUMZ, Ver 44051) were deposited in the Museum of Zoology, University of Michigan, Ann Arbor, Michigan, U.S.A.

Etymology – The specific epithet *veruwan* is from the name of Veruwan District, the locality that the new species was collected.

Diagnosis – Shell of the new species looks very close to *Krobylos maehongsonensis* Panha

and Burch, 2002, but the shell of the new species is lower with less whorl numbers, and the outside last whorl near the aperture has a deep spiral sulcus run about $\frac{1}{4}$ of last whorl.

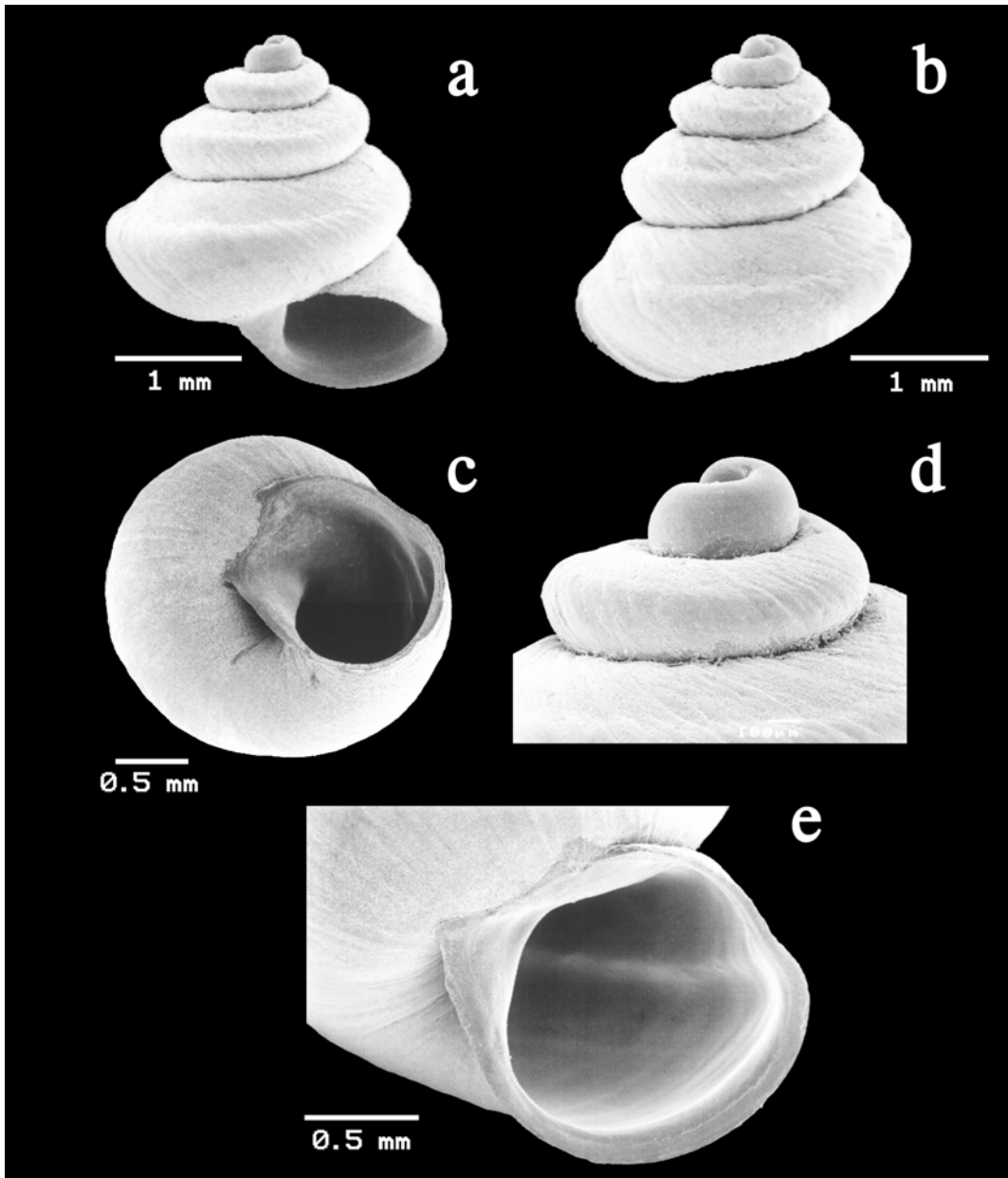


FIGURE 14. *Krobylos veruwan* n. sp., holotype. a, apertural view; b, abapertural view; c, ventral view; d, horizontal position of apical whorl; e, aperture enlarged.

TABLE 13. Shell dimensions (in mm) of *Krobylos veruwan* n. sp.

Types	Height	Width
Holotype	1.5	1.2
Paratype		
1	1.5	1.2
2	1.5	1.2
3	1.5	1.2
4	1.5	1.2
5	1.5	1.2

***Krobylos takensis* Panha & Burch n. sp.**

Description of Holotype – The shell (Fig.

15) is small (1.3×1.7 mm; see Table 14), with $5\frac{1}{4}$ whorls. The whorls is gradually expanded. The last two whorls have a pronounced peripheral angulation. The sutures are well defined and deep. The peristome is rounded shape, sharp, not expanded or thickened and not reflected, except at the columellar margin which almost covers the umbilicus. The aperture lacks barrier.

Type locality – An isolated limestone Hill near Wat Prabat, Samngao District, Tak Province, $17^{\circ} 14' 51''$ N $98^{\circ} 56' 21''$ E, 80 meters elevation. *Gyliotrachela khaowongensis* Panha, 1997 was also found in this habitat.

Type material – The holotype (CUMZ, Ver 44052), leg. S. Panha, is deposited in the

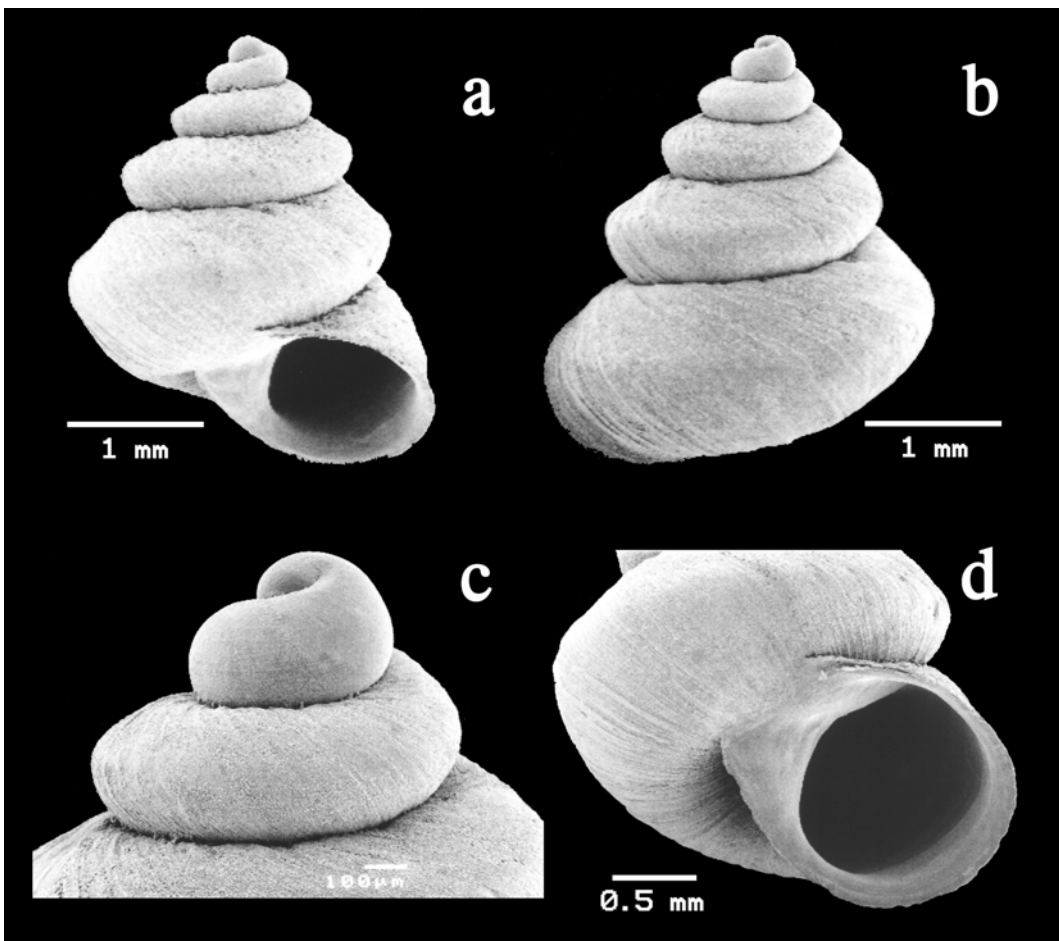


FIGURE 15. *Krobylos takensis* n. sp., holotype. a, apertural view; b, abapertural view; c, horizontal position of apical whorl; d, aperture enlarged.

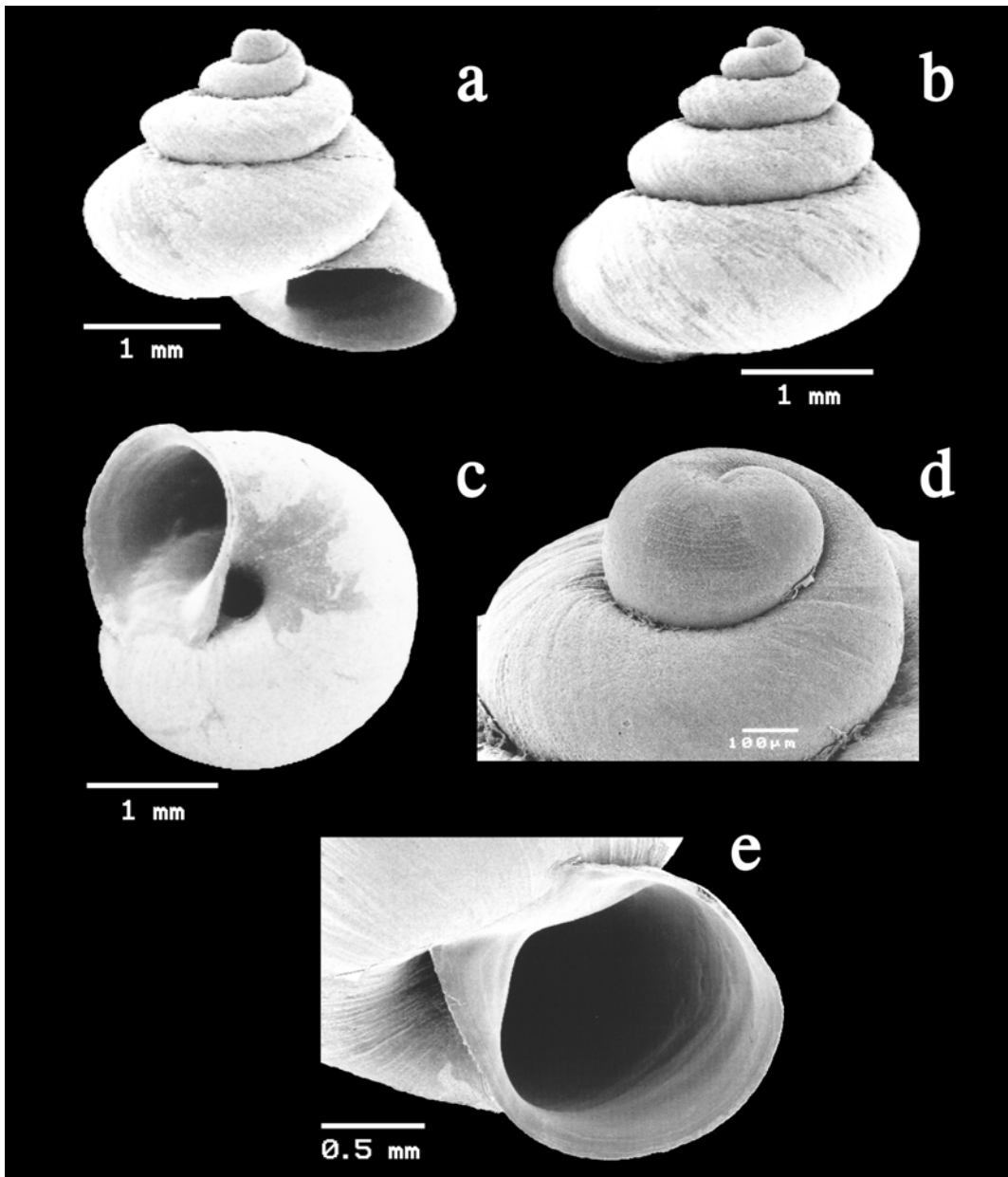


FIGURE 16. *Krobylos tampla* n. sp., holotype. a, apertural view; b, abapertural view; c, ventral view; d, horizontal position of apical whorl; e, aperture enlarged.

Chulalongkorn University Zoological Museum, together with 3 paratype specimens (CUMZ, Ver 44053). Other 3 paratype specimens (CUMZ, Ver 44054) were deposited in the

Museum of Zoology, University of Michigan, Ann Arbor, Michigan, U.S.A.

Etymology – The specific epithet *takensis* is from the name of Tak Province, the locality of the new species.

Diagnosis – Shell of the new species looks very close to *Krobylos maehongsonensis* Panha and Burch 2002, but the new species has more steep whorl arrangement, and larger whorl numbers.

TABLE 14. Shell dimensions (in mm) of *Krobylos takensis* n. sp.

Types	Height	Width
Holotype	1.7	1.3
Paratype		
1	1.7	1.3
2	1.7	1.3
3	1.7	1.3

***Krobylos tampla* Panha & Burch n. sp.**

Description of Holotype – The shell (Fig. 16) is small (1.3×1.4 mm; see Table 15), with 3¾ whorls. The whorls expand rapidly, with the last whorl being especially large and almost inflated. The last two whorls are weakly angular. The sutures are well defined and deep. The peristome is semi-oval in shape, sharp, not expanded or thickened and not reflected, except at the columellar margin which covers a half portion of the umbilicus. The aperture lacks barrier.

Type locality – Tam Pla (Fish Cave), Maesai District, Chiangrai Province, 20° 19' 44" N 99° 51' 48" E, 10 meters elevation. *Gylotrachela khaowongensis* Panha, 1997 was also found in this habitat.

Type material – The holotype (CUMZ, Ver 44055), leg. S. Panha, is deposited in the Chulalongkorn University Zoological Museum, together with 3 paratype specimens (CUMZ, Ver 44056). Other 2 paratype specimens (CUMZ, Ver 44057) were deposited in the Museum of Zoology, University of Michigan, Ann Arbor, Michigan, U.S.A.

Etymology – The specific epithet *tampla* is from the name of Tam Pla (Fish Cave), the locality which the new species was collected.

Diagnosis – Shell of the new species places in between the two species, *Krobylos pomjuk* Panha and Burch 2002 and *K. maehongsonensis* Panha and Burch 2002.

TABLE 15. Shell dimensions (in mm) of *Krobylos tampla* n. sp.

Types	Height	Width
Holotype	1.4	1.3
Paratype		
1	1.4	1.3
2	1.4	1.3
3	1.4	1.3

ACKNOWLEDGEMENT

The research was supported by a grant from Biodiversity Research and Training Programme (BRT 245005).

LITERATURE CITED

- Burch, J. B., Panha, S. and Tongkerd, P. 2002. New taxa of Pupillidae (Pulmonata: Stylommatophora) from Thailand. *Walkerana*, 13: 129-187.
- Burch, J. B. and Panha, S. 2000. The pupillid genus *Anauchen* in Thailand (Pulmonata: Stylommatophora). *Walkerana*, 11: 239-248.
- Panha, S. 1997a. Three new species of microsnails from southern Thailand (Pulmonata: Vertiginidae : Prosobranchia: Diplommatinidae). *Malacological Review*, 30: 53-59.
- Panha, S. 1997b. Three new species of *Hypselostoma* from Thailand (Pulmonata: Vertiginidae). *Malacological Review*, 30: 61-69.
- Panha, S. and Burch, J. B. 1999a. New taxa of Pupillidae (Pulmonata: Stylommatophora) from Thailand. *Walkerana*, 10: 113-134.
- Panha, S. and Burch, J. B. 1999b. Two new genera of pupillid land snails from Thailand (Pulmonata: Pupillidae: Gastrocoptinae). *Malacological Review*, 31/32: 143-153.
- Panha, S. and Burch, J. B. 2002. New pupioid land snails from Thailand (Pulmonata: Pupillidae). *The Natural History Journal of Chulalongkorn University*, 2: 21-24.

- Thompson, F. G. and Upatham, E. S. 1997. Vertiginid land snails from Thailand (Gastropoda, Pulmonata, Pupilloidea). Bulletin of the Florida Museum of Natural History, 39: 221-245.
- Tongkerd, P., Lee, T., Panha, S., Burch, J. B. and Ó Foighil, D. 2004. Molecular phylogeny of certain Thai gastropodine micro land snails (Stylommatophora: Pupillidae) inferred from mitochondrial and ribosomal DNA sequences. Journal of Molluscan Studies, 70: 139-147.

Received: 16 January 2004

Accepted: 23 August 2004