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Additional information on the distribution, anatomy, and systematics of living and fossil Chinese Plectopylidae (Gastropoda: Pulmonata)

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Abstract. This paper describes two new species, *Gudeodiscus marmoreus* Páll-Gergely n. sp. and *Sicradiscus vargabalinti* Páll-Gergely n. sp. from China. New conchological information indicates that *Plectopylis stenochila* var. *basilia* Gude, 1897 is the synonym of *Sinicola stenochila* (Möllendorff, 1885). We present the reproductive anatomy of *Gudeodiscus emigrans otanii* Páll-Gergely, 2013, *Gudeodiscus eroessi eroessi* Páll-Gergely & Hunyadi, 2013, *Gudeodiscus giardi giardi* (H. Fischer, 1898), *Gudeodiscus okuboi* Páll-Gergely & Hunyadi, 2013, *Gudeodiscus pulvinaris pulvinaris* (Gould, 1859), *Sicradiscus invius* (Heude, 1885), *Sicradiscus transitus* Páll-Gergely, 2013, *Sinicola asamiana* Páll-Gergely, 2013, *Sinicola murata* (Heude, 1885), and *Sinicola stenochila* (Möllendorff, 1885), with special focus on the morphology of the inner penial wall, and new locality information for several other Chinese Plectopylidae species. We moved the genus *Amphicoelina* Haas, 1933 from the family Plectopylidae to Camaenidae and synonymized the subgenera of Chinese Eocene *Plectopyloides* described by Li (1986) (*Henanspirus*, *Menyinspirus*, *Yenellus*) with the genus *Plectopyloides*.

Key words: malacology, taxonomy, *Sinicola*, *Sicradiscus*, *Gudeodiscus*, *Plectopylis*, anatomy, China.

INTRODUCTION

The family Plectopylidae is a group of approximately 120 flat-shelled land snail species having palatal and parietal plicae and lamellae about one quarter to half whorl behind the aperture. According to Schileyko (1999), Plectopylidae is a member of the superfamily Plectopyloidea together with the mainly Sri Lankan Corillidae. Bouchet and Rocroi (2005) classified Sculptariidae in this superfamily. Plectopylids differ from

corillids and other conchologically similar groups by presence of one or two vertical lamellae on the parietal wall.

Benson (1860) described the genus *Plectopylis* as a "helicid" group. He subdivided the genus (including only six Indian and Burmese species) into three "sections", without naming them. Gude (1899a) revised the whole genus *Plectopylis* and subdivided into seven "sections", namely *Endothyra* (replaced by *Endothyrella* by Zilch 1960), *Chersaecia*, *Endoplon*, *Plectopylis*, *Sinicola*, *Enteroplax* and *Sykesia* Gude, 1897. Recent papers classified the latter two genera in Strobilopsidae (Schileyko 1998, Solem 1968) and Endodontidae (see Gude 1914, Schileyko 2001) or Charopidae (see Schileyko 2010), respectively. Zilch (1960) included *Corilla* H. & A. Adams, 1858, *Sculptaria* L. Pfeiffer, 1856, *Plectopylis* (with the subgenera *Endothyrella*, *Chersaecia*, *Endoplon*, *Plectopylis* and *Sinicola*) and *Amphicoelina* F. Haas, 1933 within the family Corillidae. Schileyko (1999) elevated all plectopylid subgenera to separate genera, and classified the genera *Plectopylis*, *Endoplon*, *Sinicola*, *Endothyrella*, *Chersaecia*, and *Amphicoelina* into the Plectopylidae.

The family Plectopylidae is widely distributed from northeastern India to many parts of Southeast Asia and southern Japan (Gude 1899b, Páll-Gergely & Hunyadi 2013 and references therein). Most information on this family was described by G. K. Gude between 1896 and 1920 based on the material from India, Burma (Myanmar) and Vietnam. Most Chinese taxa were described at the end of the 19th and the beginning of the 20th Century (e.g. Möllendorff 1882, 1883, 1885a, 1885b, 1886, Heude 1882, 1885, 1889, Gredler 1881, 1887, Martens 1875, Ancey 1885, Gude 1897). The previous revision of Chinese Plectopylidae (Páll-Gergely & Hunyadi 2013) revealed 46 subspecies and species, including four questionable ones and 20 newly described species and subspecies. This paper presents further information on Chinese Plectopylidae.

MATERIALS AND METHODS

Ethanol-preserved specimens were dissected under Leica stereomicroscope, and photographs of the genital structures were taken with a camera attachment to provide basis for sketches presented here. To describe the reproductive system, we used the terms "distal" and "proximal" in relation to the atrium. Shells were directly observed without coating under a low vacuum SEM (Miniscope TM-1000, Hitachi). We followed the nomenclature of plicae and lamellae, genital organs and terminology of the shells size in the diagnosis by Páll-Gergely and Hunyadi (2013).

We list previously unpublished localities together with the name of the collector(s), the date of collection, the number and location of specimens under each taxon. The relevance of the new localities is explained in the Notes section under each species. Collection data of anatomically examined specimens is indicated in the Genital structure section before the description of the reproductive organs.

Geographic names are presented in pinyin without tone numbers. Only names of populated places (district=Xian, town region=Shi, community=Xiang and Zhen, Cun= village and autonomous regions=Zizhizhou) are written separately. Geographic names, such as mountain (shan), cave (dong) rock (yan) forest (lin) are not separated. The

appendix includes all mentioned localities and their respective provinces presented in simplified Chinese characters.

Abbreviations:
HNHM: Hungarian Natural History Museum (Budapest Hungary);
JUO: Collection Jamen Uiriamu Otani (Osaka, Japan);
MNHN: Muséum National d'Histoire Naturelle (Paris, France);
OK: Collection Kenji Ohara, Nishinomiya Shell Museum (Nishinomiya, Japan);
PGB: Collection Barna Páll-Gergely (Mosonmagyaróvár, Hungary).

RESULTS

As we taxonomically describe below, we found two new species and obtained new information on the genital anatomy, shell morphology and distribution of 15 known species. The genus *Amphicoelina* does not belong to Plectopylidae and should be moved to the Camaenidae. The Eocene subgenera described by Li (1986) are synonyms of the genus *Plectopyloides* Yen 1969.

Family Plectopylidae Möllendorff, 1898

Genus *Gudeodiscus* Páll-Gergely, 2013

2013 *Gudeodiscus* Páll-Gergely, In: Páll-Gergely & Hunyadi: Archiv für Molluskenkunde, 142 (1): 8.

Type species: *Plectopylis phlyaria* Mabille ,1887, by original designation.

Gudeodiscus emigrans otanii Páll-Gergely, 2013

New locality: Guangxi, Laibin Shi, Xingbin Qu, Qidong Xiang, cliffs above the Poliu Elementary School, 150 m, 24°0.512'N, 109°4.288'E, leg. Hunyadi, A. & Szekeres, M., 20.09.2013., HA/12, PGB/2.

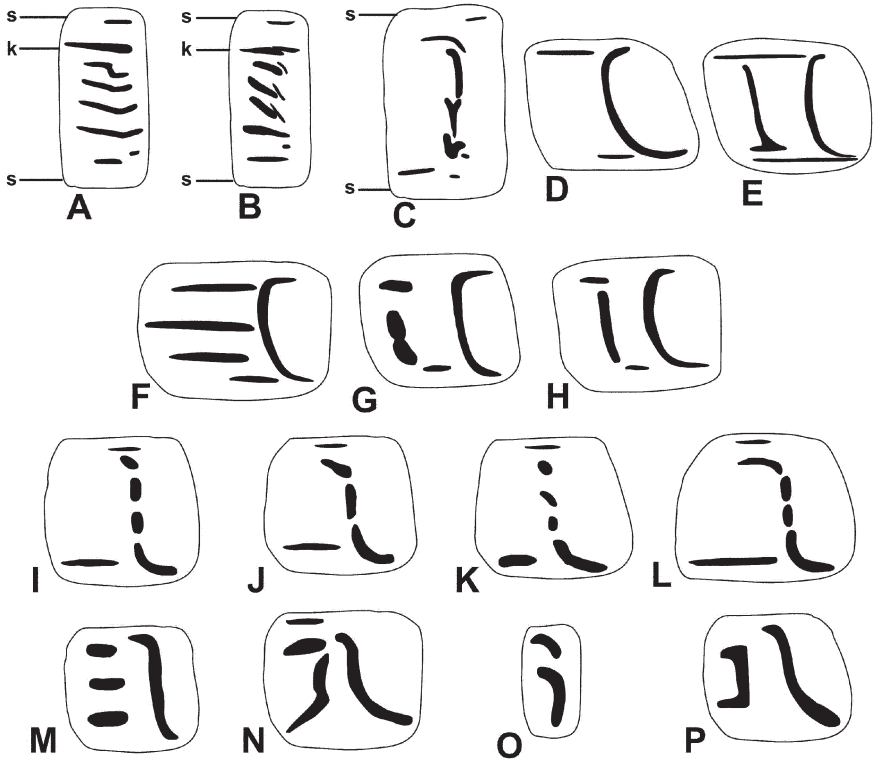
Characters of the genital structure (Fig. 6–7, Fig. 20A–B): Ethanol-preserved bodies are deposited in coll. PGB, respective shell in coll. JUO. Locality information: Guangxi, Yizhou Shi, Aishan Xiang, Xiannuyan, 172 m, 24°29.292'N, 108°34.057'E, leg. Nakahara, Y., Ohara, K., Okubo, K. & Otani, J. U., 13.11.2004. Three specimens were dissected. "Specimen1" had four parallel parietal plicae anterior to the single lamella, whereas both "Specimen2" and "Specimen3" had two vertical, "normal" lamellae. "Specimen1" and "Specimen2" had several embryos developing in uterus. "Specimen3" was entirely aphallic, having the proximal end of the vas deferens attached to the vagina near the genital opening. "Specimen3" had no embryos in its uterus, but had a spermatophore in its bursa copulatrix, which is the indication of a successful mating.

The right ommatophoral retractor crosses male and female genitalia. Penis of "Specimen1" was inflated, gradually tapering towards the end, "Specimen2" had a

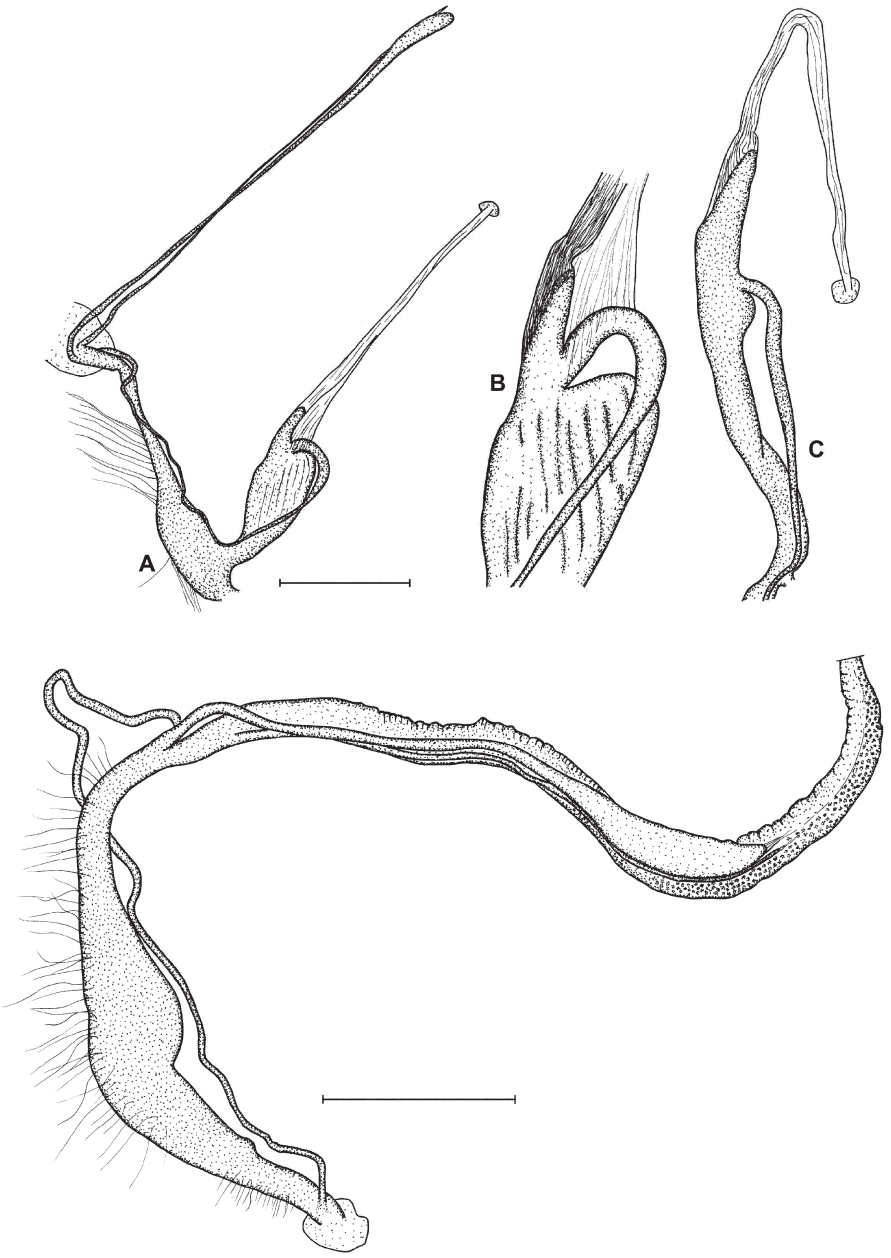
relatively slender penis with a thickening at its end; inner wall of "Specimen1" with parallel, longitudinal folds, of which some (2–4) are conspicuously thickened at the distal part of the penis (Fig. 20A); penial wall of "Specimen2" was more complex, with the

1-4. Shells of Chinese Plectopylidae: 1 – *Gudeodiscus marmoreus* n. sp. Guangxi, Hechi city, east of BaMa Xian, ex coll. Yang Hao, 2013, HNHM 97457 (holotype); 2 – *Sinicola vargabalinti* n. sp., Guangxi, LaiBin City, WuShan Xiang, ex coll. Yang Hao, 2013, HNHM 97455 (holotype); 3 – same data, HNHM 97456 (paratype); 4 – *Sinicola fimbriosa* (von Martens, 1875), Hunan, Huangcai Zhen, Ningxiang Xian, Qianfodong (Thousand Buddha Cave), 350–380 m, 28°12'53"N, 112°08'21"E, ex coll. Dengxin, 2011

parallel folds forming “hollows” between each other (Fig. 20B). Penial caecum short, about one third of the length of the penis; retractor muscle attaches to the end of penial caecum with several fibres, but some fibres attach at the base of the penial caecum on the distal end of the penis; vas deferens-epiphallus transition is not conspicuous and therefore boundary between the two organs is not well visible; epiphallus about as long or a bit longer than penial caecum. Vagina well-developed, its proximal part is inflated, its slimmer, distal part is slightly longer than the thicker proximal; vagina attached to diaphragm with several long, rather widely-spaced fibres; proximal part of vas deferens slender but distal end thickened; bursa copulatrix and additional organ next to the bursa copulatrix are both very slender (bursa slightly thickened) and extremely long.



5. Palatal (A–C, I–L) and parietal (D–H, M–P) plication of Chinese living and fossil Plectopylidae. Figs I–P after Li (1986). A and D: holotype of *Sinicola vargabalinti* n. sp. (same data as Fig. 3); B: paratype of *S. vargabalinti* n. sp. (same data as Fig. 2, HNHM 97456); C and E: holotype of *Gudeodiscus marmoreus* n. sp. (same data as Fig. 1, HNHM 97457); F–G: parietal plication of three different specimens of *Gudeodiscus emigrans otanii* Páll-Gergely, 2013, Guangxi, Yizhou Shi, Aishan Xiang, Xiannuyan, 172 m, 24°29.292’N, 108°34.057’E, leg. Nakahara, Y., Ohara, K., Okubo, K. & Otani, J. U., 13.11.2004; I and M: *Plectopyloides cretaceous* Yen, 1969; J, N: *Plectopyloides regularus* Li, 1984; K, O: *Plectopyloides guanzhuangensis* Li, 1986; L, P: *Plectopyloides multispiralus* Li, 1986. Abbreviations: k: keel, s: suture



6. Genital anatomy of *Gudeodiscus emigrans otanii* Páll-Gergely, 2013. Locality: Guangxi, Yizhou Shi, Aishan Xiang, Xiannuyan, 172 m, 24°29.292'N, 108°34.057'E, leg. Nakahara, Y., Ohara, K., Okubo, K. & Otani, J. U., 13.11.2004. Fig. 6A–B: "Specimen1", Fig6C: "Specimen2". Scale represents 5 mm, and refers to Fig. 6A only; 7. Genital anatomy of an aphallic *Gudeodiscus emigrans otanii* Páll-Gergely, 2013 specimen ("Specimen3"). Locality: same as in Fig. 6. Scale represents 5 mm

Remarks: In the original description (see Páll-Gergely & Hunyadi 2013) we mentioned that this species exhibits interesting variation in parietal plicae. Some specimens have four relatively long horizontal plicae anterior to the single vertical lamella (similar to those of the Vietnamese *G. emigrans quadrilamellatus* Páll-Gergely, 2013), whereas others have two vertical lamellae, the anterior being sometimes somewhat S-shaped. These two radically different forms were even found to occur within the same population (Guangxi, Yizhou Shi, Shibie Xiang, Qingtan, 225 m, 24°23.719'N, 108°42.137'E, leg. Nakahara, Y., Ohara, K., Okubo, K. & Otani, J. U., 13.11.2004.). Other shell characters, such as the shell sculpture, aperture shape and palatal plicae of these specimens were, however, identical. Therefore they would not represent two different species. In another population, which is situated approximately 17 km from the previous one (Guangxi, Yizhou Shi, Aishan Xiang, Xiannuyan, 172 m, 24°29.292'N, 108°34.057'E, leg. Nakahara, Y., Ohara, K., Okubo, K. & Otani, J. U., 13.11.2004.) we only found specimens having two vertical lamellae (Páll-Gergely & Hunyadi 2013). After the revision (Páll-Gergely & Hunyadi 2013) we examined seven additional specimens, which made the total number of observed shells from this population nine. Among the nine shells, two had four parallel plicae (Fig. 5F) and six other shells exhibited two lamellae, with horizontal plicae above and below the anterior lamella (Fig. 5H). In the ninth shell, anterior to the curved lamella, two oval plicae were connected to each other and located between the other horizontally short plicae (Fig. 5G). The plicae structure of Fig. 5G may be interpreted as the intermediate phenotype between those of Fig 5F and H.

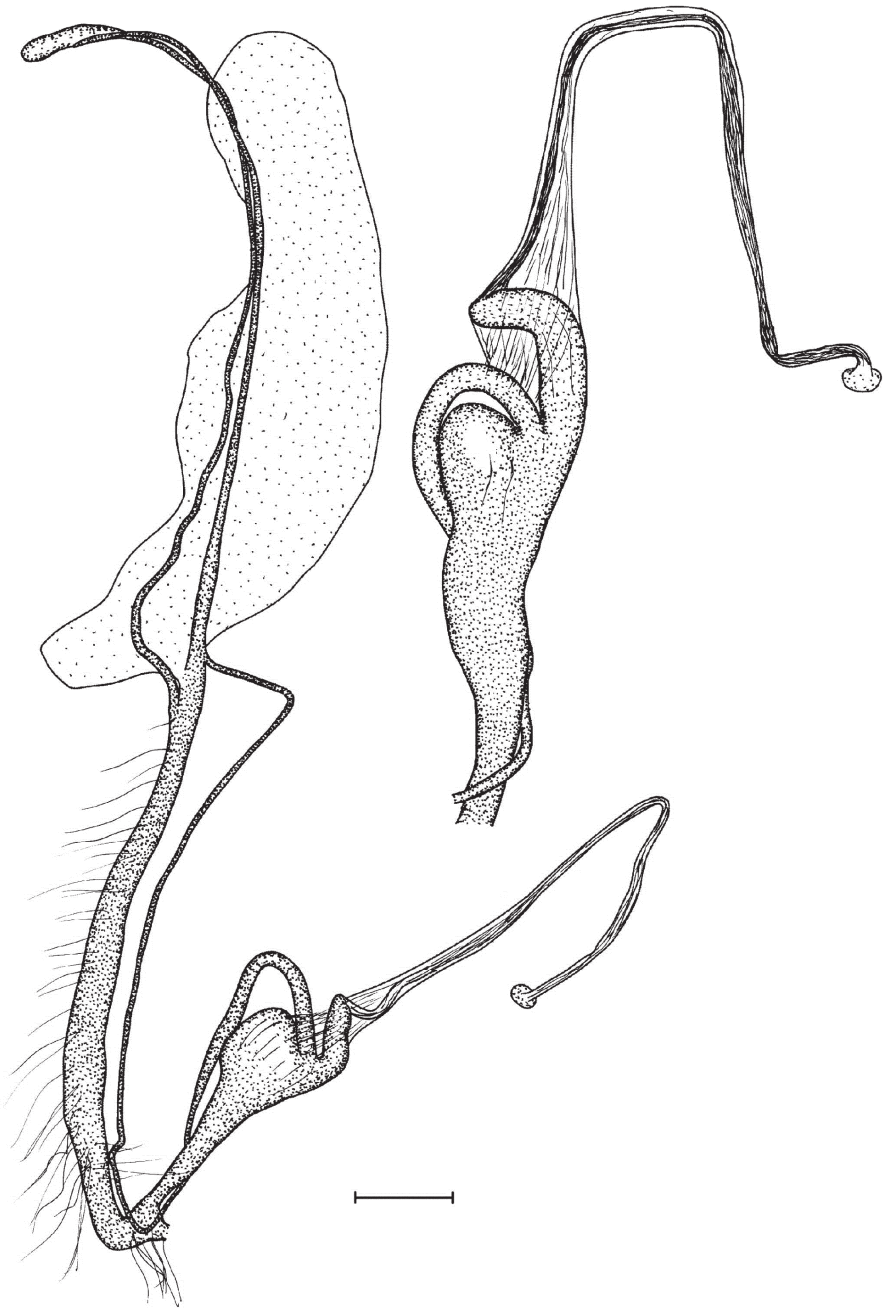
The anatomical differences between the two different forms (i.e. shell with four parallel, horizontal plicae and the shell with two lamellae) represent intraspecific variability only (see under description of the genitalia).

The new locality is situated about 45 km southwest from the nearest known location (Liuzhou Shi). The shells collected at this locality are unusually large (D=29–29.2 mm, n=2) and have only a single upper horizontal parietal plica anterior to the lamella (3 shells opened).

Gudeodiscus eroessi eroessi Páll-Gergely & Hunyadi, 2013

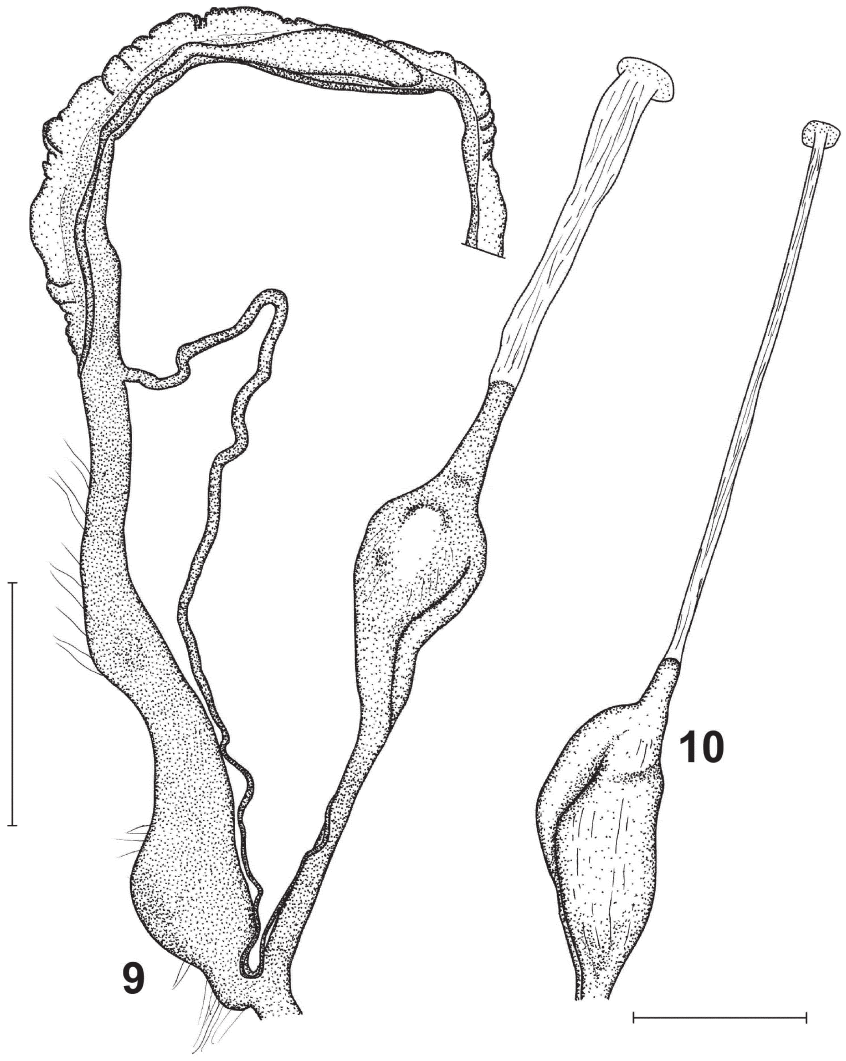
Characters of the genital structure (Fig. 8, Fig. 20F): Two specimens were anatomically examined. Both specimens had several embryos developing in the uterus. Ethanol-preserved body is deposited in coll. PGB, respective shell in coll. JUO. Locality information: Guangxi, Guigang Shi, Guzhang Xiang, beyond Chuanshan village, 153 m, 23°20.848'N, 109°19.256'E, leg. Nakahara, Y., Ohara, K., Okubo, K. & Otani, J. U., 09.11.2004.

The right ommatophoral retractor crosses the male and female genitalia. Penis rather long, its distal portion inflated; inner wall of the proximal part smooth or with weak longitudinal folds all along the whole penis; inner wall of the distal penis part with several, slit-like pockets standing in a transversal row. The pockets did not contain calcareous crystals. Penial caecum well-developed, curved, internally with approximately 16 folds which may be wavy forming slit-like pockets for calcareous crystals,



8. Genital anatomy of *Gudeodiscus eroessi eroessi* Páll-Gergely & Hunyadi, 2013 ("Specimen1": whole genitalia, "Specimen2": only penis). Locality: Guangxi, Guigang Shi, Guzhang Xiang, beyond Chuanshan village, 153 m, 23°20.848'N, 109°19.256'E, leg. Nakahara, Y., Ohara, K., Okubo, K. & Otani, J. U., 09.11.2004. Scale represents 2 mm

which were absent in the examined *G. eroessi eroessi* specimens, but were visible in *G. pulvinaris pulvinaris* specimens (see below). Epiphallus shorter than the penis, but its exact length is unknown due to the obscure boundary between the epiphallus and the vas deferens. Retractor muscle attaches at the lateral side of the tip of the penial caecum. Several additional muscle fibres attach to the distal end of the penis. Vagina



9-10. Genital anatomy of *Gudeodiscus* species: 9 – *G. giardi giardi* (H. Fischer, 1898). Locality: Guangxi, Longzhou Xian, Wude Xiang, Qunhe Cun, Banxintun, 308 m, 22°35.46563'N, 106°46.29486'E, leg. Ohara, K., Okubo, K. & Otani, J. U., 11.01.2006. Scale represents 5 mm; 10 – Penis of *G. multispira* (Möllendorff, 1883). Locality: Guangxi, Qingshan, Qingshan Zhen, Lipu Xian, 252 m, 24°26.189'N, E110°20.008'E, leg. Nakahara, Y., Ohara, K., Okubo, K. & Otani, J. U., 12.11.2004. Scale represents 2 mm

slightly longer than the penis and epiphallus together; with weak vaginal bulb; several weak muscle fibres attach the vagina to the diaphragm. Bursa copulatrix and additional organ next to it extremely long; bursa slightly thickened.

Gudeodiscus giardi giardi (H. Fischer, 1898)

New localities: Guangxi, Longzhou Xian, Nonggang Protected Area, near ranger station, 205 m, 22°28.48990'N, 106°57.43325'E, leg. Ohara, K., Okubo, K. & Otani, J. U., 12.01.2006., OK/2; Guangxi, Longzhou Xian, near Nonggang, 202 m, 22°29.31403'N, 106°57.31251'E, leg. Ohara, K., Okubo, K. & Otani, J. U., 12.01.2006., OK/4; Guangxi, Longzhou Xian, Nonggang Protected Area, inner side of ranger station, 173 m, 22°28.13390'N, 106°57.63413'E, leg. Ohara, K., Okubo, K. & Otani, J. U., 12.01.2006., OK/6.

Characters of the genital structure (Fig. 9, Fig. 20D): One specimen was anatomically examined, which had no embryos in its uterus. Ethanol-preserved body is deposited in coll. PGB, respective shell in coll. JUO. Locality information: Guangxi, Longzhou Xian, Wude Xiang, Qunhe Cun, Banxintun, 308 m, 22°35.46563'N, 106°46.29486'E, leg. Ohara, K., Okubo, K. & Otani, J. U., 11.01.2006.

The right ommatophoral retractor crosses the male and female genitalia. Penis very long, club-shaped with long, slender, proximal portion and thickened distal "head"; penial caecum moderately long, slightly shorter than the epiphallus; epiphallus slender, approximately as long as the thickened distal part of the penis. Penis internally with longitudinal folds, in some parts with hardly visible reticulated sculpture; the inner wall of the distal end of the penis had several longitudinal slit-like "pockets", which contained flat, thin, calcareous crystals (one crystal per pocket). Distal end of the penis and the proximal part of penial caecum had reticulated sculpture. The inner wall of penial caecum was tuberculated, the tubercles were paired, probably forming pockets for calcareous crystals, as it was visible in *G. pulvinaris pulvinaris* (see below). Epiphallus internally with longitudinal folds. Vas deferens very long, curly; thickened near its insertion to spermoviductus. Vagina very long, approximately as long as the penis and penial caecum together, it has well-developed vaginal bulb at its proximal part. Bursa copulatrix and additional organ next to it are very long and slender; the bursa with a thickened distal end.

Remarks: *G. giardi giardi* is known from the Vietnamese Cao Bằng Province and western Guangxi (Páll-Gergely & Hunyadi 2013). The localities reported here are situated within the boundaries of the known distribution.

Gudeodiscus marmoreus Páll-Gergely n. sp.

Fig. 1, 5C, 5E.

Diagnosis: A very large, flat species with a low, long fold in the aperture which is free from the callus. Dorsal surface with coarse radial ribs and very fine spiral lines. On the parietal wall there are two lamellae with horizontal plicae above and below the anterior lamella.

Description of the holotype: Shell brownish with lighter mosaic colouration dorsally and a yellowish band around the umbilicus, which is visible in all whorls inside the infundibular umbilicus; shell flat with a slightly elevated apex; 7.5 whorls are separated by rather shallow suture; protoconch very finely, regularly ribbed; dorsal surface of teleoconch with extremely fine, microscopic spiral lines and coarse, irregular radial growth lines; shell surface almost smooth around the umbilicus; within the umbilicus spiral lines not visible, only the radial growth lines; peristome brown, thickened and reflexed, with slightly S-shaped, low callus and a white, low entering fold free from it.

The armature is situated very deep, about half whorl behind the aperture; parietal wall with two lamellae; anterior one rather straight and short, above slightly elongated anteriorly, below both anteriorly and posteriorly; posterior lamella long and very much curved; two horizontal plicae are above and below the first lamella, the lower one starts from the lower end of the posterior lamella and stops and the middle of the anterior lamella; the upper plica is about as long as lower, starts just anterior to the posterior lamella, and it exceeds the anterior lamella. Palatal wall with six plicae; first long and slim, close to the suture and situated posterior of the other plicae; second bent posteriorly; third and fourth almost vertical, slightly depressed Z-shaped; fifth short and V-shaped, probably consists of two plicae; the sixth one is situated anterior of the other plicae, slim; there are two additional small, denticle-like plicae posterior to the fifth and sixth plicae.

Measurements (in mm, holotype): D=26.7, H=9.6.

Differential diagnosis: The coloration (mosaic structure dorsally, light band around the umbilicus) and the sculpture (extremely fine spiral lines and rough radial growth ridges) of the new species is unique among *Gudeodiscus*. Moreover, most large, flat species reported from China ("*Chersaecia*" *andersoni* (Blanford, 1869), *G. concavus* Páll-Gergely, 2013, *G. eroessi* Páll-Gergely, 2013, *Gudeodiscus goliath* Páll-Gergely & Hunyadi, 2013, *G. okuboi* Páll-Gergely & Hunyadi, 2013, *G. pulvinaris* (Gould, 1859)) have only one parietal lamella. Some taxa however, have two parietal lamellae (*G. emigrans otanii* Páll-Gergely, 2013, *G. giardi*, *G. phlyarius*, *G. yanghaoi* Páll-Gergely & Hunyadi, 2013). These differ from the new species in the following shell characters; *G. emigrans otanii* has Y-shaped palatal plicae, sometimes four parallel plicae instead of an anterior lamella in front of the lamella and has fine ribbing on the whole shell. *G. giardi* and its subspecies have a more elevated spire, domed shell shape and their anterior lamella is connected to the lower plica. *G. phlyarius* usually has the more elevated spire, stronger apertural fold, thicker peristome and finely ribbed sculpture than the new species. *G. yanghaoi*, which is probably the closest relative to *G. marmoreus* n. sp., has the more elevated spire, a long entering fold connected to the callus, all middle palatal plicae are united and being visible as one plate through the semitransparent shell, which has the finely ribbed dorsal surface.

Etymology: The new species is named after its marbled dorsal shell surface (*marmoreus* = marbled in Latin).

Material: China, Guangxi, Hechi city, east of BaMa Xian, ex coll. Yang Hao, 2013, HNHM 97457 (holotype).

Gudeodiscus multispira (Möllendorff, 1883)

New localities: Guangxi, Yangshuo Xian, Fuli Zhen, Xinzhai Cun, 118 m, 24°45.816'N, 110°34.131'E, leg. Ohara, K., Okubo, K. & Otani, J. U., OK/1; Guangxi, Sanjiang Xiang, Jiahui Xiang, Luohanduyan, 238 m, 25°01.120'N, 110°53.961'E, leg. Ohara, K., Okubo, K. & Otani, J. U., OK/5; Guangxi, Sanjiang Xiang, Pingan Xiang, Chuanyan, 153 m, 24°55.120'N, 110°48.979'E, leg. Ohara, K., Okubo, K. & Otani, J. U., OK/1; Guangxi, Pingyue Xian, Ertang Zhen, north of Chaotianyan, 182 m, 24°37.577'N, 110°45.710'E, leg. Ohara, K., Okubo, K. & Otani, J. U., OK/2; Guangxi, Pingle Xian, Ertang Zhen, in front of Chaotianyan, 168 m, 24°37.500'N, 110°45.474'E, leg. Ohara, K., Okubo, K. & Otani, J. U., OK/4; Guangxi, Zhongshan Xian, Wanggao Zhen, Bishuiyan, 170 m, 24°35.992'N, 111°25.447'E, leg. Ohara, K., Okubo, K. & Otani, J. U., OK/1; Guangxi, Yangshuo Xian, Puyi Xiang, Muqiao, 125 m, 24°43.590'N, 110°32.355'E, leg. Ohara, K., Okubo, K. & Otani, J. U., OK/1; Guangxi, Yangshuo Xian, Yangshuo Zhen, Mushan, 126 m, 24°46.342'N, 110°31.301'E, leg. Ohara, K., Okubo, K. & Otani, J. U., JUO/3; Guangxi, Guilin Shi, Gongcheng Xian, Pingan Xiang, Jiaojintang, 750 m, 24°45.454'N, 110°53.530'E, leg. Ohara, K., Okubo, K. & Otani, J. U., OK/2, PGB/1.

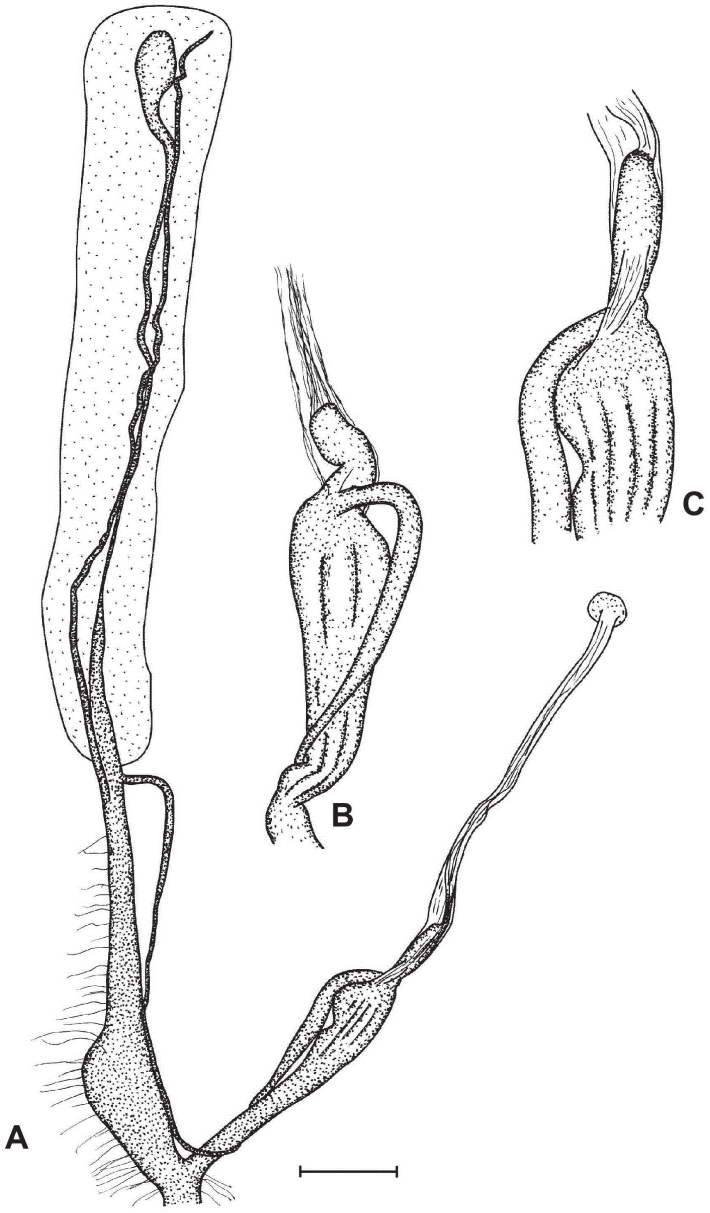
Characters of the genital structure (Fig. 10, Fig. 20E): The anatomy of *G. multispira* specimens collected in the southern part of Lipu (190 m a.s.l., 24°28.909'N, 110°24.024'E) was described by the Páll-Gergely & Hunyadi (2013). We dissected two specimens from a nearby locality (Guangxi, Qingshan, Qingshan Zhen, Lipu Xian, 252 m, 24°26.189'N, E110°20.008'E, leg. Nakahara, Y., Ohara, K., Okubo, K. & Otani, J. U., 12.11.2004.). The only notable difference is the much shorter penial caecum in the newly examined specimen in relation to the others published in the Chinese revision (Páll-Gergely & Hunyadi 2013).

Remarks: *G. multispira* is known from two nearby occurring localities in southern Hunan province, and from several localities from north-eastern Guangxi. The new localities published here extend the known distribution further in Guangxi. The locality near Bishuiyan is situated about 95 km east from the nearest known location.

Gudeodiscus okuboi Páll-Gergely & Hunyadi, 2013

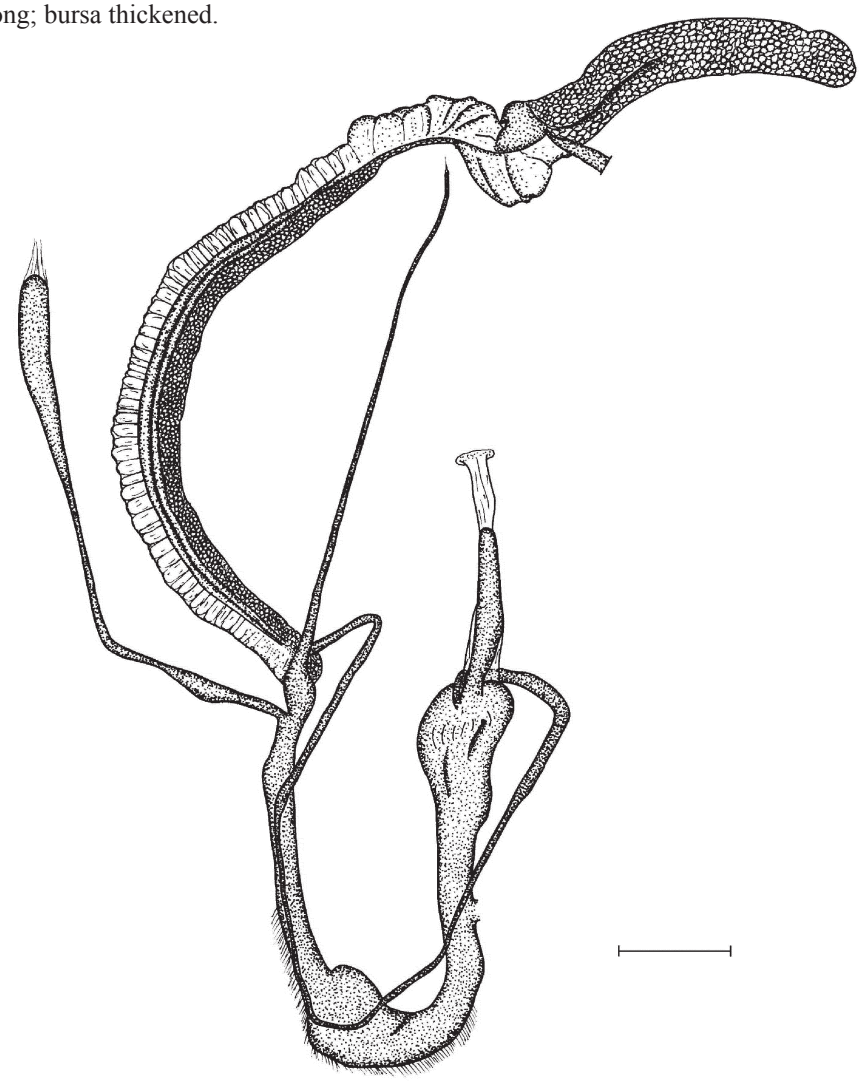
Characters of the genital structure (Fig. 11, Fig. 20C): Two specimens were anatomically examined. "Specimen1" had several embryos developing in its uterus, "Specimen2" was not gravid. Ethanol-preserved bodies are deposited in coll. PGB, respective shell in coll. JUO. Locality information: Guangxi, Guigang Shi, Guzhang Xiang, road to Wushan Xiang, 131 m, 23°21.178'N, 109°17.432'E, leg. Nakahara, Y., Ohara, K., Okubo, K. & Otani, J. U., 09.11.2004.

The right ommatophoral retractor crosses the male and female genitalia. Penis rather long, gradually tapers to the end; internally with weak longitudinal folds all along the whole penis and pockets on the wall of the thickened, distal part; the pockets did not contain calcareous crystals; a portion of the penis wall more conspicuously thickened



11. Genital anatomy of *Gudeodiscus okuboi* Pál-Gergely & Hunyadi, 2013. Locality: Guangxi, Guigang Shi, Guzhang Xiang, road to Wushan Xiang, 131 m, 23°21.178'N, 109°17.432'E, leg. Nakahara, Y., Ohara, K., Okubo, K. & Otani, J. U., 09.11.2004. Fig. 11A and C: "Specimen1", Fig. 11B: "Specimen2". Scale represents 2 mm, and refers to Fig. 11A only

than other parts of penis; penial caecum relatively short and thick, internally with two well-visible folds; epiphallus shorter than the penis, but its length is unknown due to obscured boundary between the epiphallus and the vas deferens; retractor muscle attaches at the end of penial caecum, and several additional muscle fibres attach to the distal end of the penis. A muscle fibre is visible between the middle section of the penial caecum and the distal end of the penis. Vagina slightly longer than penis and epiphallus together, with well-developed vaginal bulb; several weak muscle fibres attach vagina to diaphragm. Bursa copulatrix and additional organ next to it are extremely long; bursa thickened.



12. Genital anatomy of *Gudeodiscus pulvinaris pulvinaris* (Gould, 1859). Locality: Hong Kong Peak. Scale represents 5 mm

Gudeodiscus pulvinaris pulvinaris (Gould, 1859)

Characters of the genital structure (Fig. 12, Fig. 21H): Two specimens collected at the Hong Kong Peak by Miu Yeung in June 2013, were anatomically examined. Specimens are deposited in the PGB collection. The genital anatomy of *G. pulvinaris pulvinaris* does not differ notably from that of *G. pulvinaris robustus* Páll-Gergely & Hunyadi, 2013. This confirms their close relationship and supports their subspecific status.

The dissected *G. pulvinaris robustus* specimen (see Páll-Gergely & Hunyadi 2013) had developing embryos in its uterus, and had no calcareous crystals or granules within the penis lumen, whereas the *G. pulvinaris pulvinaris* specimens examined this time were not gravid and had several translucent claws within the "pockets" on the wall of the distal part of the penis. Additionally, the *G. pulvinaris pulvinaris* specimens had similar, but smaller calcareous claws between the folds inside the penial caecum.

Genus *Sicradiscus* Páll-Gergely, 2013

2013 *Sicradiscus* Páll-Gergely, In: Páll-Gergely & Hunyadi: Archiv für Molluskenkunde, 142 (1): 50.

Type species: *Plectopylis schistoptychia* Möllendorff, 1886.

Sicradiscus invius (Heude, 1885)

Characters of the genital structure (Fig. 13, Fig. 21A): Two specimens were anatomically examined. Ethanol-preserved bodies are deposited in coll. PGB, respective shells in coll. JUO. Locality information: Sichuan, Dujiangyan Shi, Taian Zhen, Sanlong Shuijingrongdong, 1087 m, 30°55.039'N, 103°29.662'E, leg. Hosoda, T., Ohara, K., Okubo, K., Otani, J. U., 17.09.2013.

The right ommatophoral retractor crosses the male and female genitalia. Penis short, blunt, consists of a longer proximal and a shorter distal portions; it is the widest at the distal end of the proximal part; inner wall with rather parallel folds which form "pockets" in the distal part of the penis; penial caecum missing, epiphallus is a little longer than the distal part of the penis; extremely long retractor muscle attaches to the point of penis-epiphallus transition; Vagina longer than penis, with well-developed vaginal bulb and many short fibres which connect it to diaphragm; vas deferens slender, but thickened at the end; additional organ next to bursa copulatrix slender, long; bursa copulatrix slightly shorter and tapers towards the end.

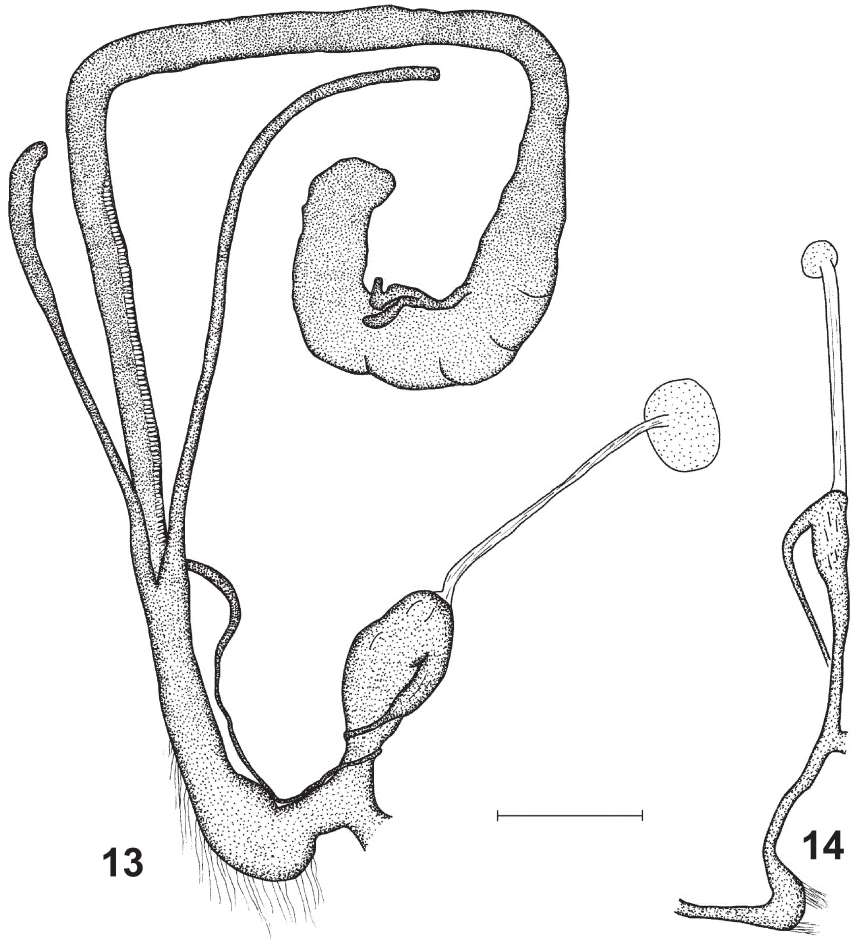
Sicradiscus schistoptychia (Möllendorff, 1886)

Characters of the genital structure: The outer morphology of the genital structure was described in our revision of species from China (Páll-Gergely & Hunyadi 2013). Re-examining the same samples revealed that the inner wall of the posterior half of the penis contained approximately 12 simple parallel folds with tiny calcareous crystals

between them. We found no signs of characteristic "pockets" (see under *Gudeodiscus* species, *Sic. invius* and *Sic. transitus*). The proximal, extremely slender half of the penis had smooth internal wall.

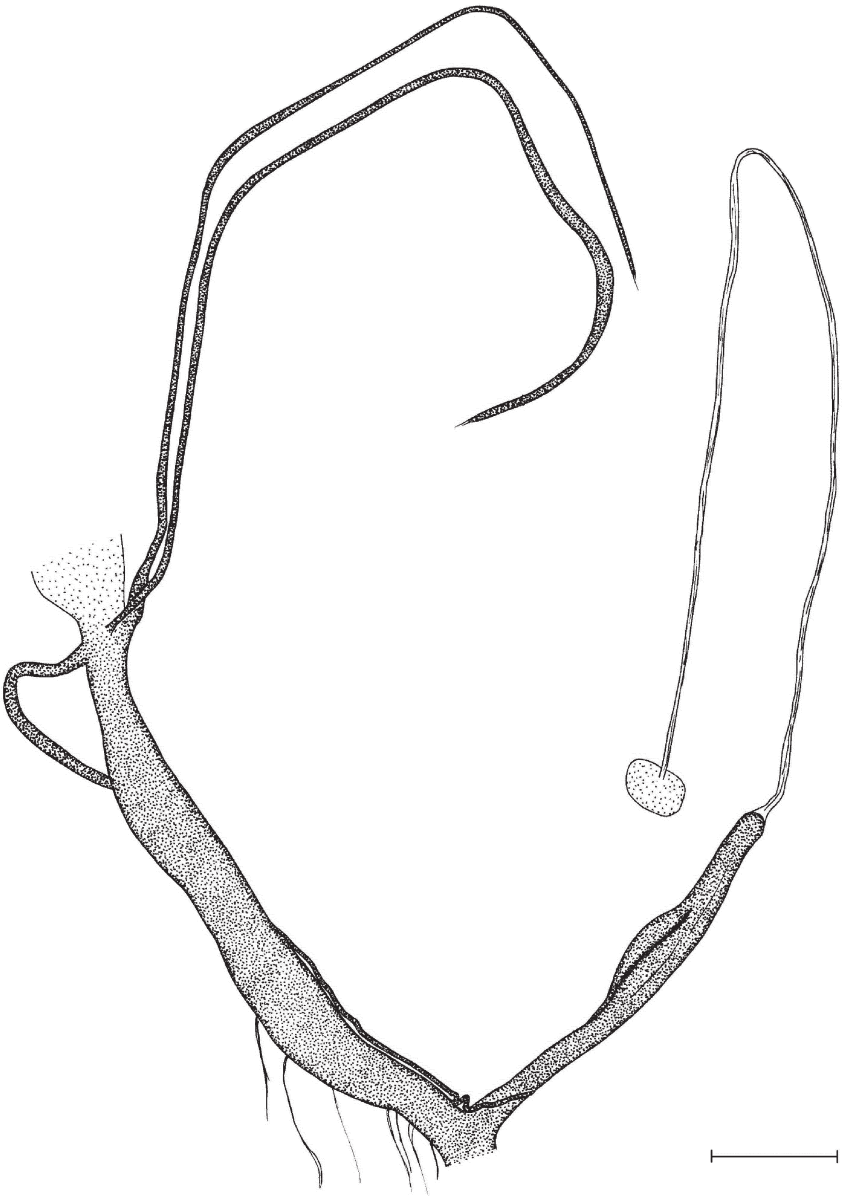
Sicradiscus transitus Páll-Gergely, 2013

Characters of the genital structure (Fig. 14, Fig. 21B): Two subadult specimens (without "finished" peristome) were anatomically examined (stored in coll. PGB). The locality data are the following: Guangxi, Hechi Shi, Tiane Xian, Qimu Xiang, near Lahaoyan, 650 m, 24°51.359'N, 107°11.407'E, leg. Hunyadi, A. & Szekeres, M., 12.09.2013.



13-14: Genital anatomy of *Sicradiscus* species: 13 – *S. invius* (Heude, 1885). Locality: Sichuan, Dujiangyan Shi, Taian Zhen, Sanlongshuijingrongdong, 1087 m, 30°55.039'N, 103°29.662'E; 14 – *S. transitus* Páll-Gergely, 2013. Locality: Guangxi, Hechi Shi, Tiane Xian, Qimu Xiang, near Lahaoyan, 650 m, 24°51.359'N, 107°11.407'E. Scales represent 1 mm

The right ommatophoral retractor crosses male and female genitalia. Shell and genital organs were immature. Penis rather long, consists of slim proximal and thick distal portions which are approximately the same in length; the width of the penis changes gradually between the two portions; distal end of penis with very small penial



15. Genital anatomy of *Sinicola asamiana* Páll-Gergely, 2013. Locality: Sichuan, Dujiangyan Shi, Qingchengshan Zhen, Jinbianyan, 860 m, 30°53.762'N, 103°33.101'E. Scale represents 1 mm

caecum-like part; long retractor muscle attaches the caecum; epiphallus about as long as the distal, thickened part of the penis; inner wall of the penis with approximately 10 parallel folds which are becoming more pronounced towards the distal end of the penis, where the folds are more elevated and form "pockets". Very tiny calcareous crystals were found between these "pockets". Vagina also long, with well-developed vaginal bulb; with several short fibres attaching it to diaphragm.

Genus *Sinicola* Gude, 1899

1899a *Sinicola* Gude, Science Gossip, 6: 148.

Type species: *Helix fimbriosa* von Martens, 1875.

Sinicola asamiana Páll-Gergely, 2013

New localities: Sichuan, Dujiangyan Shi, Taian Zhen, Sanlongshuijingrongdong, 1087 m, 30°55.039'N, 103°29.662'E, leg. Hosoda, T., Ohara, K., Okubo, K., Otani, J. U., JUO/1; Sichuan, Dujiangyan Shi, Qingchengshan Zhen, Jinbianyan, 860 m, 30°53.762'N, 103°33.101'E, leg. Hosoda, T., Ohara, K., Okubo, K., Otani, J. U., 16.09.2013.

Characters of the genital structure (Fig. 15, Fig. 21C): One specimen was dissected. Ethanol-preserved body is deposited in coll. PGB, respective shell in coll. JUO. Locality information: Sichuan, Dujiangyan Shi, Qingchengshan Zhen, Jinbianyan, 860 m, 30°53.762'N, 103°33.101'E, leg. Hosoda, T., Ohara, K., Okubo, K., Otani, J. U., 16.09.2013.

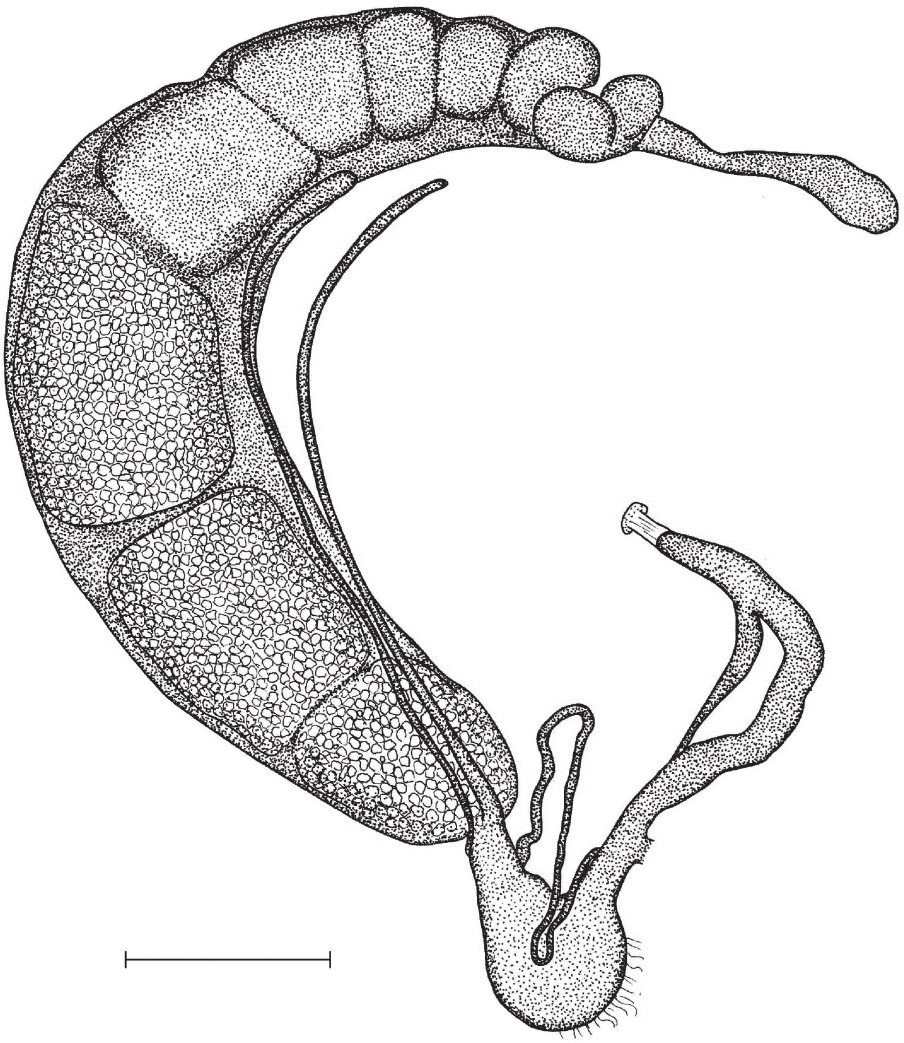
The right ommatophoral retractor crosses male and female genitalia. Penis very long, rather flat, equally wide to the end, internally with approximately 10 parallel, longitudinal folds; penial caecum as wide as penis; penis about five times as long as the penial caecum; epiphallus as long as the caecum but much thinner, spindle-shaped; retractor muscle attaches the distal end of the penial caecum, and is extremely slender and almost four times as long as penis. Vagina flat, almost twice as long as penis and much thicker than penis; no vaginal bulb present; vagina attached to diaphragm with a few long and widely-spaced fibres; proximal part of vas deferens slender but distal end thickened; bursa copulatrix and additional organ next to the bursa copulatrix are both very slender and extremely long.

Remarks: The species were reported from three localities west of Qingchengshan Zhen, Sichuan (see Páll-Gergely & Hunyadi 2013). The present new localities are in the vicinity (2-3 km) of these localities. For notes on the anatomy see under *S. murata*.

Sinicola emoriens (Gredler, 1881)

New locality: Guangxi, Yangshuo Xian, Yangshuo Zhen, Mushan, 126 m, 24°46.342'N, 110°31.301'E, leg. Ohara, K., Okubo, K. & Otani, J. U., OK/17, PGB/2.

Remarks: The genital structure of the species was described in a previous paper (Páll-Gergely & Hunyadi 2013). An additional specimen from the same locality was anatomically examined (collection data: Hunan, Yongzhou Shi, Lingling Qu, Dengjiachong, rocky wall, 125 m, 26°13.808'N, 111°35.907'E, leg. Hunyadi, A., 8.11.2010, specimens in coll. PGB). This specimen had 10 embryos developing inside the semi-stransparent capsule in the uterus (see Fig. 16). Calcareous granules were present in the capsule layers of only the three largest embryos, which were situated most closely to the genital opening. However, the other seven embryos had no granules. This may indicate that those embryos with granules belong to a single litter.



16. Genital anatomy of *Sinicola emoriens* (Gredler, 1881). Locality: Hunan, Yongzhou Shi, Lingling Qu, Dengjiachong, rocky wall, 125 m, 26°13.808'N, 111°35.907'E. Scale represents 2 mm

The dissected specimens had approximately 14 elevated, more or less parallel folds on the inner wall of penis (Fig. 21F).

The new collection site reported here represents the southernmost locality of the species, which extends its distribution range by approximately 20 km.

Sinicola fimbriosa (von Martens, 1875)

(Fig. 4)

New locality: Guangxi, Sanjiang Xiang, Limu Zhen, Yankou Cun, 210 m, 25°10.509'N, 110°56.366'E, leg. Ohara, K., Okubo, K. & Otani, J. U., OK/1.

Remarks: The species is widely distributed in Hunan Province. Additionally, it has been reported from a single locality in northern Guangxi (Páll-Gergely & Hunyadi 2013). The present new locality is about 50 km east from the previous one.

Sinicola murata (Heude, 1885)

New localities: Sichuan, Dujiangyan Shi, Taian Zhen, Qingchenghoushan, Shenxiandong, 835 m, 30°54.61750'N, 103°30.97445'E, leg. Nakahara, Y., Ohara, K., Okubo, K. & Otani, J. U., 09.07.2007., JUO/2; Sichuan, Dujiangyan Shi, Taian Zhen, Qingchenghoushan, above lower station of Jinli cable station, 979 m, 30°55.62540'N, 103°29.08667'E, leg. Nakahara, Y., Ohara, K., Okubo, K. & Otani, J. U., 08.07.2007., JUO/1; Sichuan, Qionglai Shi, Tiantaishan Zhen, Tiantaishan Dengyuean, 1071 m, 30°16.78396'N, 103°07.22660'E, leg. Nakahara, Y., Ohara, K., Okubo, K. & Otani, J. U., 12.07.2007., JUO/2; Sichuan, Dujiangyan Shi, Qingchengshan Zhen, Jinbianyan, 860 m, 30°53.762'N, 103°33.101'E, leg. Hosoda, T., Ohara, K., Okubo, K., Otani, J. U., 16.09.2013.

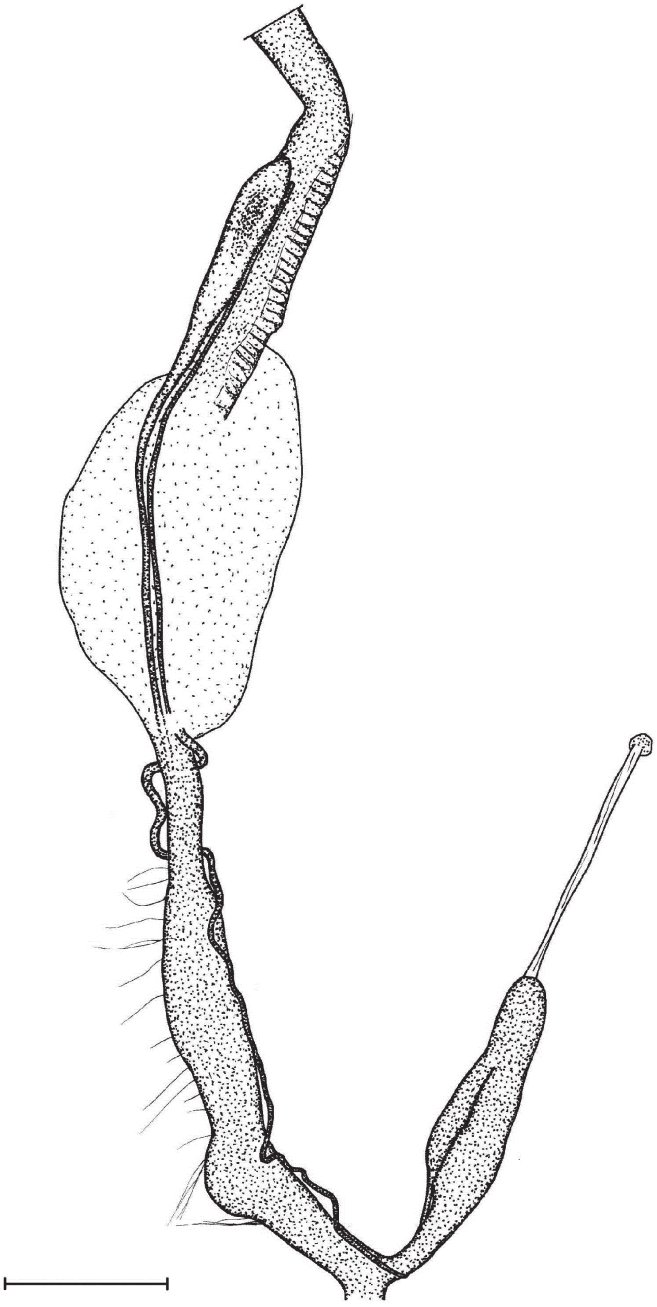
Characters of the genital structure (Fig. 17, Fig. 21E): Two specimens were anatomically examined from two different localities: Sichuan, Dujiangyan Shi, Qingchengshan Zhen, Jinbianyan, 860 m, 30°53.762'N, 103°33.101'E, leg. Hosoda, T., Ohara, K., Okubo, K., Otani, J. U., 16.09.2013.; Sichuan, Dujiangyan Shi, Taian Zhen, Sanlongshuijing-rongdong, 1090 m, 30°55.039'N, 103°29.662'E, leg. Hosoda, T., Ohara, K., Okubo, K., Otani, J. U., 17.09.2013. Ethanol-preserved bodies are deposited in coll. PGB, respective shells in coll. JUO.

The right ommatophoral retractor crosses male and female genitalia. Penis very long, rather spindle-shaped; inner wall of the distal portion is with 10–12 parallel folds; two of these folds become thickened proximally and connect at their proximal ends; penial caecum very short, pointed; epiphallus slender, cylindrical, about half as long as penis; retractor muscle about twice as long as the penis, very slender. Vagina flat, slightly longer than penis; equally wide to its proximal part, its distal end a bit more slender; proximal part of vagina attached to diaphragm with few slender fibres; vas deferens long, slender, and very slightly thickened at the end; bursa copulatrix and additional organ next to it are extremely long and very slender; only the bursa is slightly thickened. The uterus of the figured specimen from Jinbianyan contained six embryos, and the one from Sanlongshuijingrongdong had two embryos.

Remarks: This species has been reported from middle Sichuan (Páll-Gergely & Hunyadi 2013). The present localities are less than 5 km from the nearest locality.

Sinicola murata differs from *S. stenochila* only in shell size, relative size of the aperture, and shell colour (Páll-Gergely & Hunyadi 2013). Anatomical features of *S. murata*, however, are more similar to those of *S. asamiana*, which also inhabits Sichuan. Both species have the extremely long penial retractor muscle, short penial caecum and several long, widely-spaced muscle fibres along the vagina. *S. stenochila* differs from these species by having extremely long and terminally pigmented penial caecum of which the short and divided retractor muscle is attached, and vaginal muscle fibres which are restricted to the vaginal bulb.

17. Genital anatomy of *Sinicola murata* (Heude, 1885). Locality information: Sichuan, Dujiangyan Shi, Qingchengshan Zhen, Jinbianyan, 860 m, 30°53.762'N, 103°33.101'E. Scale represents 1 mm



18. Genital anatomy of *Sinicola reserata azona* (Gredler, 1887). Locality: Guizhou, Tongren Shi, Wanshanchen dirt road, Xianrendong, 863 m, 27°31.785'N, 109°13.008'E, leg. Ohara, K., Okubo, K. & Otani, J. U., 10.5.2010. Scale represents 2 mm

Sinicola reserata azona (Gredler, 1887)

Characters of the genital structure (Fig. 18, Fig. 20G, Fig. 21D, 21G): One specimen was dissected. Ethanol-preserved body is deposited in coll. PGB, respective shell in coll. JUO. Locality information: Guizhou, Tongren Shi, Wanshanchen dirt road, Xianrendong, 863 m, 27°31.785'N, 109°13.008'E, leg. Ohara, K., Okubo, K. & Otani, J. U., 10.5.2010.

The right ommatophoral retractor crosses male and female genitalia. Penis relatively long, spindle-shaped, slightly thickened at its middle part; internally with several longitudinal folds which form small "pockets" with neighbouring ones, in the whole distal portion of penis (Fig. 21D); penial caecum short, thickened; epiphallus slender, about half the length of penis; vas deferens slender, but becomes thicker near its insertion to spermoviductus; retractor muscle slender and moderately long, attaching to the end of penial caecum. Vagina flat, with a weakly developed "vaginal bulb"; vagina attaches to diaphragm with a few rather long fibres; diverticulum and bursa copulatrix are long and slender, with bursa slightly thickened. The anatomized specimen had a flat spermatophore with two round "packages", resembling two peas in a pod (Fig. 20G). A single, well-developed embryo was found in the uterus (Fig. 21G).

Sinicola stenochila (Möllendorff, 1885)

1885b *Plectopylis stenochila* Möllendorff, Nachrichtsblatt der Deutschen Malakozoologischen Gesellschaft, 11–12: 165 ["cum praec." = "Badung provinciae sinensis Hubei"].

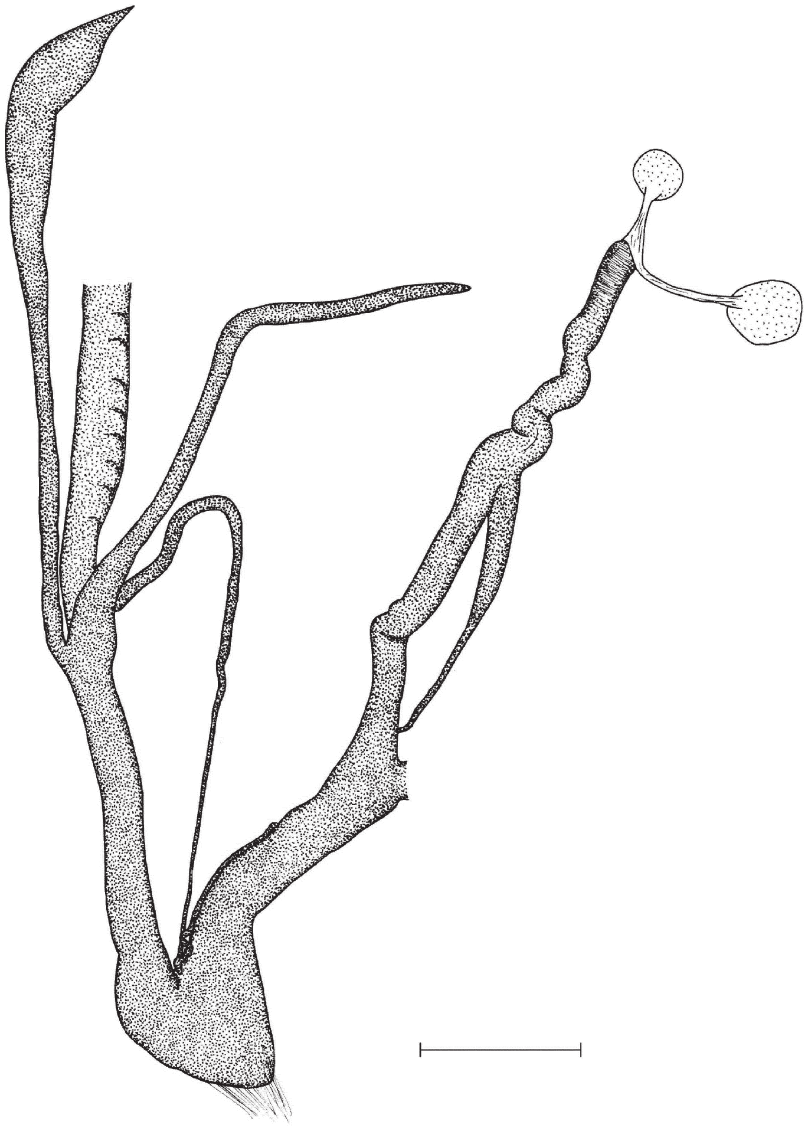
1897 *Plectopylis stenochila* var. *basilia* Gude, Science Gossip, 38 (4): 36, figs. 49a–c ["Badung, Province Hoo-Pé, China"].

New localities: Hubei, Badong Xian, Yanduhe Zhen, Shiyang Cun, 374 m, 31°11.98743'N, 110°21.46432'E, leg. Ohara, K., Okubo, K. & Otani, J. U., 10.05.2007., OK/4; Chongqing, Chongqing Shi, Wushan Xian, Jianping Xiang, near toll station, 710 m, 31°03.05724'N, 109°55.51583'E, leg. Ohara, K., Okubo, K. & Otani, J. U., 09.05.2007., OK/11 (one of them with smooth base); Chongqing, Chongqing Shi, Wushan Xiàn, Luoping Zhen, near toll station in Liziping, 1097 m, 31°11.55433'N, 110°04.46165'E, leg. Ohara, K., Okubo, K. & Otani, J. U., 10.05.2007., OK/16 (one of them with smooth base).

Characters of the genital structure (Fig. 19): Two specimens were anatomically examined. Collection information: Hubei, Enshi Tujiazu Miaozu Zizhizhou, Badong Xian, Badong E, Bashan Senlin Gongyuan, 300 m W from the entrance, 220 m, 31°01.684'N, 110°25.094'E, leg. Hunyadi, A., 3.11.2010. Ethanol-preserved specimens are deposited in coll. PGB.

The right ommatophoral retractor crosses male and female genitalia. Penis very long, cylindrical, equally wide throughout its length; distal half of penis internally with pockets which contained tiny calcareous granules; penial caecum very long, almost as long as penis, but slightly more slender than penis; distal end of penial caecum finely pigmented with transversal lines; two short, independent retractor muscles (or

a single, basally divided one?) attaches to distal end of caecum; epiphallus shorter and slimmer than caecum. Vagina about twice as long as penis, with well-developed vaginal bulb in the middle; vagina attached to diaphragm with several dense fibres on vaginal bulb; vas deferens long, slender, but thickened at the end; bursa copulatrix and additional organ next to the bursa are moderately long, the bursa is more thickened than the additional organ.



19. Genital anatomy of *Sinicola stenochila* (Möllendorff, 1885). Locality: Hubei, Enshi Tujiazu Miaozu Zizhizhou, Badong Xian, Badong E, Bashan Senlin Gongyuan, 300 m W from the entrance, 220 m, 31°01.684'N, 110°25.094'E. Scale represents 1 mm

Remarks: Yen (1939) treated *Sinicola stenochila* var. *basilia* (Gude, 1897) as a synonym of *Sinicola stenochila stenochila* (Möllendorff, 1885) based on some *S. stenochila stenochila* specimens that bear as sharp a keel as *basilia*. Páll-Gergely & Hunyadi (2013) distinguished these two forms based on the sculpture in the ventral shell surface (smooth in *basilia* and ribbed in *stenochila*), although specimens from Changyang showed intermediate shell characters between "typical" *stenochila* and *basilia*. New information revealed that smooth and ribbed specimens occur in the same new localities, which suggests that they represent variation within populations. Therefore, we conclude that *S. basilia* is a synonym of *S. stenochila* as proposed by Yen (1939). For anatomical notes, see under *S. murata*. The present new localities are 30–40 km from the nearest known sites.

Sinicola vargabalinti Páll-Gergely n. sp.

Fig. 2–3, 5A–B, 5D, 22 E–F.

Diagnosis: A middle-sized, uniformly coloured *Sinicola* species with thickened apertural lip and a weaker callus. Parietal wall with a single lamella and two horizontal plicae anteriorly, one above and one below.

Description: Shell yellowish corneous or reddish brown; lenticular with domed apical part, keel situated slightly above the middle line of shell in apertural view; apex slightly elevated from the dorsal surface; the 6.25–7 (n=5) regularly growing whorls separated by shallow suture; finely and regularly ribbed protoconch consists of about two and a half whorls; dorsal side of teleoconch sculpture above the keel dominated by irregular radial ribs with some spiral lines between them; ventral side under the keel smooth; dorsal and ventral surfaces change discontinuously in morphology across the keel; the keel with flat deciduous periostracal folds; these are sometimes visible on the preceding whorls on the dorsal surface of shell; peristome whitish, thickened and reflexed, callus relatively weak but always present, slightly S-shaped and both ends of callus are separated from peristome by shallow canals;

Two specimens were opened. On parietal wall there is a curved lamella and two long horizontal plicae anteriorly without denticles in between; first palatal plica short and situated close to suture; the last one also straight or curved downwards with an additional denticle above its posterior end; the remaining five plicae are more or less horizontal and parallel, but they are usually depressed V-shaped, with the longer arm of the "V" pointing in anterior direction. One specimen had "doubled" palatal plicae (Fig. 5B).

Measurements: (in mm, n=5): D= 16–19.5, H= 6.6–8.5.

Differential diagnosis: In size the most similar species is *Sinicola fimbriosa*, which has a more flattened shell with shouldered body whorl. The keel of *S. vargabalinti* is lower in position in apertural view than *S. fimbriosa* and slightly above the middle line of the shell. Moreover, *S. fimbriosa* has a light band around the umbilicus, stronger reticulated surface on the dorsal side of the teleoconch, and six more regular and straight palatal plicae, whereas seven slightly V-shaped palatal plicae are present in the new species. *S. fimbriosa* lacks the callus, but *S. vargabalinti* has the weak callus.

Material: China, Guangxi, Laibin Shi, Wushan Xiang, ex coll. Yang Hao, 2013, HNHM 97455 (holotype), HNHM 97456 (paratype), PGB/3.

Etymology: *S. vargabalinti* is named after Bálint Varga, a friend of the first author, to celebrate a 25 year-old friendship.

Genus *Plectopyloides* Yen, 1969

1969 *Plectopyloides* Yen, — Sitzungsberichte der Österreichisch Akademie der Wissenschaften (Abt.I), 177: 56.

1986 *Plectopyloides* (*Plectopyloides*), Li, — Professional Papers of Stratigraphy and Palaeontology, 14: 242.

1986 *Plectopyloides* (*Henanspirus*) Li, — Professional Papers of Stratigraphy and Palaeontology, 14: 246. **new synonym**

1986 *Plectopyloides* (*Menyinspirus*) Li, — Professional Papers of Stratigraphy and Palaeontology, 14: 244. **new synonym**

1986 *Plectopyloides* (*Yenellus*) Li, — Professional Papers of Stratigraphy and Palaeontology, 14: 245. **new synonym**

Remarks: Li (1986) revised the system of *Plectopyloides* Yen 1969 (type species: *Plectopyloides cretaceous* Yen 1969) after Li (1984, 1985) and Yen (1969) described plectopyloids. According to Yen (1969) the age of these fossils is late Cretaceous, but Li (1986) argued based on other fossils (gastropods, ostropods and mammals) that they belong to Eocene. Based on differences in umbilicus, palatal and parietal plicae and lamellae, Li (1986) erected three subgenera within the genus *Plectopyloides*, namely *Yenellus* (with the species *guanzhuangensis*), *Menyinspirus* (with the species *multispiralus*) and *Henanspirus* (with the species *altus*, *applanatus* and *regularus*; type species: *Plectopyloides regularus*). Li (1986) did not mention *Plectopyloides shantungensis* Yen, 1969. The palatal plicae and umbilicus differ only slightly among species of this genus. In contrast, the parietal plicae and lamellae differ from one another considerably. According to Li (1986), *Plectopyloides* has one vertical lamella and three parallel horizontal plicae anterior to the lamella (Fig. 5M), and *Yenellus* a single parietal lamella (Fig. 5O), whereas *Henanspirus* and *Menyinspirus* have two vertical lamellae (Figs 5 N, P). In addition, *Henanspirus* has a horizontal straight plica above the first lamella, but *Menyinspirus* lacks this plica. Our revision of living Chinese Plectopylidae (Páll-Gergely & Hunyadi 2013) revealed huge diversity in palatal as well as parietal plication within the same genera, between subspecies or sometimes even within specimens from the same localities. All of these types in variable parietal lamellation occur within the genus *Gudeodiscus*. The parietal plicae and lamellae of *G. ursula* Páll-Gergely & Hunyadi, 2013 are similar to those of the genus *Plectopyloides* (*Plectopyloides*). The "*Yenellus*-type" plication (presence of a single lamella) occurs in several species of the genus *Gudeodiscus*. Moreover, the "*Plectopyloides*-type" specimens as well as the "*Henanspirus*-type" specimens are found together with *Gudeodiscus emigrans otanii* in the same localities (see Páll-Gergely & Hunyadi 2013, and this study). Accordingly, these differences, although are seemingly large, do not support taxonomical separation into multiple subgenera or in other higher ranks than species. The subgenera described by Li (1986) (*Menyinspirus*, *Yenellus* and *Henanspirus*) are

synonyms of *Plectopyloides*. The taxonomic position of "*Plectopylis*" *antiquus* Yu & Pan, 1982 is questionable because the inner lamellae of fossils could not be observed, and thus should be placed in the genus *Plectopyloides*.

In the original description, Li (1986) used two different spellings for each of two species; *multispiralus* and "*multispiralul*" for one species and *guanzhuangensis* and "*guanzhangensis*" for the other species. We propose to use the names spelled as *multispiralus* and *guanzhuangensis*.

Plectopyloides and *Gudeodiscus* are more similar to each other than others, in the rounded body whorl and morphology of plicae and lamellae. *Plectopyloides* differs from *Gudeodiscus* in the conspicuously narrow umbilicus and arrangement of palatal plicae. According to the drawings of Li (1986) (see Fig. 5I–L), the lower, straight and long palatal plica is situated anteriorly of the penultimate and curved plica. This is never the case in *Gudeodiscus*, which has the short, usually curved plica usually under the penultimate plica. In some cases, such as in *Gudeodiscus marmoreus* n. sp., the lower plica is positioned anteriorly to the other plicae, but much lower in position, unlike in *Plectopyloides*. *Plectopyloides* is so far only fossil genus that can be assigned to family Plectopylidae without doubts, based on the vertical parietal lamellae which distinguishes plectopylids from all other conchologically similar groups. The other genera that have been mentioned as probably related to Plectopylidae/Corillidae, such as the Middle European *Proterocorilla* Hrubesch, 1965 and *Pseudostrobilus* Oppenheim, 1892 (see also Tausch 1886) or the Indian "*Anchistoma*" species (see Stoliczka 1868 and Nevill 1881), are all much older (Cretaceous) and have no vertical lamellae. The systematics of these fossils require a comprehensive revision. They may probably be assigned to the superfamily Plectopyloidea but not to the family Plectopylidae.

Family Camaenidae Pilsbry, 1895

Remarks: Molecular phylogenetic studies (Wade et al. 2006, 2007) showed that former Camaenidae (without dart apparatus) and Bradybaenidae (with dart apparatus) are mutually polyphyletic within a monophyletic clade. Therefore Bradybaenidae is a junior synonym of Camaenidae.

Genus *Amphicoelina* Haas, 1933

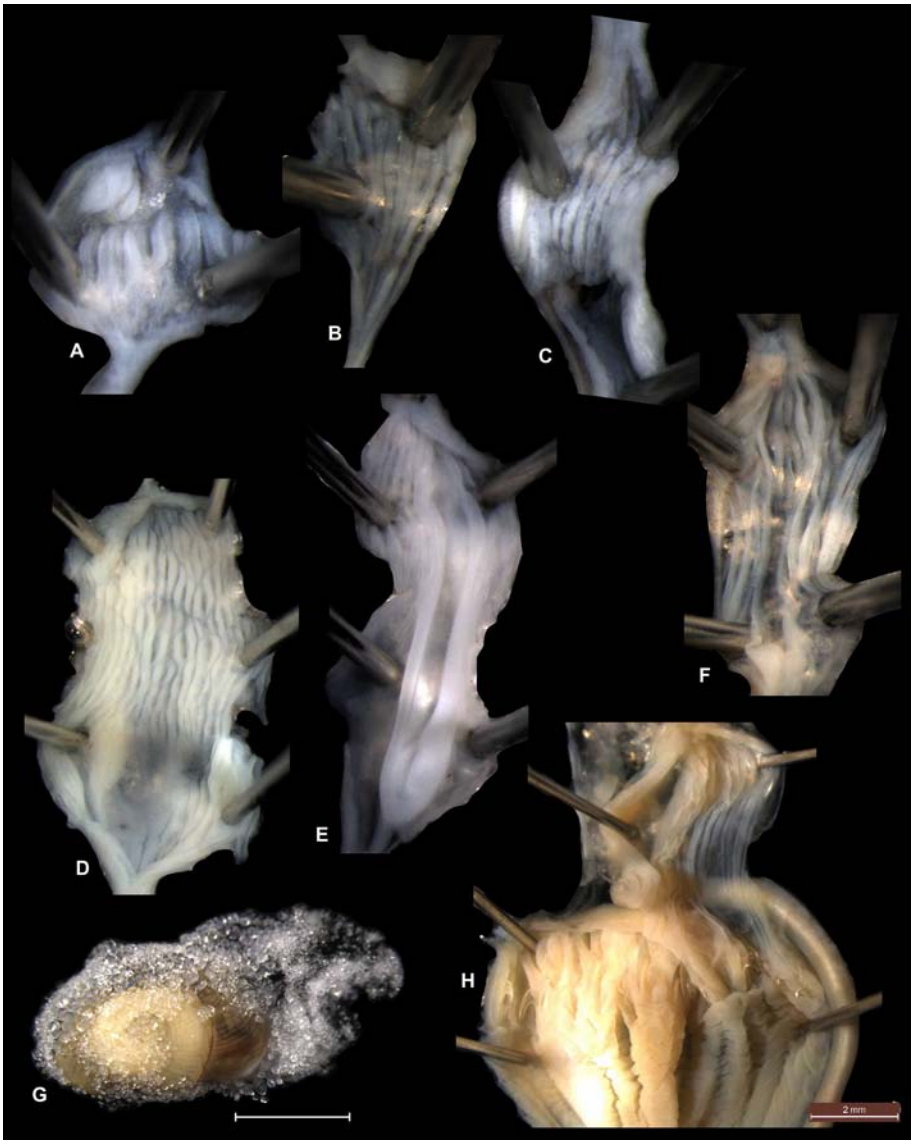
1933 *Amphicoelina* Haas, Archiv für Molluskenkunde, 65 (4/5): 231.

Type species: *Helix biconcava* Heude, 1882.

Content: *biconcava* (Heude, 1882), *diplomphala* (Möllendorff, 1886), *omphalospira* (Möllendorff, 1897) and *subobvoluta* (Ancey, 1882).

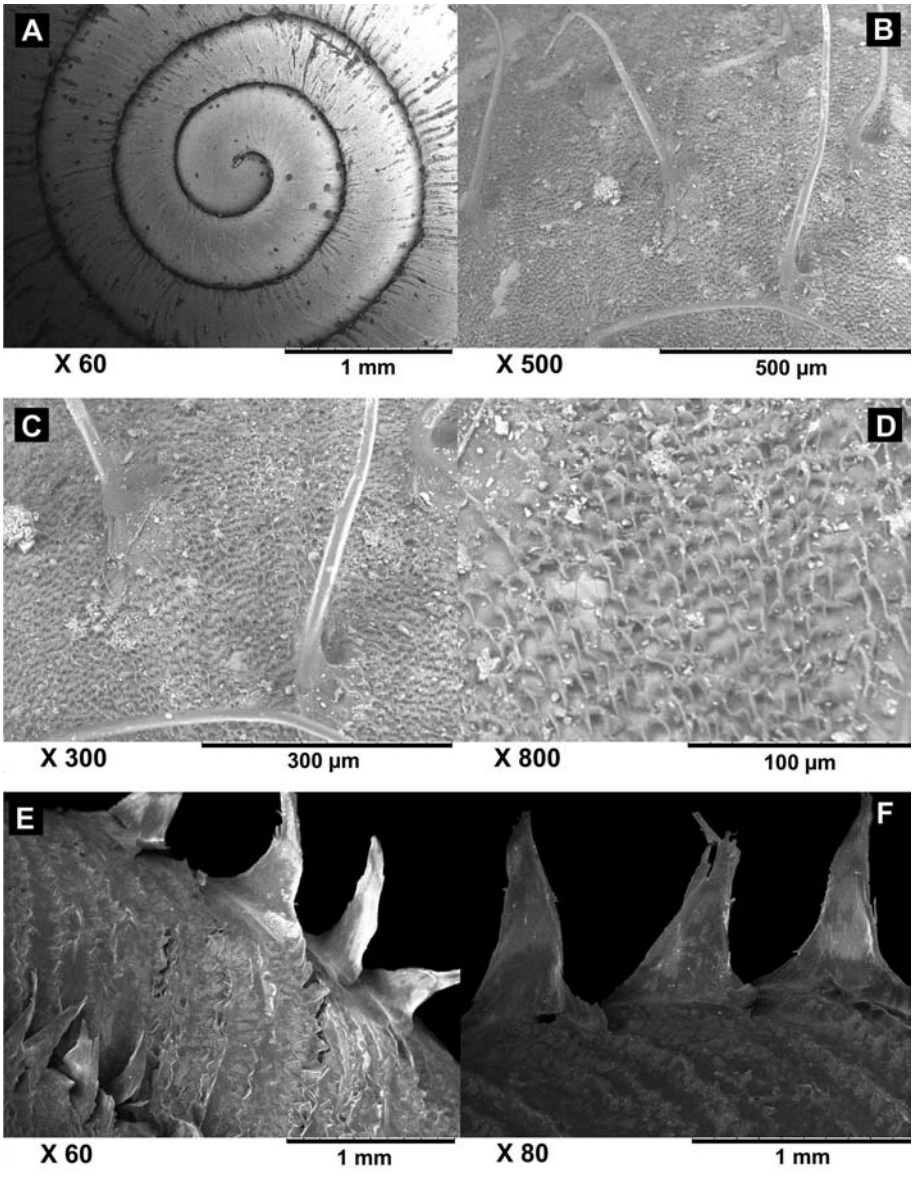
Remarks: Haas (1933) erected the genus *Amphicoelina* for four Chinese *Drepanostoma*-like (*Drepanostoma* Porro, 1836, family Helicodontidae) species, and chose *Helix biconcava* Heude, 1882 as the type species. He proposed that the genus is closely related to *Chloritis* (now family Camaenidae, see Schileyko 2003). To our knowledge,

20A-F: inner wall of the penis and penial caecum of Chinese *Gudeodiscus* species. 20G-H: both sides of spermatophore of Chinese Plectopylidae species. For geographic localities see previous figure captions. A: *G. emigrans otanii* Páll-Gergely, 2013, "Specimen1"; B: *G. emigrans otanii* Páll-Gergely, 2013, "Specimen2"; C: *G. okuboi* Páll-Gergely & Hunyadi 2013 ("Specimen1"); D: *G. giardi giardi* (H. Fischer, 1898); E: *G. multispira* (Möllendorff, 1883); F: *G. eroessi eroessi* Páll-Gergely & Hunyadi, 2013 ("Specimen1"); G: *Sinicola reserata azona* (Gredler, 1887); H: *G. emigrans otanii* Páll-Gergely, 2013 ("Specimen3")



21A-F, H: inner wall of the penis and penial caecum of Chinese *Gudeodiscus*, *Sicradiscus* and *Sinicola* species. Fig. 21G: embryo in the embryo sac. A: *Sic. invius* (Heude, 1885); B: *Sic. transitus* Páll-Gergely, 2013; C: *Sin. asamiana* Páll-Gergely, 2013; D: *Sin. reserata azona* (Gredler, 1887), E: *Sin. murata* (Heude, 1885) (same specimen as in Fig. 18); F: *Sin. emoriens* (Gredler, 1881); G: *Sin. reserata azona*; H: *Gudeodiscus pulvinaris pulvinaris* (Gould, 1859)

the first author who classified *Amphicoelina* within the Corillidae was Yen (1939). Zilch (1960) followed this idea, and classified *Plectopylis*, *Corilla* and *Amphicoelina* within Corillidae. Schileyko (1999) mentioned that there is a thin parietal lamella inside the body whorl and classified the genus together with Gude's sections into the Plectopylidae. Our examination, however, did not confirm the presence of a vertical



22. SEM images of the shell of *Amphicoelina* sp. China, Chensi merid., Mont Tsin-Ling (?), leg. l'Abbé David, MNHN 2012-27024, (A–D) and *Sinicola vargabalinti* n. sp. (E–F; paratype, same data as Fig. 2)

plate beyond the aperture (or any inner lamellae or teeth). In the SMF collection we examined the *Amphicoelina* shells, and found three shells with broken apertural part (i.e. the last half/quarter whorl was missing): paralectotype of *A. diplomphala*, Patung, Hupei: China, coll. Möllendorff, SMF 7018; paralectotype of *A. omphalospira*, Patung, Hupei: China, coll. Möllendorff, SMF 7016A; one corroded specimen labelled as *A. subobvoluta*, Njŭ-tsoŭ-shan, Ta-Yeh, Hupei, China, Krejci-Graf, S 1937, SMF 24755. The internal lamellae would have been visible in these shells if they were present, but we found no signs of folds. Moreover, one *Amphicoelina* specimen (China, Chensi merid., Mont Tsin-Ling (?), leg. l'Abbé David, MNHN 2012-27024) has a small hole of the last whorl which allowed us to observe the parietal wall. We again found no signs of plicae. To our knowledge, no illustrations of lamellae of *Amphicoelina* have ever been published.

The shell sculpture of *Amphicoelina* consists of extremely small (about 10–20 μm) scale-like structure as well as long, slender and cylindrical hairs (Fig. 22). These slender periostracal hairs are not in spiral or radial arrangement. This sculpture clearly differs from that of Plectopylidae, which usually have the reticulated surface. Some plectopylid species (*Chersaecia dextrorsa*, several *Sinicola* and *Endothyrella* species) also possess long periostracal folds, but these are arranged in well-visible spiral lines on the body whorl. At present, our information on *Amphicoelina* is limited, without anatomy of soft bodies. However, the absence of internal lamellae and the camaenid-like sculpture on shell surface suggest that *Amphicoelina* belongs to the Camaenidae as proposed by Haas (1933).

Distribution: Southern China (Hunan and Hubei).

REMARKS ON THE ANATOMY

Out of approximately 120 plectopylid species, genital anatomy is only known in the following species: *Plectopylis bensoni* (Gude, 1914 under the name *achatina*) and *P. cyclaspis* (both in Stoliczka 1871); *Chersaecia simplex* (Solem 1966, in the original description); *Endothyrella pinacis* (Godwin-Austen 1889–1914, Schileyko 1999); *Sicradiscus hirasei* (Pilsbry, 1904) (Azuma & Azuma 1984), *Sic. ishizakii* (Kuroda, 1941), (Chang & Ookubo 1999), *Sic. schistoptychia* (in Páll-Gergely & Hunyadi 2013), *Sic. transitus* and *Sic. invius* (this study), *Sinicola fimbriosa*, *Sin. emoriens* (in Páll-Gergely & Hunyadi 2013), *Sin. asamiana*, *Sin. murata*, *Sin. reserata azona*, *Sin. stenochila* (this study), *Gudeodiscus pulvinaris robustus*, *G. multispira*, *G. phlyarius* (in Páll-Gergely & Hunyadi 2013), *G. emoriens otanii*, *G. eroessi eroessi*, *G. giardi giardi*, *G. okuboi*, *G. pulvinaris pulvinaris* (this study). Stoliczka (1871) mentioned that he also "examined the animal" of *Plectopylis macromphalus* (W. Blanford, 1870) (now genus *Endothyrella*), but described only the anatomy of *Plectopylis achatina* and *P. cyclaspis*.

The genital organs of Plectopylidae are rather simple and do not show significant diversity. Most species share simple penis and epiphallus with or without penial caecum, having the retractor muscle attached to the penis-epiphallus transition or on the penial caecum. The female genitalia are also simple, usually with a (1) "vaginal bulb",

which is a thickening at the middle of the vagina where the organ is folded ("turns back") in the animal when it is withdrawn into the shell; (2) muscle fibres which fix the vagina to the diaphragm, and (3) a long bursa copulatrix with usually an additional and similarly shaped organ running in parallel with the bursa copulatrix. The genitalia of *Chersaecia simplex* differ from all the other known plectopylids by lack of an epiphallus and unique formation of vas deferens. According to Solem (1966), the vas deferens "becomes an integral part of the fibres surrounding the penis, ascends penis laterally to its head, entering through small penis papilla". Additionally, *Ch. simplex* lacks the additional organ next to the bursa copulatrix.

There are two characters which show dimorphism across plectopylid species (all except for *Ch. simplex*). Namely, the presence or absence of the penial caecum and the additional organ next to the bursa copulatrix. The penial caecum is absent in *S. invius*, *S. ishizakii* (see Chang & Ookubo 1999) and in both *Plectopylis* species (Stoliczka 1871). It is probably also absent or vestigial in *S. hirasei* as well, but the drawing and the description of Azuma and Azuma (1984) is not clear in this respect. On the other hand it is present in all known *Sinicola* species (*asamiana*, *emoriens*, *fimbriosa*, *murata*, *stenochila*), in *Sicradiscus schistoptychia* and it is vestigial in *S. transitus*. All known Chinese *Gudeodiscus* species has penial caecum (Páll-Gergely & Hunyadi 2013 and this study).

The organ next to the bursa copulatrix was described by Stoliczka (1871) as "a shorter, more muscular gland which appears to represent the arrow or amatorial gland" and by Pilsbry (1894) as "An organ of unknown homology, either a dart sack, a diverticulum of the spermatheca or an appendicula". The identity of this organ is unknown. It is extremely slender and it is difficult to dissect out especially in case of gravid animals, because it is attached to the very thin wall of the oviduct. Probably for this reason, this organ is absent in figures in the literature (see Páll-Gergely & Hunyadi 2013). This makes the evaluation of taxonomic importance of this trait difficult. These results suggest that the presence or absence of penial caecum and additional organ parallel next to the bursa copulatrix within the family Plectopylidae may have only limited values of taxonomy. The variation of other characters such as the morphology of the inner plicae and lamellae of the shell and the surface of the inner wall of reproductive organs could be more informative for the taxonomy of this group.

We see two types in terms of the morphology of the penis-epiphallus-retractor muscle complex in the genus *Gudeodiscus*. In one type, the epiphallus is slender, cylindrical, and addition to the retractor muscle, which attaches on the penial caecum, several muscle fibres attach to the penis itself (*emigrans*, *eroessi*, *okuboi*, *pulvinaris*). In the other type the epiphallus has a somewhat thickened proximal part, and has no additional muscle fibres attached to the penis. In this second type only the single retractor muscle is visible which attaches at the end of the penial caecum (*giardi*, *multispira*, *phlyarius*). Even if these two groups seem to be clearly distinct, we cannot state that they form monophyletic units, because the shell morphology of *G. multispira* and *G. eroessi*, as well as *G. phlyarius* and *G. emigrans* are very similar. More information is needed to see if the genus *Gudeodiscus* is separable on the basis of the penial morphology.

The morphology of the inner penial wall might be useful to reveal the taxonomic relationship between the genera *Gudeodiscus*, *Sicradiscus* and *Sinicola*. All known *Sinicola* species (*asamiana*, *emoriens*, *fimbriosa*, *murata*, *reserata azona*, *stenochila*) have parallel folds on the inner wall of penis, sometimes with tiny, flat or rounded calcareous granules between these folds, or within the slit-like pockets which are formed by neighbouring folds. Even if "pockets" are formed by the folds, they cover the whole inner wall of the distal portion of the penis. In contrast, in the genus *Gudeodiscus* the pockets are arranged in one or two transversal rows. In the genus *Gudeodiscus* these pockets are occasionally filled with hook- or claw-like calcareous crystals. The presence of these crystals seems to be associated with the mating season (or absence of embryos within the uterus). *Sicradiscus invius* and *Sic. transitus* also had "pockets" on the inner wall, similar to those of the genus *Gudeodiscus*. In contrast, *Sicradiscus schistoptychia* had simple parallel folds, similar to those of *Sinicola* species. *S. schistoptychia* is very similar to *Sic. transitus* in terms of shell morphology. Thus, the anatomical similarity to the former to *Sinicola* and the latter to *Gudeodiscus* species is surprizing. Since the anatomy of the majority of *Gudeodiscus* and *Sicradiscus* species is unknown, we find the available information insufficient to draw a conclusion regarding the value of this character and the relationship between *Sicradiscus* and *Gudeodiscus*.

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APPENDIX

All mentioned Chinese localities and their respective provinces presented in simplified Chinese characters.

Pinyin	**Chinese characters**	**Province**
Aishan Xiang	矮山乡	Guangxi
Badong Xian	巴东县	Hubei
Bama Xian	巴马县	Guangxi
Banxintun	板新屯	Guangxi
Bishuiyan	碧水岩	Guangxi
Chaotianyan	朝天岩	Guangxi
Chongqing	重慶	Chongqing
Chongqing Shi	重慶市	Chongqing
Chuanshan	川山	Guangxi
Chuanyan	穿岩	Guangxi
Cili Xian	慈利县	Hunan
Daxin Xian	大新县	Guangxi
Dujiangyan Shi	都江堰市	Sichuan
Ertang Zhen	二塘镇	Guangxi
Fuli Zhen	福利镇	Guangxi
Gongcheng Xian	恭城县	Guangxi
Guangxi	广西	Guangxi
Guigang Shi	贵港市	Guangxi
Guilin Shi	桂林市	Guangxi
Guizhou	貴州省	Guizhou
Guzhang Xiang	古樟乡	Guangxi
Hechi Shi	河池市	Guangxi
Huangcai Zhen	黄材鎮	Hunan
Hubei	湖北	Hubei
Hunan	湖南	Hunan
Jiahui Xiang	嘉会乡	Guangxi
Jianping Xiang	建平乡	Chongqing
Jiaojintang	蛟津塘	Guangxi
Jinbianyan	金鞭岩	Sichuan
Jinli	金骊	Sichuan

Lahaoyan	拉号岩	Guangxi
Laibin Shi	来宾市	Guangxi
Limu Zhen	栗木镇	Guangxi
Lipu Xian	荔浦县	Guangxi
Liuzhou Shi	柳州市	Guangxi
Liziping	梨子坪	Chongqing
Longzhou Xian	龙州县	Guangxi
Luohanduyan	罗汉肚岩	Guangxi
Luoping Zhen	骡坪镇	Chongqing
Muqiao	木桥	Guangxi
Mushan	木山	Guangxi
Ningxiang Xian	寧乡县	Hunan
Nonggang	弄岗	Guangxi
Pingan Xiang	平安乡	Guangxi
Pingyue Xian	平乐县	Guangxi
Poliu Elementary School	坡六小学	Guangxi
Puyi Xiang	普益乡	Guangxi
Qianfodong	千仏洞	Hunan
Qidong Xiang	七洞乡	Guangxi
Qimu Xiang	岂暮乡	Guangxi
Qingchenghoushan	青城后山	Sichuan
Qingshan	青山	Guangxi
Qingshan Zhen	青山镇	Guangxi
Qionglai Shi	邛崃市	Sichuan
Qunhe Cun	群合村	Guangxi
Sanguansitujiazu Xiang	三官寺土家族乡	Hunan
Sanjiang Xiang	三江乡	Guangxi
Sanlongshuijingrongdong	三龙水晶溶洞	Sichuan
Shenxiandong	神仙洞	Sichuan
Shiyang Cun	石羊村	Hubei
Shuanghedong	双合洞	Hunan
Sichuan	四川	Sichuan
Taian Zhen	泰安鎮	Sichuan
Tiane Xian	天峨县	Guangxi

Tiantaishan Dengyuean	天台山等乐安	Sichuan
Tiantaishan Zhen	天台山	Sichuan
Tianzishan	天子山	Hunan
Tongren Shi	銅仁市	Guizhou
Wanggao Zhen	望高镇	Guangxi
Wanshanchen	万山特区	Guizhou
Wude Xiang	武德乡	Guangxi
Wulingyuanqu	武陵源区	Hunan
Wushan Xian	巫山县	Chongqing
Wushan Xiang	五山乡	Guangxi
Xiannuyan	仙女岩	Guangxi
Xianrendong	仙人洞	Guizhou
Xingbin Qu	兴宾区	Guangxi
Xinhe	新合	Guangxi
Xinzhai Cun	新寨村	Guangxi
Yanduhe Zhen	沿渡 河镇	Hubei
Yangshuo Xian	阳朔县	Guangxi
Yangshuo Zhen	阳朔镇	Guangxi
Yankou Cun	岩口村	Guangxi
Yizhou Shi	宜州市	Guangxi
Zhangjiajie Shi	张家界市	Hunan
Zhangjiajieda Xiagu	張家界大峡谷	Hunan
Zhongshan Xian	钟山县	Guangxi