# THE ANATOMY OF *RIZZOLIA LINEATA* (ELIOT) (NUDIBRANCHIA-EOLIDOIDEA)[1]

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*With Plates XV-XVI*

A proposal has been made by LEMCHE, 1964 a, in order to validate the generic name *Rizzolia* TRINCHESE, 1877, which will take the place of *Cratena* BERGH, 1864. The type species of *Rizzolia* is *Doris peregrina* GMELIN, 1791 (cf. LEMCHE, 1964 a, p. 51). The family-group name forms Favorinidae BERGH, in CARUS, 1889 (cf. LEMCHE, 1964 a, p. 51; 1964 b, p. 126). Unfortunately the author is not in a situation to get sufficient informations concerning the various characters of the Mediterranean genus *Rizzolia* in the classics, or in the light of the modern systematics (cf. PRUVOT-FOL, 1954, pp. 398-399; MACNAE, 1954 a, pp. 28-29). Following to MACNAE (1954 a, p. 29), *Cratena capensis* BARNARD, 1927 and *Hervia lineata* ELIOT, 1904 have been presumed here to belong to *Rizzolia*. This paper, solely occupied in the anatomy of *lineata*, is hoped to be useful in the speculation about the relationship between species of *Rizzolia*, or furthermore, between genera of the family Favorinidae.

The author is thankful for the cooperation offered by Messrs. Iwao HAMATANI (Osaka Gakugei University) and Takeo ABE (Takaoka High School, Toyama Pref.) in collecting part of the specimens used in this study.

## *Rizzolia lineata* (ELIOT, 1904)

*Hervia lineata* ELIOT, 1904, pp. 286-287, pl. 16, figs. 2-3.—Zanzibar.
*Cuthona (Hervia) lineata* BABA, 1938, pp. 17-18, text-fig. 12.—Seto, Kii.
*Hervia lineata* BABA, 1949, pp. 103-104, 177-178, pl. 44, figs. 152-153, text-fig. 137.—Sagami Bay.
*Cratena lineata* BABA, 1955, pp. 36, 56 (generic name change).
*Cratena lineata* ABE, 1964, pp. 67-68, pl. 33, fig. 116.—Toyama Bay; Togi-Kazanashi, W. coast of Noto Peninsula.
? *Aeolidia trunca* RISBEC, 1928, pp. 236-238, pl. 9, fig. 8, text-fig. 72.—N. Caledonia.
? *Hervia trunca* RISBEC, 1953, pp. 135-136, text-fig. 92.—N. Caledonia.

1) Contributions from the Seto Marine Biological Laboratory, No. 425.

In Japan this species is widely distributed on the Pacific coasts (Sagami Bay; Shima; Kii; Osaka Bay; Inland Sea of Seto; Amakusa) as well as on the Japan Sea side (Toyama Bay; W. coast of Noto Peninsula). It is fairly common and specimens are found usually from underneath pebbles in shallow water. The natural diet of this species, however, is left unknown.

As far as allowed, the specimens collected by the author or by his friends were examined in fresh, and of these the following served as material for preparing serial sections.

Sp. No. 1. *Loc.*: Seto, Kii. *Date*: Dec. 27, 1962. (H. S.)
Sp. No. 2. *Loc.*: Tannowa, Osaka Bay. *Date*: July 25, 1957. (H. S.)
Sp. No. 3. *Loc.*: Ohkawa, Osaka Bay. *Date*: Aug. 20, 1959. (H. S.)
Sp. No. 4. *Loc.*: Ohkawa, Osaka Bay. *Date*: Sept. 4, 1960. (H. S.)
Sp. No. 5. *Loc.*: Ogi, Toyama Bay. *Date*: Aug. 7, 1960. (H. S.)
Sp. No. 6. *Loc.*: Abugashima, Toyama Bay. *Date*: Aug. 20, 1961. (H. S.)
Sp. No. 7. *Loc.*: Abugashima, Toyama Bay. *Date*: Aug. 20, 1961. (T. S.)

The specimens listed above were mostly in a matured state. For staining DELAFIELD'S haematoxylin and eosin were usually employed. Only the specimen No. 3 was tried with dilute toluidine blue solution.

*Externals*: The general body-form is as repeatedly reported before (BABA, 1938 and 1949; ABE, 1964), and the maximum length (Code Ac) measures 15 mm. The body proper is narrowed. The cephalic tentacles are exceedingly slender. The rhinophores are shorter, and smooth in fresh. The foot-corners are tentaculiform. The tail is long and tapering behind. The branchial groups are at most in 7–8, and usually in 5–6 pairs. The right liver branch (and the left partner) forms a horseshoe. The genital orifice lies immediately below the middle of the right liver branch. The first right branch of the left posterior liver is horseshoe-shaped with an anal papilla in the centre, or sometimes it is merely oblique with the anus closely behind. The succeeding branches of the left posterior liver are all oblique in constitution. The branchial papillae lie in a single row on each of the liver branches. They are elongated fusiform when fully extended, easily falling off, and number at most 8–10 on the largest liver branches. The nephroproct is interhepatic. The body-colours are quite as recorded previously (BABA, 1938 and 1949; ABE, 1964). On the head there occur always 4 red blotches, of which only the two lying between cephalic tentacles and rhinophores seem to be noted by ELIOT (1904). One more thing of the most distinctive in colours of this species is the presence of irregular, longitudinal, opaque white lines running on the back and sides, and on each of the branchial papillae. In *Aeolidia trunca* the four red blotches are evident on the head, but no mention is made of the opaque white lines just cited. The vein (=liver diverticulum) of the papillae is yellowish brown or dark brown above, and reddish below, and this transition of tones depends largely upon the variety of colours in the liver cells

lining the diverticulum. The upper half of each of the cephalic structures is opaque white or opaque yellow. The general integument of the body above is slightly yellowish white, and the sole is almost colourless.

*Internals*: The chief diagnoses of the jaw-plates and radula are also as described in the preceding papers (BABA, 1938 and 1949). The central tooth is broadly V-shaped, and makes a contrast against the narrow central in *Rizzolia peregrina* (cf. PRUVOT-FOL, 1954, text-fig. 155, d-e). *Rizzolia capensis* and *R. lineata* are almost alike in their liver systems. In the latter species the whole inner surface of the digestive tract excepting the liver diverticula is covered with cilia. The salivary glands are long and band-like. The freshly isolated liver cells assume different facies: some are colourless, and some are yellow, and others are yellowish to deep orange yellow. The deep orange yellow liver cells are especially abundant near the lower (proximal) end of the diverticulum. In mounted sections the diverticular epithelium appears to be highly vacuolated just as in the case of *Favorinus japonicus* BABA. The mass of yellow concretions contained within each of the vacuoles is destined to be sent forth. Actually the accumulation of the shed concretions is observed passing through the rectal lumen. The cnidocysts of the cnidophore sac are thickly packed with nematocysts, and no formation of colourless droplets was secured within the cell body in fresh. The reno-pericardial canal is simple when young, and the wall tends to be folded with age. The main canal of the kidney sends off branches on either side at about the level of every pair of the branchial groups from the second to the last, and the branching becomes more or less thicker with the growth of the body. Concerning the genital organs, *Rizzolia lineata* appears to agree with *R. capensis* especially in the possession of an accessory gland to the penis. In *lineata* this gland is pear-shaped, and attached to the inner wall of the penis sheath close to the root of the penis. The distal end of the gland is narrowed. At the apex there is a small opening to the exterior. The fine structure of this pear-shaped organ is very difficult to understand. In short, it may be said to consist of several sorts of gland cells packed by interlaced muscle fibres. The vas deferens is short, thick, and prostatic. The penis in the contracted state is lobiform (or tongue-shaped), and possibly it is very soft owing to the lack of muscular coat. The lining epithelium of the penis does not appear to be glandular. No chitinous armature is present at the apex of the penis. The male and female orifices are united. The general composition of the accessory genital complex of this species is nearly as in *Favorinus japonicus*.

A spiral egg-string similar in appearance to that of *Favorinus japonicus* was deposited in an aquarium by a specimen collected from Wagu, Shima Province, on August 2, 1951. It comprised 2-4 rows of opaque white eggs.

Remarks: The original description of *Hervia lineata* by ELIOT is not ade-

quate. But our specimens have been identified with that species neglecting disagreement in the number of red blotches on the head. Also our specimens appear to be near akin to *Aeolidia trunca*. *Hervia affinis* (=*Cratena affinis*) is distinct from *lineata*. It will be renamed as *Rizzolia affinis* (BABA, 1949). The known localities of this species are Sagami Bay, Sado Islands (vicinity of the Sado Marine Biological Station)[1] and Toyama Bay (ABE, 1964, p. 68, pl. 33, fig. 117). The specimens could not be dissected thoroughly.

## REFERENCES

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TRINCHESE, S. 1877. Note zoologiche. 1. Descrizione del genere *Rizzolia* TRINCHESE. Rend. Accad. Sci. Ist. Bologna (not directly referred to).

1) Collected by Dr. Y. HONMA on August 6, 1955, 1 specimen.

## EXPLANATION OF THE PLATES XV-XVI

*Rizzolia lineata*

### Plate XV

Fig. 1. Entire animal in life, dorsal view, length (Code Ac) 3 mm. Material: Seto, Kii (Dec. 27, 1962).
Fig. 2. A branchial papilla (×45). Material: Sp. No. 4.
Fig. 3. A row of cnidocysts (×130). Material: Sp. No. 2.
Fig. 4. A left jaw-plate from outside (×45). Material: Tannowa, Osaka Bay (July 25, 1957).
Fig. 5. Radula (formula 20×0. 1. 0). Material: As above. a. entire ribbon (×45), b–c. individual teeth (×180). Denticles 8–11 on each side.
Fig. 6. Digestive system in the body, diagrammatic. Main material: Sp. No. 4. a. salivary gland, b. horseshoe of the right liver, c. genital orifice, d. nephroproct, e. anus, f. left posterior liver, g. horseshoe of the left anterior liver, h. stomach.
Fig. 7. Transverse section of reno-pericardial canal (×70). Material: Sp. No. 5.
Fig. 8. Transverse section of the body on level of the genital orifice (×20). Material: Sp. No. 7. a. prostatic vas deferens, b. right liver branch, c. penis sheath, d. accessory penis gland (=pear-shaped organ), e. genital orifice, f. outer oviduct, g. area of gland B (?=mucous gland), h. area of gland C (?=membrane gland), i. left anterior liver branch, j. stomach.
Fig. 9. Transverse section of the body on level of the nephroproct (×30). Material: Sp. No. 7. a. main canal of kidney, b. ureter and nephroproct, c. rectum, d. hermaphrodite duct, e. left posterior liver, f. ventricle and auricle.

### Plate XVI

Fig. 1. Transverse section of a liver diverticulum (×130). Material: Sp. No. 4. Showing a vacuolated epithelium in the preserved state. Note the yellow concretions (b) contained within each of the vacuoles (a).
Fig. 2. Transverse section of the rectum (×90). Material: Sp. No. 7. Showing accumulation of the shed concretions (a).
Fig. 3. Excretory system in the body, diagrammatic. Main material: Sp. No. 4. a. reno-pericardial canal, b. nephroproct, c. main canal of kidney.

Fig. 4. Genital system in the body, diagrammatic. Main material: Sp. No. 4.

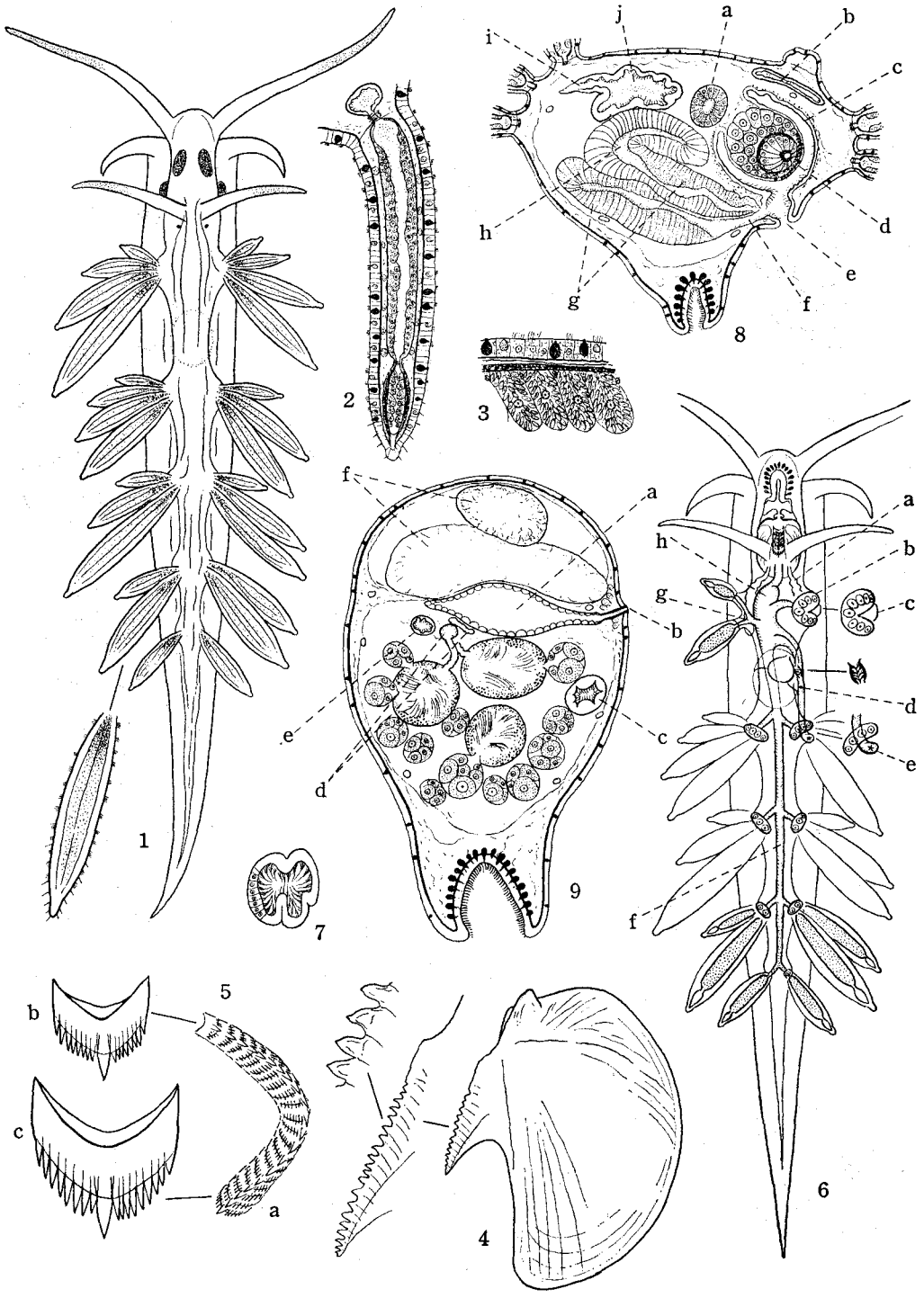
Fig. 5. Genital organs from above, diagrammatic (×30). Main material: Sp. No. 4. Penis supplemented from Sp. No. 5. a. penis, b. accessory penis gland (=pear-shaped organ), c. penis sheath, d. genital orifice, e. outer oviduct, f. area of gland B (?=mucous gland), g. area of gland A (?=albumen gland), h. hermaphrodite duct, i. spermatheca, j. ampulla, k. area of gland C (?=membrane gland), l. inner oviduct (?=fertilization chamber), m. prostatic vas deferens. The gland A communicates with the gland B on one hand, and opens into the outer oviduct on the other. The gland A itself is a small mass filled with eosinophile secretion. On the ventral side of the genital mass, the glands B and C are completely united to open into the female tract. With toluidine blue solution, the secretion of gland C stains normally, and that of gland B metachromatically.

Fig. 6. Distal male organs enlarged. Material: Sp. No. 5. a. penis in longitudinal section, b. accessory penis gland in transverse section, c. penis sheath, d. prostatic vas deferens.

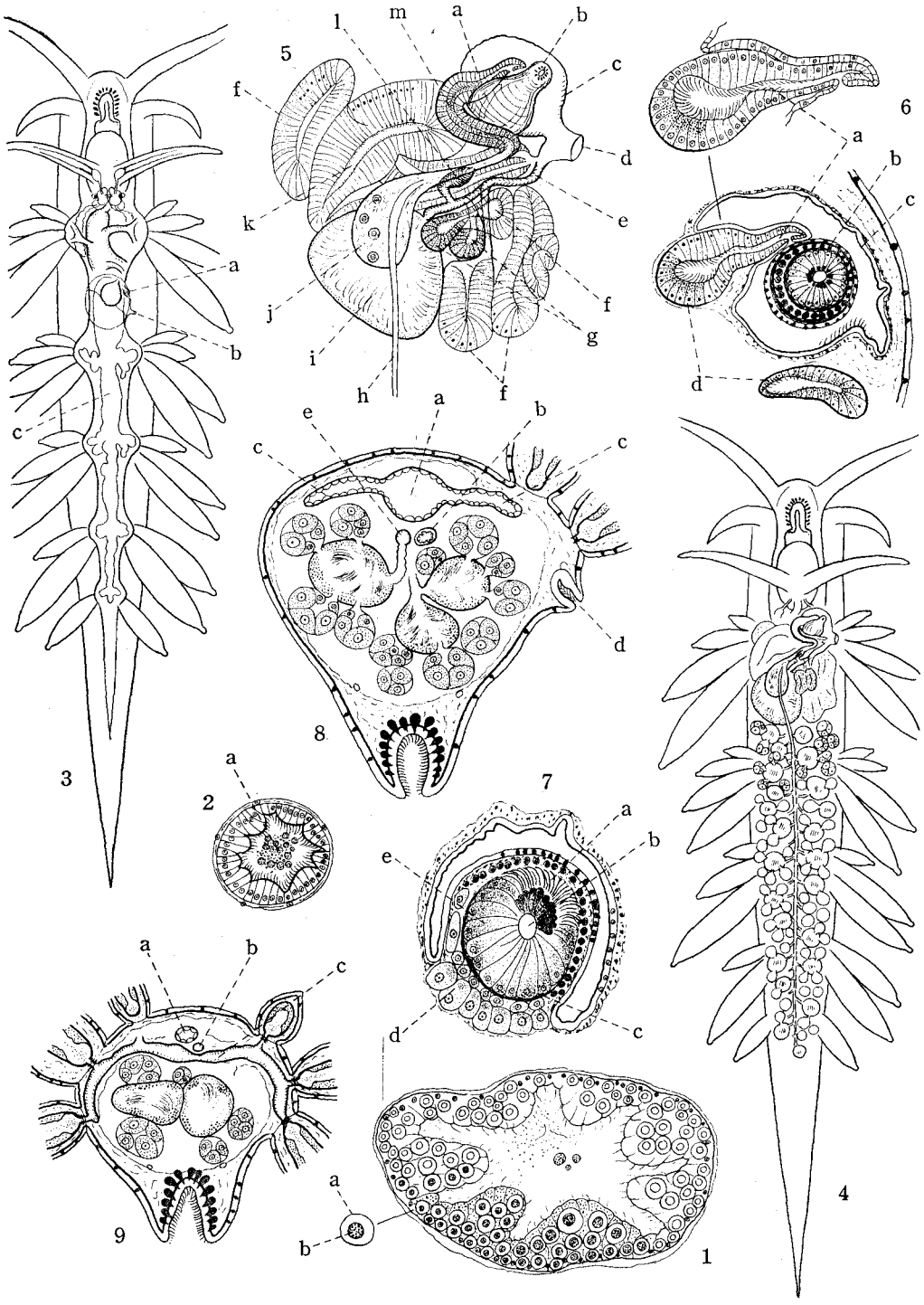
Fig. 7. Accessory penis gland enlarged (×80), in oblique section. Material: Sp. No. 3. a. longitudinal muscle fibres, b. apical opening of the accessory penis gland (this opening is guarded by mucous cells), c. circular muscle fibres, d. lower gland cells staining light green with toluidine blue, e. upper gland cells staining deep blue-green with toluidine blue. Epithelial and subepithelial mucous cells are shown also on the surface of the accessory penis gland.

Fig. 8. Transverse section of the body on level of the anus (×30). Material: Sp. No. 7. a. main canal of kidney, b. left posterior liver, c. lateral branches of the kidney, d. anus, e. hermaphrodite duct.

Fig. 9. Transverse section of the body on level of the fourth branchial groups (×30). a. main canal of kidney, b. hermaphrodite duct, c. main canal of the left posterior liver, sending lateral branches to the branchial groups.




K. BABA: ANATOMY OF *RIZZOLIA LINEATA*.

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