ANATOMY OF *CONIGLOBUS NUX PAIWANUS* (KURODA) AND *CONIGLOBUS PEKANENSIS* (ROLLE) FROM SOUTH TAIWAN (PULMONATA : CAMAENIDAE)

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關鍵詞： 有肺類—南亞蝸牛科，蝸牛。
Key words: Pulmonata-Camaenidae, Landsnail.

Coniglobus nux paiwanus was originally described by T. Kuroda (1941) and *C. pekanensis* was reported by Rolle with specimens from south Taiwan, but so far no studies have been done on their anatomy. The reproductive systems of *C. nux paiwanus* and *C. pekanensis* are reported here for the first time. By the characters of reproductive system, these species should be settle in genus *Coniglobus* which is a synonym of genus *Satsuma* of Japan and differed from *Pancala batanica pancala* (Schmacker & Böttger) which was settled in same family Camaenidae and was the allied species from south Taiwan.

Materials and Methods

Three living specimens of *C. nux paiwanus* are collected from Chihsan, Kaohsiung county and two living specimens of *C. pekanensis* from Chihpen, Taitung county were immersed in boiling water a few seconds and were separated their soft parts from shells in water. They were dissected in FAA solution under a dissecting microscope.

Result

Shell:

C. nux paiwanus; medium in size (20.0 mm long 27.5 mm wide), dextral winding, more depressed conic shaped, relatively solidy shell with lustrous yellow brown coloured on surface. Whorls 5¼ in number. Each whorl less convexious with shallow suture. Irregular fine oblique striae on surface. Body whorl fine red-brown coloured band on periphery, acute peripheral angle in front of aperture. Peristome and interior of aperture pale red-violet, basal lip not so flattened as in *C. nux*. Base much convex with narrow umbilicus. Umbilical margin and columellar lip also red-brown in colour (Fig. 1-1, Table 1).

General shape of shell resembles *Pancala succincta* (H. Adams) but differs from it in the less convex whorls, shallow suture, narrow umbilicus, much convexious base and around of the umbilicus. The peripheral red-brown band linear, not so broad as in *P. succincta*.

C. pekanensis; medium in size (19.4 mm long, 24.9 mm wide), sinistral winding, depressed conic shape, relatively solid shell with lustrous chest-nut brown on surface. Whorls 6 in number. Each whorl weakly convex with shallow suture, incremental irregular oblique fine striae on surface. Body whorl slightly descended on anterior, fine red-brown band on carinated periphery with rather paler colored band below. Acute angulation in front of aperture. Base almostly flat. Aperture diagonal, semilunar shape. Thicken whitish peristome reflected distinctly to outward. Umbi-

Fig. 1-1: *Coniglobus nux paiwanus*.
Left: Ventral view.
Right: Basal view.

Table 1. Comparison of conchometries among *C. nux paiwanus*, *C. pekanensis* and *C. nux*.

(in mm)

	C. nux paiwanus (n* = 8, Chang)	*C. pekanensis* (n* = 20, Chang)	*C. nux* (n* = 8, Chang)
Shell			
Length	20.6 (23–20)	20.5 (23.6–16.1)	20.5 (24.8–17.3)
Width	28.0 (31–26.5)	25.9 (31.1–23.4)	24.1 (29.15–20.1)
Length/Width	0.73 (0.77–0.72)	0.79 (0.82–0.68)	0.85 (0.95–0.80)

*n = Sample size.

licus opened widely. Callus of columellar lip well developed and covered the umbilical opening partially. Dark brown colour also on columellar lip and umbilicus (Fig. 1-2, Table 1).

Reproductive system:

C. nux paiwanus; Penial sheath long, well developed, large in diameter to posterior, faint violet on anterior half, loose fibrous adhesion with epiphallus. Penial appendix globose or ellipsoid shape on posterior end of penial sheath, distinct constricture between appendix and penial sheath. Epiphallus long, slender, almost same in diameter on full length with long flagellum on posterior end. Anterior end of epiphallus inserted into the appendix where is a lateral side near to obtuse appendical tip. Penial retractor strongly attached anterior one third of epiphallus. Vas deferens long, slender, separating from oviduct at 2 mm anterior from the prostate gland. Vagina well developed, very long, large in diameter on posterior half. Oviduct also long, distorted on anterior. Stalk of spermatheca very long,

Fig. 1-2: *Coniglobus pekanensis.*
Left: Ventral view.
Right: Basal view.

Table 2. Measurement of reproductive system and radulae of *C. nux paiwanus*, *C. pekanensis* and *C. nux*.

(in mm)

	Abb*	*C. nux paiwanus* n** = 3 Chang	*C. pekanensis* n** = 2 Chang	*C. nux* n = 3 Chang
Reproductive system				
Penial sheath	PS	21 – 11	25 – 18	53 – 10
Epiphallus	EP	16 – 13	40	35 – 13
Penial appendix	PAP	3.0 x 1.5	1.9 – 1.0 x 1.5 – 1.3	0.8 – 1.0 x 2.0 – 2.2
Flagellum	FL	6.5 – 5.0	11	19 – 5
Vas deferens	VD	35 – 31	52	52 – 29
Vagina	VA	19.5 – 17	16	49 – 21
Oviduct	OD	15 – 10	6	5.5 – 4
Stalk of spermatheca	SS	31 – 26	16	35 – 23
Spermatheca	SP	2.3 x 1.5	8 x 4	7 – 2.5 x 4.5 – 1.4
Radula				
Ribbon size		7.2 x 2.1	6.7 x 1.8	6.1 x 3.0
Row of teeth		165	173	152
Formula of radula		C + 15 + 27	C + 11 + 25	C + 14 + 49

* Abb = Abbreviation in text figure 2. **n = Sample size.

slender to posterior. Spermatheca long pear or oval shape, white, closely attached along the prostate gland.

C. pekanensis; Penial sheath long, large in diameter to posterior. Penial appendix ellipsoid shape on posterior end of penial sheath, fibrous membrane on surface, junction is conspicuous due to presence of constricture between penial sheath and appendix. Several longitudinal folds inwardly. Orifice of epi-

phallus opened on the area between folds where is near to tip of appendix. Epiphallus also long, tortuous. Penial retractor tightly adhered to anterior part of epiphallus. Slender long flagellum on the posterior end of epiphallus. Vas deferens long, very slender, separating from oviduct at anterior end of prostate gland. Vagina relatively short, poorly developed. Oviduct

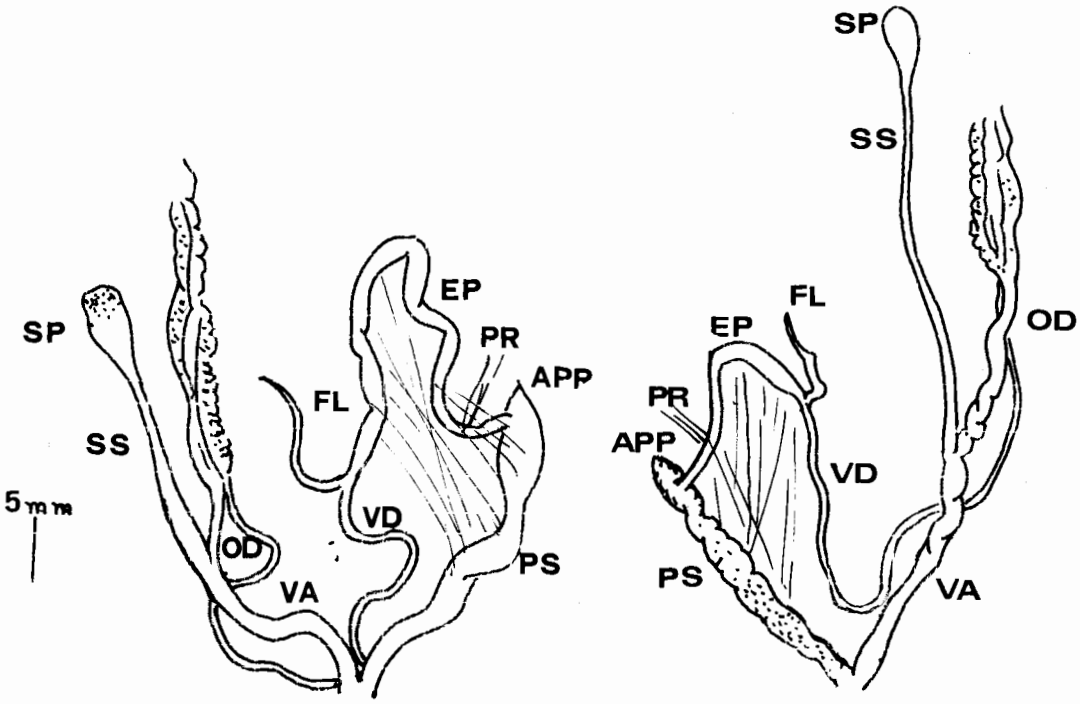


Fig. 2-1: Reproductive system of *Coniglobus nux paiwanus* (left) and *Coniglobus pekanensis* (right).

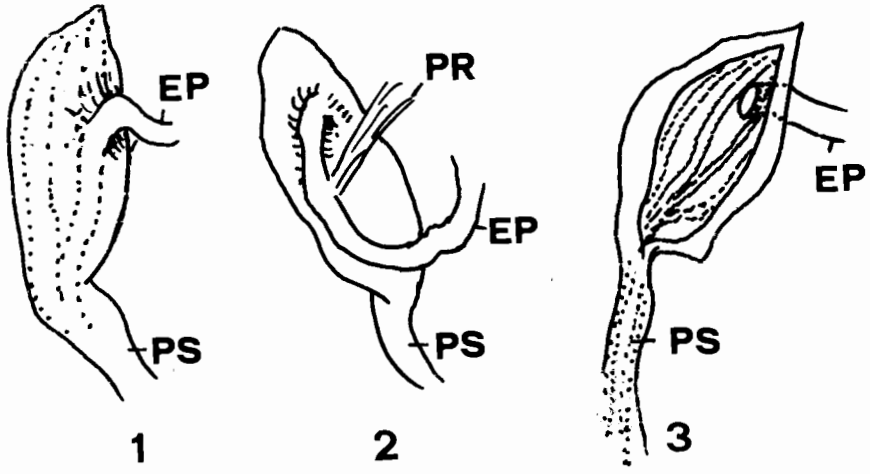


Fig. 2-2: Penial appendix of *Coniglobus pekanensis*.
1, 2: Outer view. 3: Inner view. 8–9 longitudinal folds inwardly. Orifice of epiphallus opened on an area between folds. 4 longitudinal folds in penial sheath.

very short. Stalk of spermatheca long, larger in diameter than vagina but fine to posterior. Spermatheca long pear or triangle in shape, dark red in colour on tip (Table 2, Fig. 2-1, 2-2).

Radula:

C. nux paiwanus; Radular ribbon is 7.2 by 2.1 mm in size and is carrying about 165 rows of radular teeth. The radular formula is 37+15+C. The cuspid transformed longer and variation starting from 12th tooth.

C. pekanensis; Radular ribbon is 6.7 by 1.8 mm in size and is carrying almost 173 rows of radular teeth. The radular formula is 25+11+C. The cuspid transformed longer and variation starting from 11th tooth (Table 2, Fig. 3).

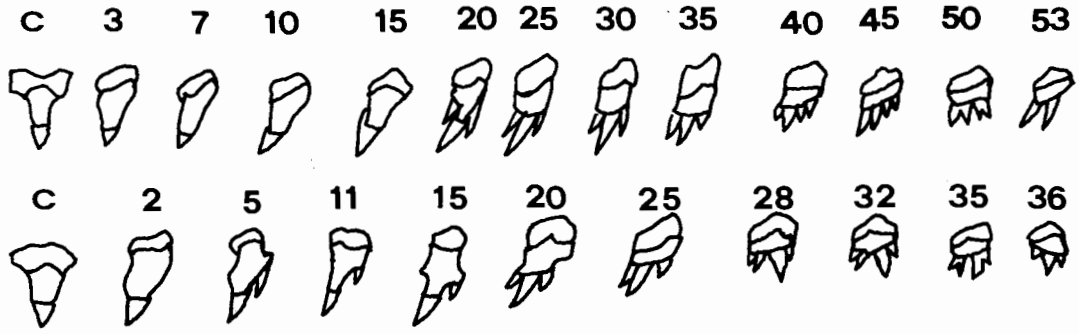


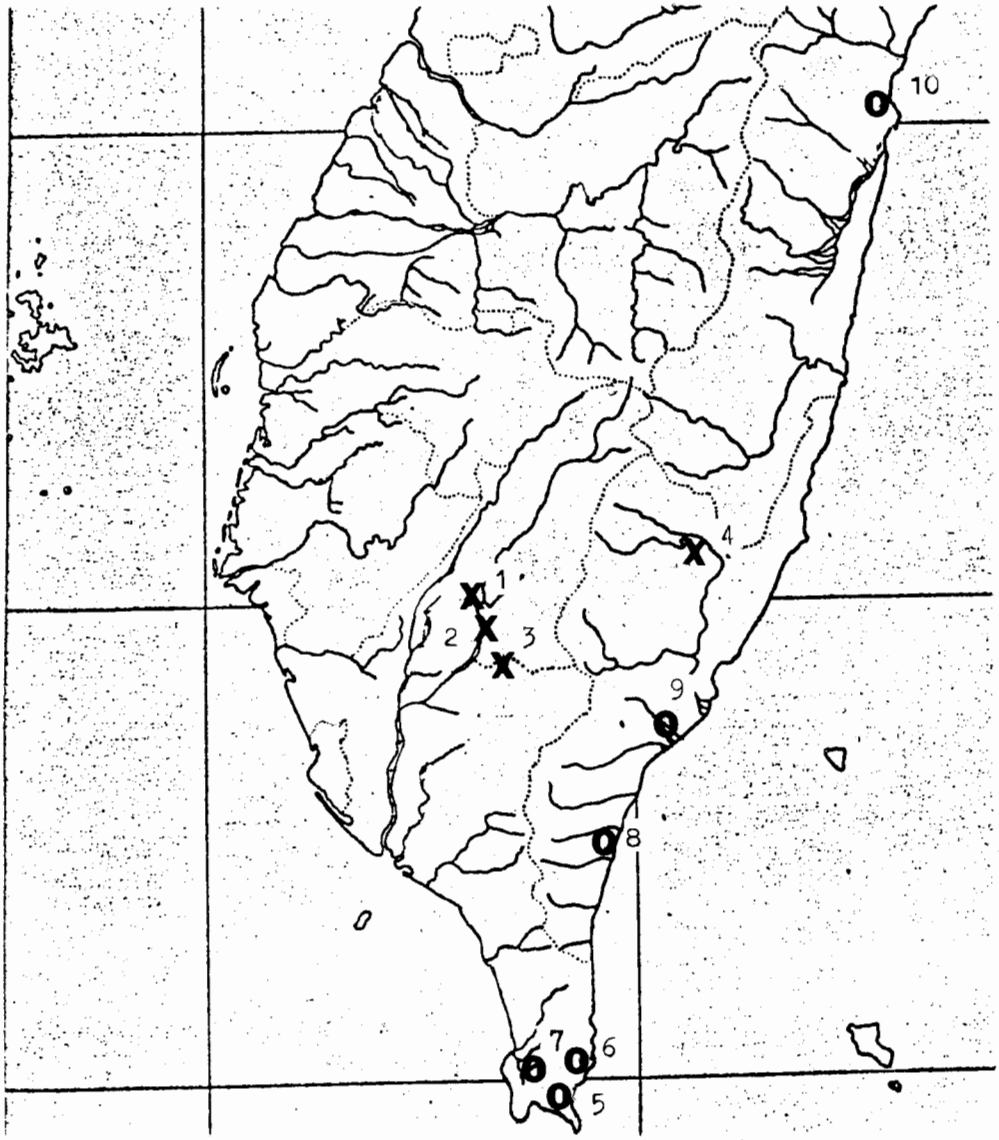
Fig. 3: Radular teeth of *C. nux paiwanus* (Above) and *C. pekanensis* (Below).

Remarks

By the absence of dart sack and mucous gland in reproductive system, *C. nux paiwanus* and *C. pekanensis* have been assigned to the family Camaenidae. In Taiwan the snails of this family are divided into four genera; *Moellendorffia*, *Trichochloritis*, *Coniglobus* and *Pancala*. Key of them are given already by the author (1981).

The taxon *Coniglobus* was created by Pilsbry & Hirase (1905) as subgenus but the same taxon was raised to a genetic status and synonymized in the "genus *Satsuma* A. Adams, 1868" of Japan due to same character of reproductive system simultaneously by Minato (1975). This genera from Taiwan is including fifteen species and seven subspecies (Kuroda, 1941). Among them *sphaeroconus* was anatomized its soft animal by Minato (1975), *nux* by Wu & the author (1975), *albida mollicula* and *arisana takahashii* by Sinakawa (1980), *melleus* by the author (1981). In this study the author ascertained again that *nux paiwanus* and *pekanensis* belong to genera *Coniglobus* according to the presence of penial appendix and flagellum in their reproductive system which was identified by the key of the author (1981).

On the other hand genera *Pancala* Kuroda & Habe, 1949 distributed in Taiwan and Orchid island, including two species and four subspecies. *Pancala batanica pancala* from south cape and *P. b. boteltobagoensis* from Orchid island were anatomized their soft animals by Table (1937), *P. b. pancala* and *P. bacca* were by Sinakawa (1979). Among Camaenidae species they are more allied to genera *Coniglobus* due to have depressed conic shape shell with smooth surface, brown coloured peripheral band and flagellum in reproductive system. Although they have not penial appendix or have penial appendix which is



Map of central and southern Taiwan shows localities of *C. nux paiwanus* (X) and *C. pekanensis* (O).

Habitats of *Coniglobus nux paiwanus*: 排灣柔蝸牛產地(括弧內：報告者)

1. Liukuei, Kaohsiung county. 高雄縣、六龜(黑田：師大生物組)
2. Meinung, Kaohsiung county. 高雄縣、美濃、黃蝶谷(著者)扇平(賴)
3. Tachin, Kaohsiung county. 高雄縣大津(張文重)
4. Hsinwulu, Taitung county. 台東縣、南部橫貫公路、新武路(賴)

Habitats of *Coniglobus pekanensis*: 左捲柔蝸牛產地

5. Kenting, Pintung county. 屏東縣墾丁(著者)
6. Chiupeng, Pintung county. 屏東縣九棚(張文重)
7. Henchun, Pintung county. 屏東縣恆春(平瀨)
8. Tawu, Taitung county. 台東縣大武(林秀雄)
9. Chipen, Taitung county. 台東縣知本(賴)
10. Hualien, Hualien county. 花蓮縣花蓮(小松崎)

not conspicuous and without folding inwardly. Their epiphallus directly communicated to penial sheath and not passed through appendix as genera *Coniglobus* (Table, 1937. Minato, 1979). In present species, their penial appendix are conspicuous with several folds inwardly and epiphallus inserted to the lateral side of appendix with its orifice between the folds.

Paiwanus was originally described as the subspecies of *Coniglobus nux* (Moellendorff, 1888) by Kuroda (1941) due to have much affinity in shell feature but differ from the latter in its more depressed spire, acute peripheral angle in front of aperture and non flatten basal lip. In anatomical study *paiwanus* has more longer oviduct and shorter penial sheath, epiphallus, flagellum, vagina.

Coniglobus pekanensis was originally described by Rolle. This species is affinitive as *nux* in its depressed conic shaped shell with brown peripheral band, but differs by sinistral winding in shell with short penial sheath, vagina, and stalk of spermatheca.

Acknowledgements

I would like to thank Mr. K. Y. Lai for providing valuable specimens for this study.

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臺灣產排灣栗蝸牛及左捲栗蝸牛之解剖

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排灣栗蝸牛*Coniglobus nux paiwanus*及左捲栗蝸牛 *Coniglobus pekanensis* 都是臺灣南部產大型美麗之蝸牛。因未曾有解剖其生殖器系統，著者自高雄縣旗山採集之前者蝸牛三個體，及台東縣知本採集的後者蝸牛二個體進行解剖之結果，這兩者因其生殖器沒有粘液腺及矢囊，却有鞭狀器及陰莖附屬枝，確定都屬於橡實蝸屬*Coniglobus*（日本之薩摩蝸屬*Satsuma*同義名稱）。這兩者都呈示陰莖附屬枝在陰莖鞘起始部顯著膨大。其內部有數條的摺痕。陰莖本體連結這膨大部的側緣而陰莖本體末端開口在上記摺痕間的內壁。

排灣栗蝸牛是1941年由黑田原記載爲栗蝸牛*Coniglobus nux*的扁平型亞種。這次的解剖結果前者呈示發達良好而更長的輸卵管及更短的陰莖鞘，陰莖，鞭狀器，陰道等異於後者。

左捲栗蝸牛雖然頗似栗蝸牛。前者不但外殼左捲，其生殖器有更短的陰道，陰莖鞘及精囊柄等異於後者。

南臺灣左捲的另種班加拉蝸牛*Pancala batanica pancala*及右捲的屏東蝸牛*Pancala bacca* 其外殼都頗似本文的兩種。但在其生殖器都沒有明顯的陰莖附屬枝。即陰莖本體直接連結於陰莖鞘起始部之緣故，必然不屬於橡實蝸屬。