

A STUDY OF THE TYPE SPECIES OF *CLAUSILIOPSIS* MÖLLENDORFF (GASTROPODA, STYLOMMATOPHORA: ENIDAE), WITH THE DESCRIPTION OF A NEW SPECIES

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Abstract *Clausiliopsis szechenyi* (Boettger 1883), the type species of *Clausiliopsis*, is re-described, including the anatomy, based on new collections. *Clausiliopsis* can be diagnosed by the presence of both penial caecum and epiphallus caecum, a rather short penis, the presence of a long diverticulum, and a more or less strongly convoluted bursa copulatrix duct. A twelfth species of the genus, *Clausiliopsis hengdan* sp. nov., is described from Hengdan, Gansu, China.

Key words *Enidae*, *Clausiliopsis*, type species, new species, China

INTRODUCTION

There are 11 known shell morphology-based species within the Chinese endemic enid genus *Clausiliopsis* Möllendorff 1901: *Clausiliopsis amphischmus* (Haas 1933), *C. anceyi* (Hilber 1883), *C. belae* (Hilber 1883), *C. buechneri* (Möllendorff 1901), *C. clathratus* (Möllendorff 1901), *C. senckenbergianus* Yen 1939, *C. elamellatus* (Möllendorff 1901), *C. phaeorhaphae* (Möllendorff 1901), *C. schalfejewi* (Gredler 1898), *C. kobelti* (Möllendorff 1901), and *C. szechenyi* (Böttger 1883). The latter was assigned as the type of the genus. These species are recognized by the occurrence of a single columellar lamella, which is obliquely situated on the columella and much expanded inside the penultimate whorl. Also, one corner of the partial lamella is attached to the parietal callus which is thickened and forms a "tooth", which is more or less visible from the aperture (Möllendorff, 1901).

Unfortunately, until now nothing was known about the anatomy of this genus. The purpose of the present study is to provide a clear definition of *Clausiliopsis*, mostly based on new anatomical data from the type species of the genus, and to propose a new species, recognized from Gansu. The most recent classification of the Enidae (Schileyko, 1998) lists 60 genera and ten subfamilies and relies heavily on anatomical data. The absence of such data for *Clausiliopsis* renders its systematic position unclear and the main aim of this paper is to rectify this position.

MATERIALS AND METHODS

The materials used for the present study were collected in Gansu in 2003 and 2006 by the authors. Specimens were preserved in 70% ethanol after relaxation. All specimens have been deposited in the Museum of Hebei University, Baoding, China. The illustrations were drawn using a stereomicroscope and *camera lucida*. Shell and genital measurements were taken with ± 0.1 mm accuracy. Whorl number was counted as described by Kerney & Cameron (1979) and was taken with $\frac{1}{8}$ whorl accuracy. Mean values of measurements are underlined in the descriptive text. Both colouration and length of soft parts in the descriptions are those observed and measured after preservation in 70% ethanol. Directions in description: proximal – towards atrium; distal – vice versa.

Abbreviations used are as follows: a.s.l. – above sea level; At – atrium; AtR – atrial retractor muscle; AR – retractor muscle of appendical branch; BC – bursa copulatrix; BCD – bursa copulatrix duct; D – diverticulum of bursa copulatrix duct; diam. – diameter; maj. – major; Ep – epiphallus; EpC – epiphallic caecum; Fl – flagellum; FO – free oviduct; P – penis; PA – penial appendix; PC – penial caecum; PR – retractor muscle of penial branch; Va – vagina; VD – vas deferens.

Institutional abbreviations HBUM – Museum of Hebei University; HBUMM – mollusc collection of HBUM.

SYSTEMATIC DESCRIPTIONS

Family Enidae Woodward 1903
Genus *Clausiliopsis* Möllendorff 1901

Type species *Buliminus (Zebrina) szechenyi*
Boettger 1883

Diagnosis Columellar margin occupied by one oblique lamella, much enlarging inside penultimate whorl, and then disappearing. Both penial caecum and epiphallus caecum present. Penis rather short, more or less globular, with a distinct V-shaped structure formed by pilasters. Bursa copulatrix duct long and proximally more or less strongly convoluted, with long diverticulum.

Clausiliopsis szechenyi (Boettger 1883)
Figs 1–2

Buliminus (Zebrina) szechenyi Boettger 1883:
Boettger in Hilber, 1883, 1366, T. 5, F. 10.

Buliminus szechenyi Boettger 1883 – Sturany, 1901:
35.

Buliminus (Clausiliopsis) szechenyi (Boettger
1883) – Möllendorff, 1901: 369.

Buliminus (?) szechenyi (Boettger 1883) – Kobelt,
1902: 548, pl. 86, figs. 11–13.

Clausiliopsis szechenyi (Boettger 1883) – Yen, 1939:
89, pl. 8, fig. 32. – Yen, 1942: 256. – Schileyko,
1998: 193, fig. 237.

Type locality Quan-yuan (=Guangyuan, in modern spelling), China.

Material examined HBUMM05478, 24 adults, 6 juveniles, 3 dissected, 15 adults measures. Collection data: China: Gansu: Wenxian, on a hill with church, near Bailongjiang River (943 m a.s.l., N32° 56' 33.5", E104° 40' 33.2"), limestone and loess, 27 Sep 2006, coll. M. Wu, J. M. Liu, W. Zheng & L. H. Gao; HBUMM00379 (for shell measurement and anatomy), 15 adults, 3 juveniles, 2 dissected. Collection data: China: Gansu: Wenxian (N32° 56', E104° 40'), 22 Sep 2003, coll. M. Wu.

Re-description Shell narrow, cylindrical with a long, pointed spire. Aperture dextral. Shell solid, surface opaque, glossy. Whorls light brown coloured, with coarse growth lines but lacking dis-



Figure 1 *Clausiliopsis szechenyi* (Boettger 1883). A. HBUMM00379- specimen 5, B. HBUMM00379- specimen 4, abapertural view, showing columellar lamella.

cernible spiral sculpture. Whorls with moderately incised sutures, smoothly rounded and moderately convex but not shouldered. Embryonic whorls smooth, slightly polished. Postnuclear whorls smooth. Shell with 10–11–11 $\frac{7}{8}$ whorls. Last whorl ascending in front, rounded at the periphery. Shell 15.4–17.0–18.5 mm high, 3.7–4.0–4.4 mm in major diameter. Aperture ovate, toothless, but bearing an angular tubercle, 2.7–3.6–4.3 mm high, 2.7–2.9–3.2 mm wide, on the columella. Palatal plica absent. Palatal margin rounded. Peristome somewhat reflexed, more or less expanded, thickened. Parietal callus indistinct. Parietal lamella absent. Last whorl without a circular depression behind aperture. Palatal wall without deep depression or tooth of irregular shape. Columellar margin reflexed, not sinuous, with prominent lamella on the middle part, much enlarging inside the penultimate whorl, and then disappearing. Columella not truncate. Umbilicus a narrow slit. Shell uniformly coloured, apex evenly light brown but paler brownish below, sometimes with very few whitish streaks. Whorl near aperture white, aperture white with reddish tint.

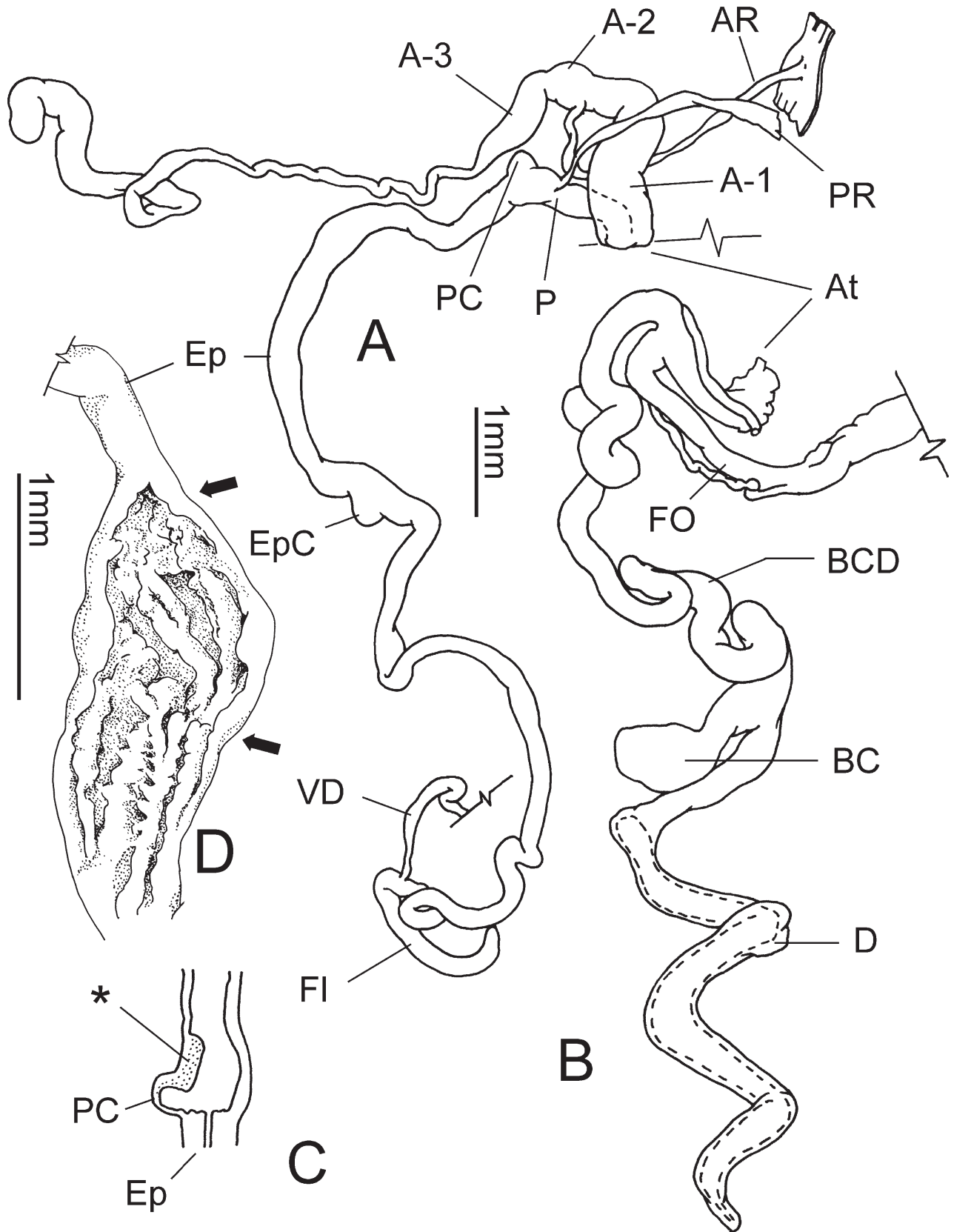


Figure 2 *Clausiliopsis szechenyi* (Boettger 1883). A. HBUMM00379- specimen 1, male part of genitalia; B. HBUMM00379- specimen 1., female part of genitalia; C. diagram of sagittal- section view of distal penis, asterisk – V-shaped pilaster; D. inner view of penis. Upper arrow – indicating the position of the opposite penial caecum, lower arrow – indicating the position of nearly opposite penial retractor insertion.

Genitalia. Vas deferens not swollen in the middle portion, entering the epiphallus directly, not at an angle. Epiphallus very long, cylindrical, forming a few loops near the vas deferens entrance, externally smooth, without glandular wall. Epiphallic caecum present, blunt apically, situated nearly in the middle of the epiphallus. Flagellum somewhat short (in HBUMM00379 longer than HBUMM005478), conic to tubular, proximally normal, with tip blunt. Penis with terminal entrance to epiphallus. Penial sheath absent. Penis clavate and of even width, thin-walled. Penis internally with numerous longitudinal pilasters and one V-shaped pilaster. Pilasters not fused at the epiphallic pore. Other structures in the penis appear absent. Penial process 1, nipple-shaped, situated at the boundary between the epiphallus and penis. Penial verge absent. Penial appendix long, branched from the proximal portion of the penis, divided into A-1, A-2, A-3, and A-4+A-5. A-1 and A-2 fused or separated. A-2 and A-3 not fused. A-5 straight. Penial retractor biramous, attaching to penis and to A-1+A-2. Arms of penial retractor arising from diaphragm separately. Penial branch of penial retractor attaching to penis in middle part. Additional retractor rather than penial or appendical absent. Muscular band connecting vagina and epiphallus absent. Atrial retractor absent. Atrium short. Free oviduct somewhat short, about 2 times longer than vagina. Vagina somewhat short, not swollen, straight, not lined with loose, spongy tissue, not pigmented. Bursa copulatrix duct very long, proximally twisted. Bursa copulatrix sessile, without apical ligament, small, with very short neck, poorly defined. Diverticulum normally present on spermathecal duct, unexpanded, distinguishable from and much longer than bursa copulatrix. Bursa copulatrix and diverticulum forked more distally from their base. Measurement (mm): penial appendix 10.6, penis 1.3, epiphallus 14.0, flagellum 0.9, vagina 1.3, free oviduct 2.2, bursa copulatrix duct 12.0, bursa copulatrix 1.7, diverticle of bursa copulatrix duct D 9.3- HBUMM00379-specimen 1.

Distribution Sichuan (Type locality: Guangyuan County), Gansu (Xigucheng, Huixian County, Liang-dshia-pa, Guanting, Shi-pa, between Da-ho and Yung-ning-ho, Wenxian).

Remarks The type species of *Clausiliopsis* and the new species (see below) have a similar character spectrum which is typical of the enid subfamily Pseudonapaeinae Schileyko 1978. Besides *Clausiliopsis*, the Pseudonapaeinae accommodates most of the Chinese enid genera, including *Pupinidius* Möllendorff 1901, *Serina* Gredler 1898, *Holcauchen* Möllendorff 1901, *Pupopsis* Gredler 1898, *Petraeomastus* Möllendorff 1901, *Coccoderma* Möllendorff 1901, *Lophauchen* Möllendorff 1901, *Mirus* Albers 1850, *Turanena* Lindholm 1922, *Subzebrinus* Westerlund 1887, and perhaps *Heudiella* Annandale 1924. Interestingly, the anatomy of *Clausiliopsis* resembles that of *Paramastus* Hesse 1933, which was grouped within the Buliminuinae Schileyko 1998 by Schileyko (1998), using the shared characters of absence of penial verge, presence of both penial and epiphallic caecums and some other characters. The systematic position of *Paramastus* deserves to be discussed later, due to its obvious similarity with pseudonapaeine genera rather than to the epiphallic caecum-free buliminuine genera, in genitalia anatomy. Compared with other Chinese enid genera, the present genus resembles *Pupinidius* in structure of the genitalia, but in *Pupinidius* the penial caecum is wanting.

Clausiliopsis hengdan sp. nov.

Figs 3–5

Type material Holotype: BUMM05557 specimen 0; paratypes: HBUMM05557 specimen 1–63 (1–2 dissected); 62 specimens measured. Fully mature shells in ethanol.

Type locality China: Gansu Province: Wenxian County: Hengdan (829 m a.s.l., N32° 51' 44.7", E104° 50' 48.2"), (779 m a.s.l., N32° 51' 49.4", E104° 50' 37.7"), (789 m a.s.l., N32° 51' 41.6", E104° 50' 43.1"); limestone and bush, 29 Sep 2006, coll. M. Wu, J. M. Liu, W. Zheng & L. H. Gao.

Etymology The new species is named after the type locality "Hengdan".

Diagnosis Shell smooth, up to 9 whorls, diam. (maj.) more than 5.5 mm, uniformly coloured.

Description Shell a medium ovoid cone with pointed apex. Aperture dextral. Shell solid,

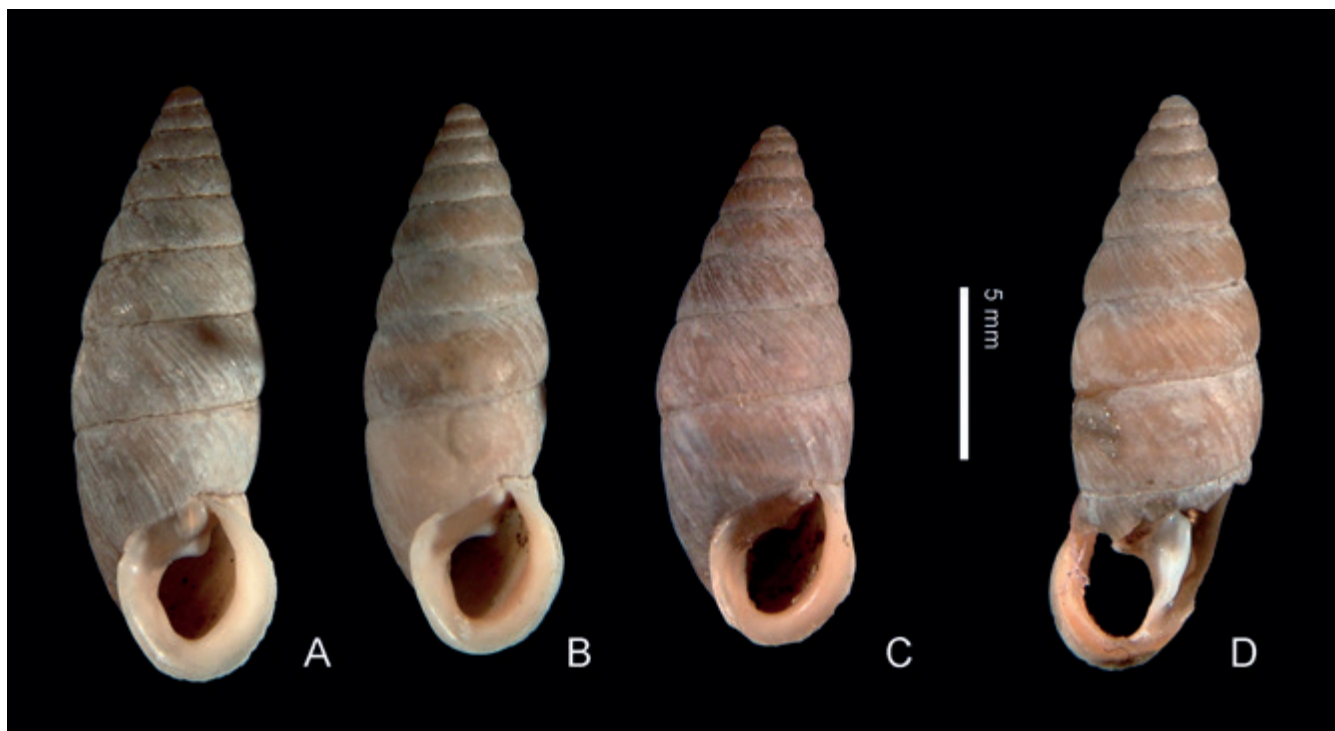


Figure 3 *Clausiliopsis hengdan* sp. nov.. A. Holotype, HBUMM05557- specimen 0; B. Paratypes, HBUMM05557- specimen 3; C. Paratype, HBUMM05557- specimen 4; D. Paratype, HBUMM05557- specimen 5, abapertural view, showing columellar lamella.

opaque, dull. Whorls yellowish-brown coloured, with coarse growth lines but lacking discernible spiral sculpture. Embryonic whorls smooth, not polished. Postnuclear whorls smooth. Shell with $7\frac{5}{8}$ – $8\frac{1}{8}$ –9 whorls. Whorls moderately convex. Last whorl ascending in front, rounded at periphery, without smoothed spiral peripheral depression. Shell 14.2–16.6–19.1 mm high, 5.5–6.2–7.1 mm in major diameter. Aperture ovate, oblique, with one small tubercle formed on the columellar lamella, 4.9–5.7–6.6 mm high, 4.1–4.7–5.2 mm wide. Palatal plica absent. Palatal margin rounded. Peristome reflexed, thickened. Parietal callus indistinct. Parietal lamella absent. Last whorl without circular depression behind aperture. Palatal wall without deep depression or tooth of irregular shape. Columellar margin reflexed, not sinuous, with prominent lamella at middle part, much enlarging inside penultimate whorl, and then disappearing. Columella not truncate. Umbilicus a narrow slit. Shell uniformly yellowish brown, whorl near the aperture lighter to white, aperture yellowish white.

Genitalia. Vas deferens not swollen in the middle portion, entering epiphallus directly, not at an

angle. Epiphallus extremely long, more or less narrowed towards distal end, distally forming a few loops, externally smooth, without glandular wall. Epiphallic caecum present at proximal $\frac{1}{3}$, blunt apically. Flagellum very short, conic, proximally normal, with tip blunt. Penis with terminal entrance to epiphallus. Penial sheath absent. Penis clavate and distally enlarged, more or less thick-walled. Penis internally with numerous longitudinal pilasters and one V-shaped pilaster. Pilasters not fused at epiphallic pore. Other structures in penis appear absent. Penis process 1, nipple-shaped, situated at boundary between epiphallus and penis. Penial verge absent. Penial appendix extremely long, branched off from proximal portion of penis, well divided into A-1, A-2, A-3 and A-4+A-5. A-1 short. Boundary between A-4 and A-5 invisible. A-5 convoluted. Penial retractor biramous, attaching to penis and to A-1 of penial appendix. Arms of penial retractor arising from diaphragm separately. Penial branch of penial retractor attaching to penis distally. Additional retractor rather than penial or appendical absent. Muscular band connecting vagina and epiphallus absent. Atrial retractor absent. Atrium short. Free oviduct long,

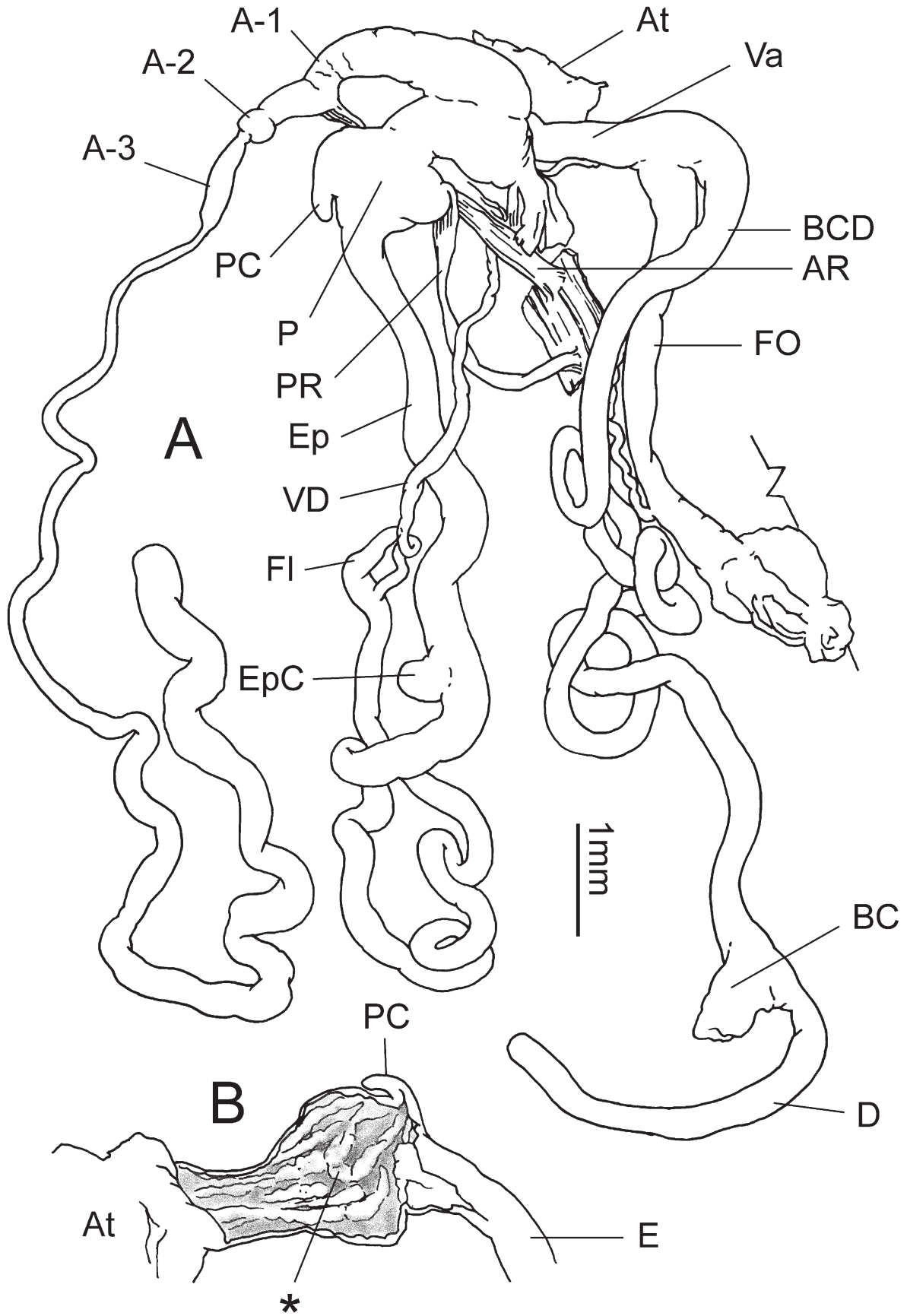


Figure 4 *Clausiliopsis hengdan* sp. nov., Paratype. A. general view of genitalia, HBUMM05557- specimen 1; B. inner view of penis, asterisk –V-shaped pilaster, HBUMM05557- specimen 2.



Figure 5 *Clausiliopsis hengdan* sp. nov., habitat.

more than 3 times longer than vagina. Vagina short, not swollen, straight, not lined with loose spongy tissue, not pigmented. Bursa copulatrix duct extremely long, proximally twisted strongly. Bursa copulatrix sessile, without apical ligament, small, without neck, poorly defined. Diverticulum normally present on spermathecal duct, longer than reservoir, unexpanded, distinguishable from bursa copulatrix. Bursa copulatrix and diverticulum forked more distally from their base. Measurement (mm): penial appendix 23.3, penis 2.2, epiphallus 18.7, flagellum 1.0, vagina 2.0, free oviduct 3.7, bursa copulatrix duct 21.3, bursa copulatrix 1.0, diverticle of bursa copulatrix duct 4.7- paratype HBUMM05557-specimen 1; penial appendix 14.3, penis 3.4, epiphallus 18.8, flagellum 1.3, vagina 1.9, free oviduct 4.7,

bursa copulatrix duct 20.0, bursa copulatrix 1.4, diverticle of bursa copulatrix duct 4.0- paratype HBUMM05557-specimen 2.

Distribution Only known from the type locality.

Ecological remarks The *C. hengdan* sp. nov. population is distributed in a low limestone hill with disordered rocks and bushes in the crevices. Rock surface were more or less moist, covered with well developed layer composed of moss and lichen (Fig. 5).

Remarks Conchologically, *C. hengdan* sp. nov. is not close to any known *Clausiliopsis* species. The shell of the new species is distinctly broadest and stoutest in the genus (see above diagnostic characters and Table 1, difference of shell measurement of *Clausiliopsis* species). The penial appendix, the epiphallus and the bursa copulatrix duct of the new species are distinctly longer than those in *C. szechenyi*. However, its genitalia characters confirm that the occurrences of both the penial caecum and the epiphallic caecum, a short and more or less globular penis, long and proximally convoluted bursa copulatrix duct with long diverticulum are diagnostic for *Clausiliopsis*.

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Table 1 Members of *Clausiliopsis* and their conchological measurement (data from Kobelt, 1902; Möllendorff, 1901, Yen, 1939 and this study; *, calculated from the left two columns; **, data from the holotype picture in Yen, 1939)

Species	Whorl number	Height	Diam. (maj.)	Height/diam. (maj.) ratio*
<i>C. amphischmus</i> (Haas 1933) **	9	15	3.7	4.1
<i>C. anceyi</i> (Hilber 1883)	11	19	5	3.8
<i>C. belae</i> (Hilber 1883)	10	14	5	2.8
<i>C. buechneri</i> (Möllendorff 1901)	10.5	14.7	4.5	3.3
<i>C. clathratus</i> (Möllendorff 1901)	11.5	12.5–14	3–3.3	4.2
<i>C. elamellatus</i> (Möllendorff 1901)	12	14	3	4.7
<i>C. kobelti</i> (Möllendorff 1901)	9.5	13.6	3.9	3.5
<i>C. phaeorhapha</i> (Möllendorff 1901)	12	15	3.8	3.9
<i>C. schalfejewi</i> (Gredler 1898)	9.5	20	5	4.0
<i>C. senckenbergianus</i> Yen 1939	8	10.0	3.5	2.9
<i>C. szechenyi</i> (Boettger 1883)	10–11 ^{7/8}	15.4–18.5	3.7–4.4	4.2
<i>C. hengdan</i> sp. nov.	7 ^{5/8} –9	14.2–19.1	5.5–7.1	2.6–2.7

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