

Anatomical Studies on Japanese Rissoacea (III)  
On *Truncatella kiusiuensis* Pilsbry

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(Text-figures 1-26)

リソツボ超科の解剖学的研究 (III)  
キュウシュウクビキレガイ

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**Introduction**

*Truncatella kiusiuensis* is one of five species of truncatellid gastropod reported from Japan. *T. pfeiferi* is recorded from only one specimen and has never been found again from Japanese territory, and *T. tatarica* is a species of doubtful standing. It is doubtful that *T. tatarica* is a true truncatellid from its shell features. Clench and Turner (1948) considered the former as a synonym of *T. marginata* and the latter to be *Cecina manchurica*. Therefore only 3 species, *T. kiusiuensis*, *T. guerinii* and *T. amamiensis*, are clearly distributed in Japan. (Kuroda, 1963). Habe (1942) reported on their radulae along with conchological remarks, but there are few available data concerning the soft anatomy, except the report on *T. truncatula* by Vayssière (1885), in which he described general organization and especially its mode of respiration, and a short report on the British species *T. subcylindrica* by Graham and Fretter (1962). The purpose of this paper is to present data on the anatomy and to compare the data with certain features found in rissoid species.

*T. kiusiuensis* dwells along the coast on the high tidal zone throughout Japan. The animal is amphibious to terrestrial. *T. kiusiuensis* differs from the rissoid species in several points as follows: 1) manner of locomotion, 2) nervous system, 3) genital duct (especially in the female).

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**Materials and Methods**

The materials were collected by Dr. Inaba at Mukaishima, Onomichi City, Hiroshima Pref., and by Mr. Toki at Kada, Wakayama Pref. The methods used in the study are same as those mentioned in my previous paper (Kosuge, 1965).

**Observations**

As the protoconch and early whorls are always eroded, the adult shell usually has only 3 or 4 whorls. The shell is elongate, narrow and rod-shaped. In young specimens

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which still retain their early whorls are elongate conical in shape (fig. 10). The surface is sculptured with axial ribs, of which the interstices are smooth. Shell color is pale salmon pink and the early whorls white. The average height is about 6.6 mm and the body whorl is 2.5 mm broad in the adult. The operculum (op, figs. 15—19) is thin, transparent, corneous, and is paucispiral of  $3\frac{1}{2}$  whorls. There is no process for attachment to the columellar muscle on its inner side and calcium is present. The cephalic tentacles (t, fig. 15) are rather broad and long, their bases are roundly and prominently expanded, and the eyes (e, fig. 15) are carried on the outside. The eye is rather large, with black pigmented retina and corneous cuticular lens. As the foot is not well developed, it has a peculiar method of locomotion, differing from other gastropods (figs. 16-18). When moving in air over the substratum, it extends the snout which is very extensible, and grips the substratum with its tip; it then pulls up the shell above the tentacles and then the foot up to grasp the ground just behind the snout, releases the snout and starts the process once again. Usually the foot slides along the surface of the substratum. It has ciliated grooves which run between the foot and the base of the snout (gv, fig. 16) as in *Assimineae* and *Paludinella*. The groove serves as an escape route for faecal pellets and eggs.

The snout (sn, fig. 15) is long and bilobed on its tip where the mouth opens. As the body wall is thin and transparent, the buccal cavity (bc, fig. 15), cerebral ganglion (cg, fig. 15) and initial part of the oesophagus (oe, fig. 15) are seen through the body wall. The mantle cavity is rather broad and its membrane is thin. On its left is the osphradium which is broad and spindle shaped, and about half the length of the ctenidium. The ctenidium, running parallel along the right side of the osphradium, is rudimentary and its boundary with the mantle wall is discernible; each leaflet is broad and low trigonal in shape. There are about  $26 \pm 4$  leaflets. The hypobranchial gland is not well developed and rather discernible, situating proximal end of the mantle cavity. Running parallel with it and further to the right are the genital duct (fig. 26) and the rectum. The anus opens at a short distance from the mantle edge. The sexes are separate, and the male and female reproductive aperture occupy a corresponding position. There is no trace of the pallial and caudal tentacles. The opening of the kidney (ko, fig. 26) to the mantle cavity is wide and thickly muscular; it opens into the proximal end of the cavity near the ctenidium. The ciliary current of the mantle cavity is very weak except over a portion of the osphradium.

The mouth is a longitudinal slit bounded on either side by the thick muscular lips which form the tip of the bifid snout. The oral tube which passes through the snout to the buccal cavity is short. The jaw plates are lacking. The buccal cavity (bc, fig. 15) is large, muscular, and red in living material. The radula is typically taenioglossate with 7 teeth in each row. The rachidian (figs. 5, 6) is broad based triangular in shape; its central cusp is large and sharply bent forward. The base bears 3 or 4 cusps on each side and is roundly curved at the middle portion. Each lateral tooth (figs. 7, 8) has a broad base which becomes elongate and narrower laterally; they bear 4 or 5 cusps, of which the second cusp from the inside is very large and sharply pointed. The inner marginal teeth (figs. 1—4) are elongate and slightly curved; they have about 8 cusps on



their outer edge. The outer marginal teeth (fig. 9) are broader than the inner ones, especially on their bases, and bear about 7 cusps.

The salivary glands are elongate rod shaped; they run posteriorly along the initial part of oesophagus, and pour their product at the middle of the buccal cavity. The oesophagus (oe, figs. 15, 21) runs forward and opens at the middle portion of the stomach opposite to the gastric shield.

The stomach is elongate; its anterior part is deeply excavated; the posterior is somewhat expanded and rather deep, and connected with the crystalline style sac (css, fig. 21) which is elongate-oval in shape. The intestine (i, fig. 21) opens at the posterior end of the stomach near the crystalline style sac, it runs beneath the ventral side of the sac and then curves along the posterior part of the kidney. The rectum, running parallel with the pallial gonoduct, opens as the anus near the mantle edge. The gastric shield (fig. 20) is a thin, twisted cuticular membrane. The mid-gut gland is divided into 2 lobes; the large lobe, together with the gonad, forms the spiral coils of the visceral mass. There is a minute anterior lobe wedged between the anterior part of stomach and the base of the ridge of the gastric shield. The kidney is a thin walled sac, situated on the left side of the stomach and extending into mantle skirt, richly corrugated and posteriorly somewhat muscular.

#### Nervous system

The cerebral ganglia (cg, figs. 11-14) are connected by a rather long and broad commissures. Each ganglion gives off labial, tentacular and ocular nerves. The left pleural ganglion (lpl, fig. 14) gives off a broad nerve to the left side of the mantle edge and a short connective to the suboesophageal ganglion which is situated on the left side because of the concentration of the ganglion, differing from rissoid groups, and the subintestinal ganglion sends a nerve to the right side of the mantle edge. The right cerebral, pleural and supraoesophageal ganglia are rather closely connected. Therefore the supraoesophageal ganglion is situated on the right side; this arrangement also differs from the species of the rissoids. The supraoesophageal ganglion gives rise to a nerve to the osphradium. The visceral ganglion is in the usual posterior position. The pedal ganglia (pg, fig. 11-13) are almost same size as the cerebral and give off the anterior and posterior pedal nerves which have a propodial ganglion on the root. They give off other nerves to the lateral areas.

The statocysts (sta, fig. 11-13) are situated on the dorsal end of the pedal ganglia and are rounded and rather large with a single, rounded calcareous statolith.

#### Reproductive system

Male: The testis is situated on the columellar side of the visceral hump. The testicular duct emerges from the terminal end of the testis and coils up around the columellar side between the testis and digestive gland; as a vesicula seminalis. It then runs down to the prostate. The anterior half of the prostate gland (prg, fig. 23) situated on the right side of the mantle cavity along-side the rectum, is voluminous and hemilunar in shape. The vas deferens (vd, fig. 23) emerges from its terminal end. The pallial vas deference runs along the left side after leaving the gland and connects with the

penis on the right side of the body wall, and opens at the tip of penis. The penis is long and rather flat, and has no appendix (fig. 22).

Female: The ovary and oviduct lie in the same position as the testis and vas deference. The genital duct is rather complex compared to the rissoid species and is diagrammatically figured by Fretter and Graham (1962). The oviduct runs down along the columellar side and is connected to the pericardial cavity by a long and rather broad gonopericardial duct, distal to which are a receptaculum seminis, which is a small, rounded pouch, and a bursa copulatrix, the latter is a thick muscular pouch and is connected to the kidney at the posterior portion. The oviduct then enters the capsule gland (pallial oviduct), of which the albumen gland occupies the initial part. The female opening is situated near the mantle edge behind the anus (figs. 24-26).

### Discussion

The general arrangement of the soft parts is the same as that found in rissoid species. The degenerate ctenidium and weak ciliary current in the mantle cavity are correlated with the peculiar circumstance in which it dwells, where it is exposed to the air much of the time. As the water supply may be poor and it may be better to retain water in the mantle cavity as long as possible, as such, the ciliary current became weaker. The ctenidium is also degenerate because of the habitat, and the mantle cavity is likewise thin and expanded in order to obtain direct gas exchange; these tendencies gradually developed and continued to the extent of loss of the ctenidium in *Paludinella* and *Assimineae*. The nervous system is more concentrated than in the rissoid species; one set of cephalic, pleural and oesophageal ganglia arranged on each side of the digestive tract. This topography corresponds to Fretter and Graham's (1962) 4th stage of the circum-oesophageal nerve ring.

This arrangement is considered the most advanced type of the mesogastropoda.

The male genital system is classified as type 1 (Kosuge, 1965), which is commonly found in Hydrobiidae and Truncatellidae. This system is closely allied to that of *Oncomelania nosophora*, which was examined with precision by Itagaki (1955). Fretter & Graham (1962) figured a female genital system which is different from the rissoids in its junction between receptaculum seminalis and bursa copulatrix. The functional meaning of this is not clear.

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## 要 約

キュウシュウクビキレガイはリソツボ超科、クビキレガイ科に属する種類である。高潮帯近くの砂地の芥や草叢の中などにすむ。邦産の本類の解剖学的研究はなされていないのでここに報告する。

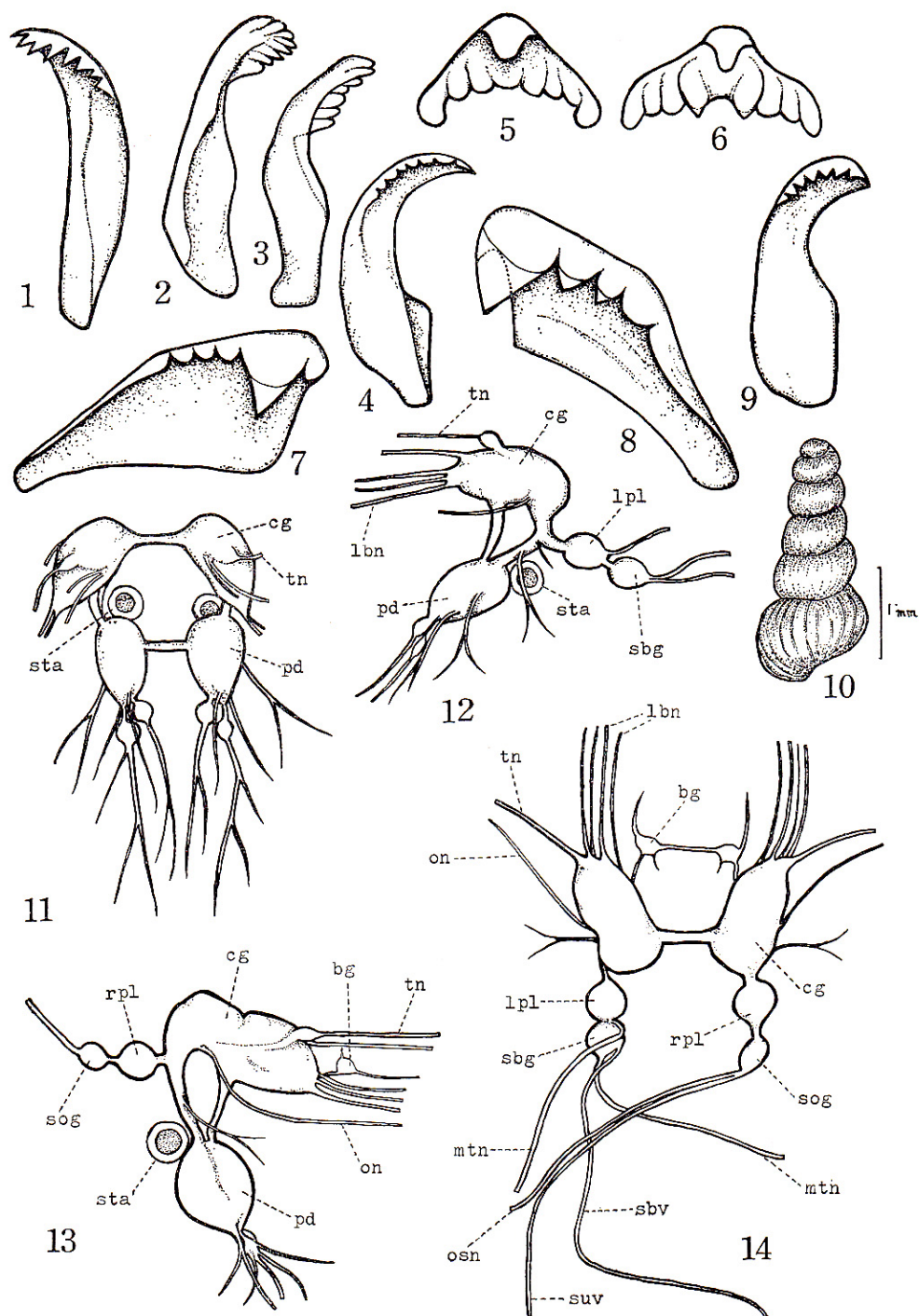
比較的乾燥した環境にすむために鰓は著しく退化しているが、カワザンショウガイ類やヘソカドガイ類のように失なわれていない。検臭器は鰓の退化と共に多くは退化するが本種では良く発達している。本種が他と著しく異なる点は次の通りである。

運動。足の発達悪く、普通の腹足類状の匍匐運動はせず、吻を地物に吸付けて殻を引ずり、足はその補足的役割をするに過ぎない。(第16—18図参照)

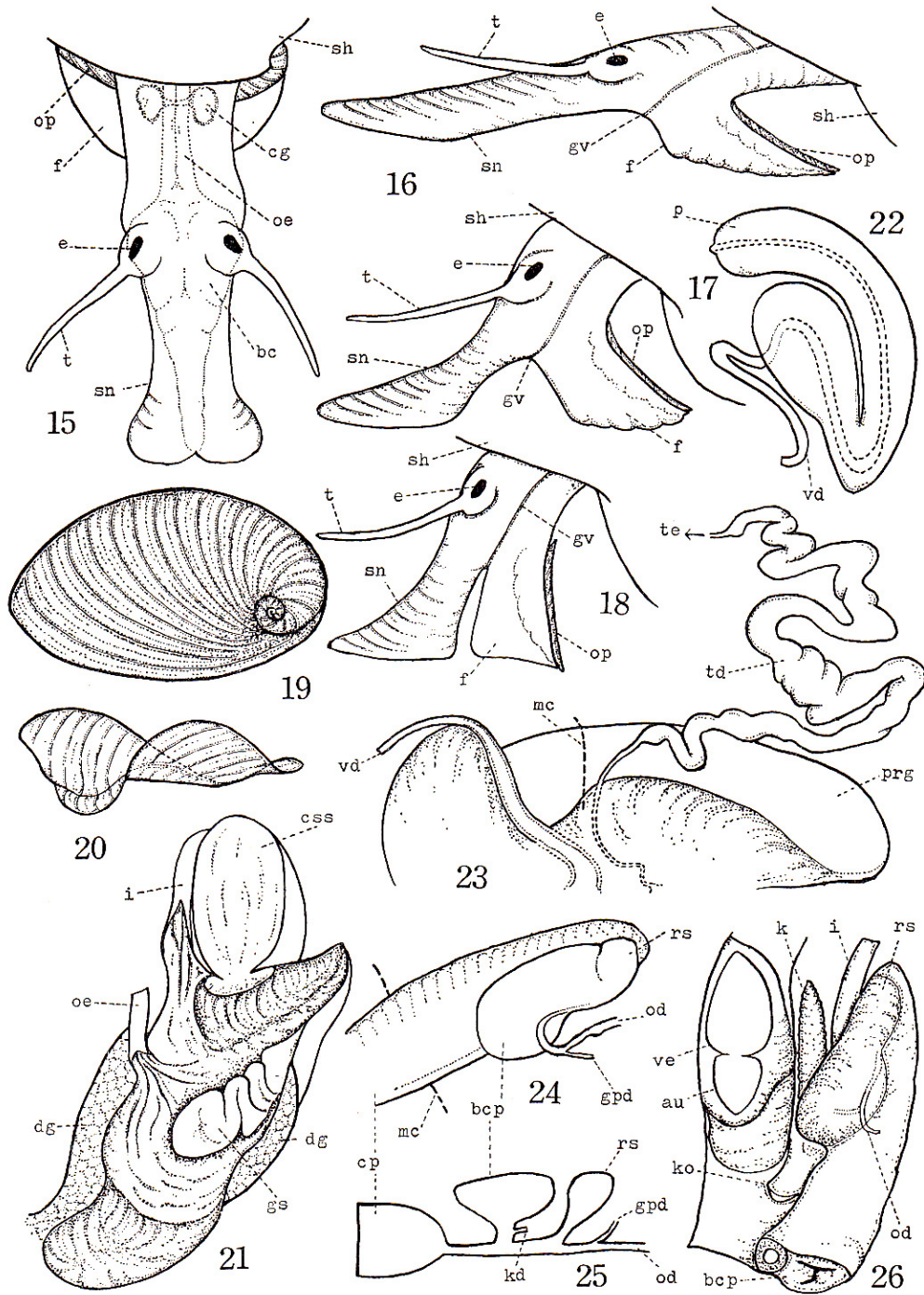
神経系、食道を囲む神経節群の配列が著しく圧縮されている。左側の頭部神経節、側神経節、食道下神経節は短かい結合枝で結ばれているので食道の左側に並び、同様に右側の頭部、側神経節と食道上神経節は食道の右側に並ぶ、他のリソツボ類では結合枝が長いので食道神経節は互に交叉して、それぞれ反対側に位置している。本類では神経交叉は腹部神経節と食道神経節との結合枝の部分でおこなわれている。腹部神経節の位置は変らない。(第14図参照)

Fretter & Graham によるとこの型は第4型として区別されるもので前鰓類の神経配置としては最も進んでいると考えられる。

生殖器官、雄の生殖器官は著者の分類によると第1型に属するものでミズツボ科などと同様である。所が雌の生殖器官は著しく異なっている。すなわち、卵管は囲心腔と細い管で結ばれて、受精囊に入り、交尾囊と連絡している。囲心腔との連絡は近縁種には見られない点である。交尾囊は腎臓と連絡しているが、この点も特徴的である。(第23-26図参照)



Figs. 1-14.



Figs. 15-26.



## Explanations of Text-figures 1-26

- Figs. 1-4. inner marginal teeth (shown from the different angle)  
5,6. rachidian tooth.  
7,8. lateral teeth.  
9. outer marginal tooth.  
10. juvenile shell.  
11-14. nervous system. central nervous system showing cerebral (cg), pleural (pl), and pedal (pl) ganglia.  
15. anterior part of creeping animal.  
16-18. method of locomotion.  
19. operculum.  
20. gastric shield.  
21. stomach.  
22. penis.  
23. male genital organ.  
24-26. female genital organ.  
25. diagram of female genital organ.

## Abbreviations used in figures

au, auricle; bc, buccal cavity; bcp, bursa copulatrix; bg, buccal ganglion; cg, cerebral ganglion; cp, capsule gland; css, crystalline style sac; dg, digestive gland; e, eye; f, foot; gpd, gono-pericardial duct; gs, gastric shield; gv, groove; i, intestine; k, kidney; kd, duct to the kidney; ko, opening of kidney to mantle cavity; lbn, labial nerve; lpl, left pleural ganglion; mc, limit of mantle cavity; mtn, nerve to mantle; oe, oesophagus; od, oviduct; on, optic nerve; op, operculum; osn, osphragial nerve; p, penis; pd, pedal ganglion; sn, snout; prg, prostate gland; rpl, right pleural ganglion; rs, receptaculum seminis; sbg, sub-oesophageal ganglion; sbv, part of visceral loop; sh, shell; sog, supra-oesophageal ganglion; sta, statocyst; suv, supra-oesophageal part of visceral loop; t, tentacle; td, testicular duct; te, testis; tn, tentacular nerve; vd, pallial vas deferens; ve, ventricle.