THE ANATOMY OF *FAVORINUS JAPONICUS* BABA (NUDIBRANCHIA-EOLIDOIDEA)[1]

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With Plate VI and 1 Text-figure

Favorinus GRAY, 1850 is a splendid genus, the distinctive characters of which were introduced in parts by ALDER & HANCOCK, 1855, and somewhat more effectively by ODHNER, 1939 (see also MACNAE, 1954a, pp. 17–19). *Eolis alba* A. & H., 1844, Atlantic, forms the type of the genus. A series of species were added to this genus by the senior author (*F. pacificus* BABA, 1937; *F. japonicus* BABA, 1949; *F. perfoliatus* BABA, 1949; and *F. mirabilis* BABA, 1955), and it was revealed that the rhinophores in *Favorinus* are either simple, or bulbed, or even perfoliated according to different species. Here *F. japonicus* BABA was taken up for special study in anatomy, with the hope to understand the various genetic features more profoundly than before. Apparently this species is one of those nearest to the type of the genus, particularly in having bulbs on the mid-length of the rhinophores.

Favorinus japonicus BABA, 1949

Favorinus japonicus BABA, 1949, pp. 101–102, 177, pl. 43, fig. 150, text-figs. 133–134.—Sagami Bay; ABE, 1964, p. 67, pl. 33, fig. 115.—Tsuruga Bay.
? *Eolis nodulosa* KELAART, 1859, p. 491.—Ceylon; ELIOT, 1906, p. 686, pl. 45, fig. 7.
? *Aeolidia gouaroi* RISBEC, 1928, p. 256, pl. 12, fig. 13, text-fig. 84.—N. Caledonia.
? *Favorinus gouaroi* RISBEC, 1953, p. 145, fig. 100.—N. Caledonia.

Further records of occurrence of this species in our seas are as follows: Shore of Seto, Kii (June 21, 1951, 1 sp., collected by the senior author; Aug. 14, 1962, 2 sps., collected by the junior author).

Together with the specimens cited above, a single one obtained by Mr. T. ABE from Tsuruga Bay (July 30, 1956), have been observed from outside and figured in life by the senior author himself at the respective collecting stations. For the examination of the internal organs, two of the specimens

1) Contributions from the Seto Marine Biological Laboratory, No. 416.

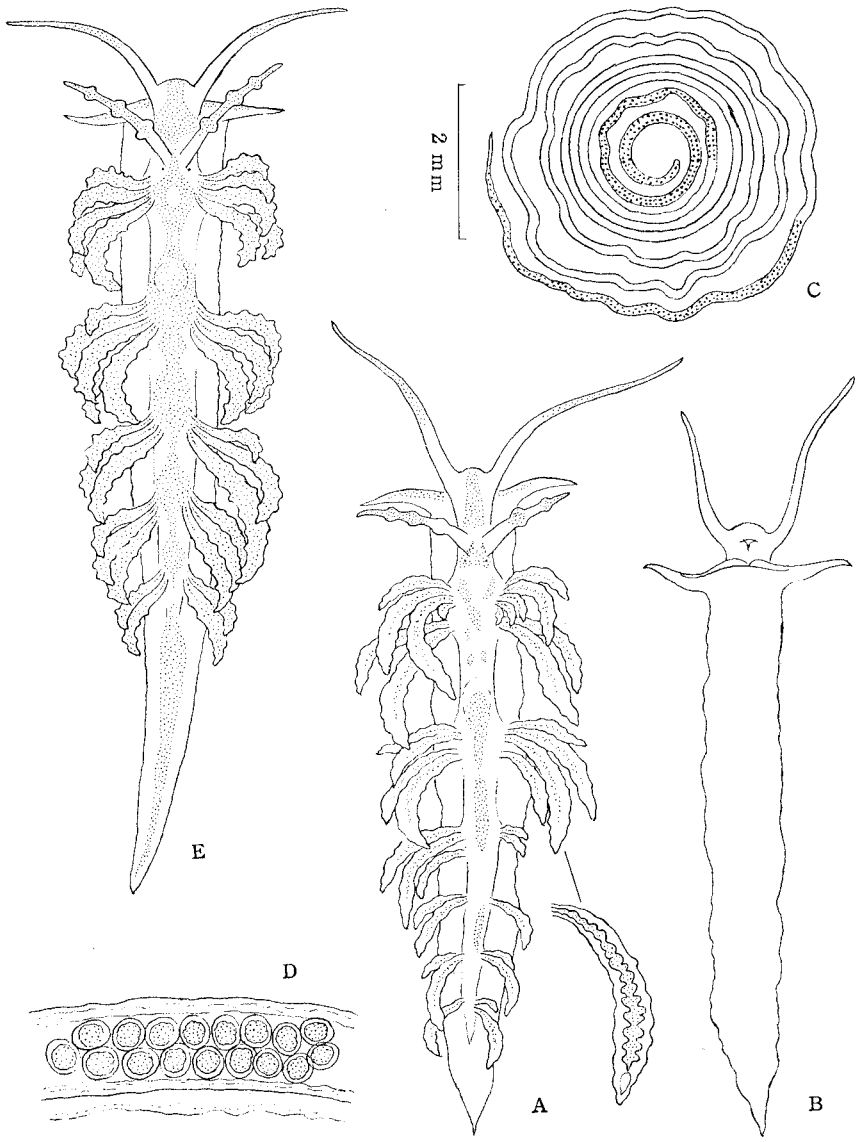

Fig. 1. *Favorinus japonicus* from Seto, Kii, Japan. A–D. From the specimen collected on June 21, 1951. A. Entire animal in life, dorsal view, length (Code Acm) 6 mm. General integument almost colourless, the back slightly yellowish. The dotted parts on the head, back, cephalic tentacles and rhinophores show opaque white markings. Vein of the branchial papillae vermilion red. B. Head and foot, ventral view. C. A spawn laid on the surface film of the water in an aquarium. Presumably the egg-string is sinistrally coiled when seen from the upper side of the spawn. D. Part of the egg-string (×15). E. From the specimen collected on Aug. 14, 1962. Entire animal in life, dorsal view, length (Code Ac) 5 mm. General integument slightly yellowish white. The dotted parts on the head, back, tail, cephalic tentacles, rhinophores and branchial papillae show opaque-white markings and shades. The vein of the branchial papillae pale yellowish brown.

from Seto were prepared in serial transverse and horizontal sections stained by DELAFIELD's haematoxylin and eosin.

Externals: The general body-form is as described previously (BABA, 1949). The length (Code Ac, Acm) measured 5–6 mm in the Seto specimens, and 20 mm in the one from Tsuruga Bay. The rhinophores showed 2–3 bulbs on each (cf. *Favorinus auritulus* MARCUS, 1955). In this species the branchial papillae are apt to be curled up slightly, and they appear more or less nodulose on the surface (cf. *Eolis nodulosa* KELAART, 1859), due to the formation of the indefinite foldings on the wall of the liver-diverticulum within each of the papillae. On each of the horseshoe-shaped arches the papillae stand in a single row. The general ground-colour of the body is slightly yellowish white. As a rule there are a series of opaque white markings, more or less rhomboidal in shape, down the middle line of the back (cf. *Eolis alba* A. & H., 1845, *Favorinus versicolor* BERGH, 1882, *F. branchialis* PRUVOT-FOL, 1954, and *Aeolidia gouaroi* RISBEC, 1928). The vein (=liver-diverticulum) of the branchial papillae is vermilion red (cf. *Eolis carnea* A. & H., 1854), or yellow, or paler yellowish brown according to different specimens.

Internals: The main characters of the jaw-edge and the radula teeth are also as recorded before (no denticles were found on the sides of each of the teeth, cf. *Aeolidia gouaroi* RISBEC, 1928). Again, the liver system of our species does not deviate materially from that shown by ODHNER, 1939, p. 78, fig. 45, in *Favorinus branchialis* (O. F. MÜLLER). The whole liver system is glandular, and the epithelium of the diverticulum has a heavy burden of vacuoles of varying sizes (cf. excretory vacuole cells of HECHT, 1895, pp. 669–671, pl. 3, fig. 35). Each of the vacuoles contains a mass of yellow concretions which may be seen conveyed to the rectal lumen in the mounted sections. The salivary glands are simply elongated and band-like. There are no oral glands as seen in *Trinchesia* (=*Catriona*) and *Cuthona*. The stomach is a simple sac without a blind-sac. The reno-pericardial canal is also simple (wall not folded). The main canal of the kidney sends off a series of branches on either side. As in the case of the liver system, the genital organs of this species do not appear to differ in any marked character from those represented by ODHNER (1939, pp. 78–79, fig. 47), in *Favorinus branchialis*. The penis is conical, unarmed, only slightly muscular, and a thick prostatic vas deferens passes into it to open at the apex. There is no accessory penis gland. The genital orifices, situated immediately below the first right horseshoe, are separated. Under the lenses three glandular areas may be distinguished in the accessory genital complex, and they are expected to constitute an albumen gland, a mucous gland and a membrane gland of GHISELIN, 1963, p. 394, separately. But further evidences by experiments are to be procured for recognizing their physiological functions.

A spiral egg-string similar in form to that of *Eolis alba* figured by A. &

H., 1845, fam. 3, pl. 21, was laid down in an aquarium by a specimen from Seto on June 22, 1951. It contained 2-3 rows of opaque white eggs.

Discussions

Favorinus was made the type of the family Favorinidae by BERGH, in CARUS, 1889[1] (see RISSO-DOMINGUEZ, 1962, pp. 142, 143), but it shows rather an extreme case of development in the V-shaped radula teeth with or without traces of lateral denticles, and in having several rows of spiny denticles (somewhat as in the primitive eolid *Coryphella*) on the edge of the jaw-plates. The position of the anus in *Favorinus* is typically cleioproctic (ODHNER, 1939, pp. 50, 53; but see the critical discussion made by RISSO-DOMINGUEZ, 1962, p. 153, against the use of the liver system for classification in the Facelinacea) and the right liver (and the left-sided partner) forms a horseshoe-shaped arch which bears a row of branchial papillae. The penis in the contracted state is conical, and unarmed. The rhinophores are smooth, or bulbed (cf. MARCUS, 1955, p. 182), or sometimes perfoliated. The foot-corners are long and tentaculiform. The tail is tapering behind.

The exotic members of *Favorinus* may be enumerated thus: (1) *F. branchialis* (RATHKE[2], 1806), Atlantic and Mediterranean. *Eolis alba* A. & H., 1844, *E. versicolor* COSTA, 1866, and others are said to be synonymous with *branchialis* (see PRUVOT-FOL, 1954, p. 400). (2) *F. auritulus* MARCUS, 1955, Brazil. (3) ?*F. gouaroi* (RISBEC, 1928), New Caledonia. This species resembles *F. japonicus* in colours, but differs from the latter in having a series of lateral denticles on each of the radula teeth. The detail of the jaw-edge is not recorded from *gouaroi*. (4) *Eolis nodulosa* KELAART, 1858, Ceylon. This species appears to be closely allied to *F. japonicus* in the possession of 3 bulbs on the rhinophores, and in the somewhat nodulose character of the branchial papillae. The jaws and radula teeth in *nodulosa* are left unknown.

The authors are grateful to Mr. Takeo ABE for placing his valuable collection at their disposal for study.

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EXPLANATION OF PLATE VI

Favorinus japonicus from Seto, Kii, Japan.

Figs. 1–2. From the specimen collected on June 21, 1951;

Figs. 3–10. From the specimens collected on Aug. 14, 1962.

Fig. 1. Rows of spiny denticles on the jaw-edge (×270).

Fig. 2. Central teeth from side (×130). Formula of the entire radula 18× 0.1.0. Teeth faintly yellowish.

Fig. 3. Digestive system in the body, diagrammatic. a. horseshoe of the right liver, b. genital orifices, c. reno-pericardial canal, d. nephroproct, e. anus, f. lateral branches of the kidney, g. left posterior liver, h. horseshoe of the left anterior liver, i. salivary gland.

Fig. 4. Part of the diverticular epithelium, showing a mass of yellow concretions contained within each of the vacuoles (×225).

Fig. 5. Genital system in the body, diagrammatic.

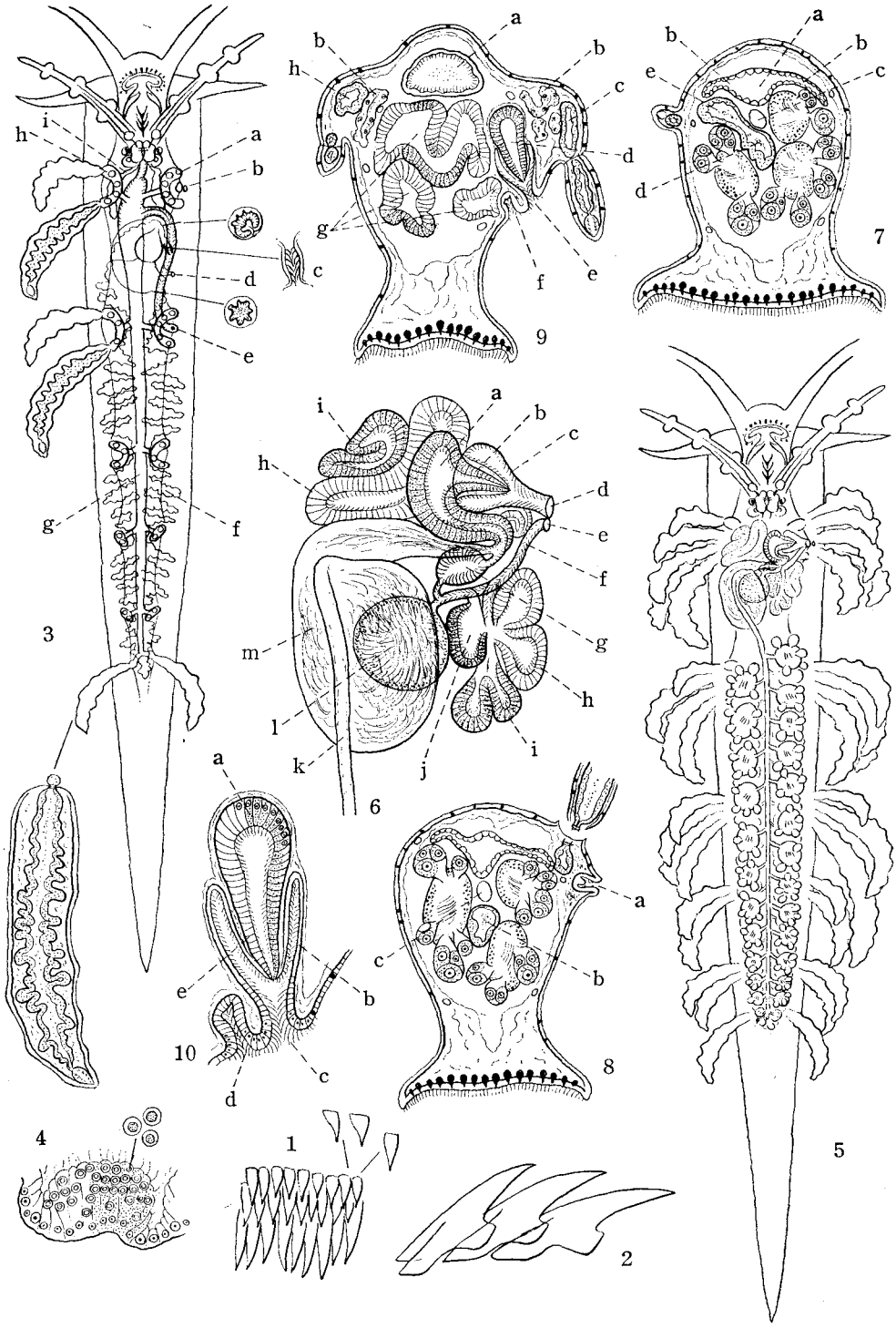
Fig. 6. Genital organs from above, diagrammatic, a. prostatic vas deferens, b. penis, c. penis sheath, d. male orifice, e. female orifice, f. outer oviduct, g. inner oviduct (?=fertilization chamber) bearing strong cilia internally, h. area of gland C (?=membrane gland), i. area of gland B (?=mucous gland), j. area of gland A (?=albumen gland) communicating with the outer oviduct on one hand, and with the gland B on the other, k. hermaphrodite duct, l. spermatheca lying ventrally to ampulla (m). On the ventral side of the genital mass the area of gland C comes to pass gradually into the area of gland B.

Fig. 7. Transverse section of the body on level of the third horseshoes (×30). a. main canal of the kidney, b. lateral branches of the kidney, c. hermaphrodite duct, d. main canal of the left posterior liver, e. a branch passing to the base of the left third horseshoe.

Fig. 8. Transverse section of the body on level of the anus (×30). a. anus, b. left posterior liver, c. hermaphrodite duct.

Fig. 9. Transverse section of the body on level of the genital orifices (×30). a. stomach, b. salivary glands, c. right liver, d. penis, e. male orifice, f. female orifice, g. complex of the glands B and C, h. left anterior liver.

Fig. 10. Penis enlarged from the transverse section Fig. 9 (×85). a. prostatic vas deferens, b. penis sheath, c. male orifice, d. female orifice, e. penis.



K. BABA AND I. HAMATANI: ANATOMY OF *FAVORINUS JAPONICUS* BABA.