

OCCURRENCES OF SPECIMENS PRESUMABLY IDENTIFIABLE
WITH *STILIGER ORNATUS* EHRENBERG, 1831, AT SETO,
KII, MIDDLE JAPAN
(OPISTHOBRANCHIA : SACOGLOSSA)¹⁾

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With Plates III-IV

In June 1964, when examining, under a lens, the first series of specimens of a sacoglossan opisthobranch just collected from a colony of *Codium pugniformis* OKAMURA in the low tide zone around Cape Bansho, Seto, Kii, we were rather excited, because those specimens seemed to be nothing other than *Stiliger ornatus* EHRENBERG, 1831, for their close affinity with it in the main colour pattern of the body. Again in August 1966, we had an additional collecting of specimens of the same form from about the same habitat as before. *Stiliger ornatus*, originally known from the Red Sea and from the surface of a tunicate *Cynthia momus* (= *Herdmania momus*), had been the type of the genus *Stiliger* EHRENBERG, 1831.

In some essential respects the specific and generic definitions given by EHRENBERG²⁾ were quite obscure for us. Despite such conditions, however, a considerable number of species of different characters have since been put on record under the name of *Stiliger* from different seas of the world.

It was noted by MACNAE & KALK (1958) briefly that *Stiliger ornatus* happened to be rediscovered from Mozambique (see also MARCUS & MARCUS, 1960, p. 149). Their specimens were obtained from "Codium on the sheltered shores of Inhaca Island off Lourenço Marques in Mozambique", in December 1956 and September 1957, and "agreed completely with EHRENBERG's description and illustration" (from Dr. MACNAE's personal communication).

The present paper is prepared to discuss the identity of our specimens with *Stiliger ornatus* so far known only from the limited localities cited above and further in a hope to refer to the taxonomical position of *Stiliger* when this identification is accepted.

We wish to express our thanks to Dr. William MACNAE, Professor in the Uni-

1) Contributions from the Seto Marine Biological Laboratory, No. 525.

2) For the copy of the original description by EHRENBERG, see TRINCHESE, 1872, p. 88.

versity of the Witwatersrand, Johannesburg, for giving us unpublished informations on his collection data of *Stiliger ornatus* from Mozambique. Our thanks are also due to Mr. Robert BURN, Hon. Associate in Conchology, National Museum of Victoria, Melbourne, who helped us with copies of references necessary for the preparation of this report.

Taxonomy

Family Hermaeidae H. & A. ADAMS, 1854

= Stiligeridae IREDALE & O'DONOGHUE, 1923

Genus *Stiliger* EHRENBERG, 1831

Type: *Stiliger ornatus* EHRENBERG, 1831

Stiliger ornatus EHRENBERG, 1831

(Japanese name: Ao-mo-umiushi)

Stiliger ornatus EHRENBERG, 1831, tab. 1, fig. 3.—TOR, Red Sea; MACNAE & KALK, 1958, pp. (86), 128.—Mozambique.

Material: Sp. No. 1. Seto, Kii, June 29, 1964. Adult (length 7 mm). (T.S.)
 Sp. No. 2. Seto, Kii, June 29, 1964. Juvenile (length 4 mm).
 Sp. No. 3. Seto, Kii, June 29, 1964. Juvenile (length 4 mm). (H.S.)
 Sp. No. 4. Seto, Kii, August 2, 1966. Adult (length 10 mm).
 Sp. No. 5. Seto, Kii, August 2, 1966. Juvenile (length 5 mm). (H.S.)

The external body form and colours were checked under a binocular microscope on every specimen while it was alive. As to the morphology of internal organs, any close analysis of the genital complex has not yet been achieved, as we failed unfortunately to make satisfactorily sectioned preparations of that part.

External features: The general body form is typically of the Hermaeidae. Special measurements taken from Sp. No. 2 after the Code system of RISSO-DOMINGUEZ (1963) in colids are: total body-length from rhinophores to tail tip (A) 5 mm; body-length from head to tail tip (Ac) 4 mm; length of tail (C) 2 mm; length of rhinophores (R) 2 mm; breadth of sole at the pericardium (Bc) 1 mm; and maximum length of an extended papilla (Px) 1.5 mm. In the type specimen (length about 4.2 mm) of *Stiliger ornatus* it was stated merely that the rhinophores were obtuse (obtusiuscula), but this structure in *Stiliger* has later been incorrectly recognized as simple (e.g. ALDER & HANCOCK, 1855, p. 23, *Stiliger*). In our specimens the rhinophores are seen to vary greatly in form: they are claviform when extended and auriform when contracted, and there is always an outer longitudinal groove over the length of each

of them. The branchial papillae in Sp. No. 1 are arranged in about 9–10 oblique rows on either side, each row consisting at most of 5 papillae; in Sp. No. 2 they are in about 6–7 rows of at most 3 papillae each. The papillae themselves are inflated fusiform (in the type specimen of *Stiliger ornatus* these were described as styloform and swollen), and subject to contraction or extension at external stimulations. The anal papilla is situated closely in front of the pericardial prominence in the median line, and partly fused with the latter (in the type specimen of *Stiliger ornatus* the anus was stated as median and dorsal). The nephroproct lies immediately behind the root of the anal papilla on the right side. On the right of the anal papilla there opens a minute pore of the melanin black vesicle (see also GONOR, 1961, p. 87, *Hermacina smithi*; BABA, 1968, p. 6, *Alderopsis nigra*). The penial and oviducal orifices are found below the right eye; the vaginal orifice lies below the middle of the pericardial prominence on the right side. The foot-corners may be produced moderately in locomotion; naturally they are obtuse and rounded. The liver diverticula within the branchial papillae are simple (not ramified). The branches of albumen glands pass into the branchial papillae in the adult animal.

Colour: At first sight our animals appeared to assume a dark green colour of *Codium* on which they lived, and in this respect they agreed with the type specimen of *Stiliger ornatus* which was noted as obscure green (obscure viridis) dorsally. The general integument of body is yellow. On the head and anterior margin of foot the yellow colour becomes a little more pronounced than elsewhere. The rhinophores are deep indigo blue on the upper half; on the lower half their colouration is paler and proximally passes into the yellow tint of the head or is still accentuated by an indigo blue band passing across the anterior edge of the head. The opaque white dots distributed through the length of rhinophores are covered practically unperceivable by so impressive indigo hue of these structures. The colouration of the rhinophores stated above differs slightly from that known on the type specimen of *Stiliger ornatus*: in the latter each rhinophore was coloured yellow both above and below, but blue in the middle. Concerning the colouration of the branchial papillae, however, there are seemingly no marked differences between our specimens and the type of the said species. At the extreme tip of each branchial papilla there is a deep indigo (almost blackish) spot. The subapical cap is bright orange yellow; then follows an indigo blue band which, in some cases, passes downward to cover the yellow integument of the papilla. Under a high magnification it is observable that the yellow integument is densely dispersed with two sorts of gland cells. The one kind consists of yellow cells full of coarser or finer granules. The other is formed of opaque white cells which seem to produce a smoky mucous substance to the exterior. The liver diverticulum within the branchial papillae is dark yellowish brown owing to the presence of dark brown pigment grains among the slightly yellowish ferment granules. The median part of the head is always of a deep indigo blue. Towards the back and sides of the body this colouration becomes gradually thinner, thus making up in

association with the yellow background of the integument a general hue of dark green of the animal. Sp. No. 5 is a light colour variety in which a melanin black (not indigo blue) pigment extends over the head, back and sides. The upper margin of the anal papilla is always opaque white. The sole is yellow, sometimes a shade of faint blue may be added there.

Internal features: Internal organs were not described on the type specimen of *Stiliger ornatus*. The radula in Sp. No. 2 contains about 7 teeth in the ascending series, 26 teeth in the descending series, and a single pre-radular tooth. Each tooth is blade-like, without denticulations on the edge. The salivary glands could not be defined. There is a tubular oesophageal diverticulum. The liver diverticulum within the branchial papillae is simple. The kidney, lying above the pericardium, is thickly branched. The pallial portion of the gonoduct is triaulic (GHISELIN, 1966, p. 338), being differentiated into a vas deferens, an oviduct and a vagina. The penis proper is small, conical, and without a stylet. A single spermatheca (=bursa copulatrix) is present. Branches of albumen glands are seen to pass into the branchial papillae in a matured specimen (Sp. No. 1).

Discussion

1. If our specimens from Seto, Kii can certainly be identified with *Stiliger ornatus* EHRENBERG, 1831 from the Red Sea, then it will be necessary to make some amendments in the generic definition of *Stiliger* as suggested below:

Stiliger EHRENBERG, 1831. General body-form typically of the Hermaeidae. Rhinophores auriform (not simple); anal papilla mid-dorsal, closely in front of pericardium; liver diverticula simple in the branchial papillae; the latter containing branches of albumen glands; genital system triaulic; with a single spermatheca; penis without a stylet; radular teeth blade-like, non-denticulated.

2. The genus *Ercolania* TRINCHESE, 1872 (type: *Ercolania siotti* TRINCHESE, 1872) was originally described to bear slightly canaliculated rhinophores (extra leviter canaliculata), but in fact these were given as simple structures in the explanatory figures (see also PRUVOT-FOL, 1954, p. 191). This genus is not a junior synonym of *Stiliger* EHRENBERG, 1831: *Ercolania* displays such unique characters as the sabot-shaped teeth (see PRUVOT-FOL, 1954, p. 192), triaulic genital system accompanied by a spermatheca and a (modified) spermatocyst, and the armed penis. In the type species of this genus the branchial papillae contain branches of liver diverticula but none of albumen glands within, and the anal papilla lies in front of the pericardium. Apparently a number of exotic species belong to this genus. For the shape of their radular teeth two of the Japanese species, *Stiliger* (*Stiliger*) *subviridis* BABA, 1959 and *Stiliger* (*Stiliger*) *boodleae* BABA, 1938 may be classified in *Ercolania*. *Stiliger* (*Stiliger*) *berghi* BABA, 1937 is, however, supposed to belong to another genus, not yet defined.

3. The genus *Calliopaea* d'ORBIGNY, 1837 (type: *Calliopaea bellula* d'ORBIGNY,

1837) is also separable from *Stiliger* EHRENBERG, 1831 for having simple rhinophores, awl-shaped teeth, and an exceedingly elongated stylet of penis. *Stiliger (Stiliger) pusillus* BABA, 1959 is tentatively referred to *Calliopaea* for the pointed shape of its radular teeth.

4. In some details (the auriform rhinophores, the branchial papillae charged each with a simple liver diverticulum and branches of albumen glands, the triaulic genital system, and the kidney lying above the pericardium) the genus *Stiliger* EHRENBERG, 1831 comes most closely to *Placida* TRINCHESE, 1876 (type: *Placida tardyi* TRINCHESE, 1876). In *Placida*, however, there are paired oral lobes, a penial stylet, and a spermatheca accompanying a spermatocyst (personal observation on *Hermaea cremoniana* from Japan of TRINCHESE, 1893). The radular teeth in *Placida* proper appear more or less chisel-shaped rather than blade-like, and in this connection *Stiliger (Ercolania) zosterae* BABA, 1959 may be allocated to *Placida*. On the other hand, *Stiliger (Ercolania) noto* BABA, 1959 is conjectured to belong to *Hermaea* LOVÉN, 1844 (type: *Doris bifida* MONTAGU, 1815) on account of its branchial papillae containing no branches of albumen glands and its blade-like radular teeth. *Stiliger (Ercolania) smaragdinus* BABA, 1949 is assigned to *Hermaeina* TRINCHESE, 1874 (type: *Hermaeina maculata* TRINCHESE, 1874) mainly for its denticulated radular teeth and diaulic genitalia. *Stiliger (Stiliger) formicarius* BABA, 1959 was previously transferred to *Costasiella* PRUVOT-FOL, 1951 by BABA, 1961 (see also MARCUS & MARCUS, 1969, p. 13). The real taxonomic position of *Stiliger (Ercolania) akkeshiensis* BABA, 1935 remains unsettled.

5. The classification of the family Hermaeidae is still in a chaotic condition. The following is a list of the genera attributable at present and in our opinion to this family:

- I. Rhinophores simple.
 - A. Teeth awl-shaped, smooth; genitalia triaulic; penis armed (stylet very long) *Calliopaea* d'ORBIGNY, 1837.
 - B. Teeth sabot-shaped, smooth; genitalia triaulic; penis armed (stylet short) *Ercolania* TRINCHESE, 1872.
- II. Rhinophores auriform.
 - A. Teeth blade- (or chisel-) like, smooth.
 - a. Genitalia triaulic.
 - 1. Penis unarmed *Stiliger* EHRENBERG, 1831.
 - 2. Penis armed *Placida* TRINCHESE, 1876.
 - b. Genitalia diaulic *Hermaea* LOVÉN, 1844.
 - c. Genitalia (?). Anus on right side *Hermaeopsis* A. COSTA, 1869.
 - B. Teeth sabot-shaped, denticulated; genitalia diaulic; penis varying in shape *Hermaeina* TRINCHESE, 1874.
- III. Eyes close together *Costasiella* PRUVOT-FOL, 1951.

Summary

1. A sacoglossan opisthobranch collected from a *Codium* colony in Seto, Kii, Middle Japan was referred presumptively to *Stiliger ornatus* EHRENBERG, 1831 from the Red Sea.

2. The various characters of the genus *Stiliger* EHRENBERG, 1831 were checked on the present identification.

3. *Stiliger* seems separable generically from *Calliopaea* d'ORBIGNY, 1837 and *Ercolania* TRINCHESE, 1872; it is situated rather near the genus *Placida*. Some discussions were made on the taxonomy of the family Hermaeidae.

4. Name changes were proposed for some species of the Hermaeidae from Japan as follows: (1) *Ercolania subviridis* (BABA, 1959) for *Stiliger (Stiliger) subviridis* BABA, 1959; (2) *E. boodleeae* (BABA, 1938) for *S. (S.) boodleeae* BABA, 1938; (3) *Calliopaea pusilla* (BABA, 1959) for *S. (S.) pusillus* BABA, 1959; (4) *Placida cremoniana* (TRINCHESE, 1893) for *Hermaea cremoniana* TRINCHESE, 1893; (5) *P. zosteriae* (BABA, 1959) for *Stiliger (Ercolania) zosteriae* BABA, 1959; (6) *Hermaea noto* (BABA, 1959) for *S. (E.) noto* BABA, 1959; and (7) *Hermaeina smaragdina* (BABA, 1949) for *S. (E.) smaragdinus* BABA, 1949.

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EXPLANATION OF PLATES III-IV

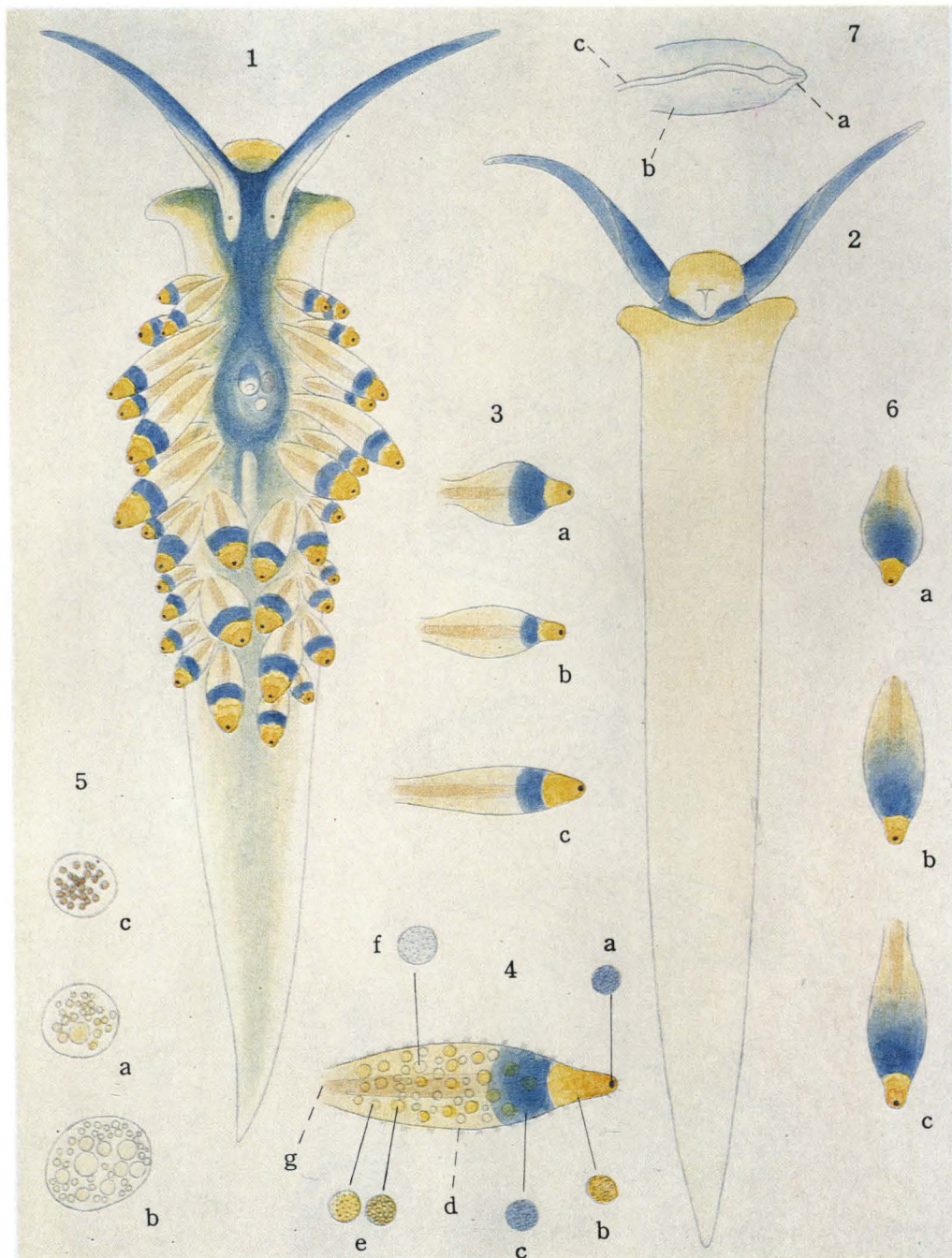
Stiliger ornatus EHRENBERG collected from Seto, Kii, Japan.

Plate III

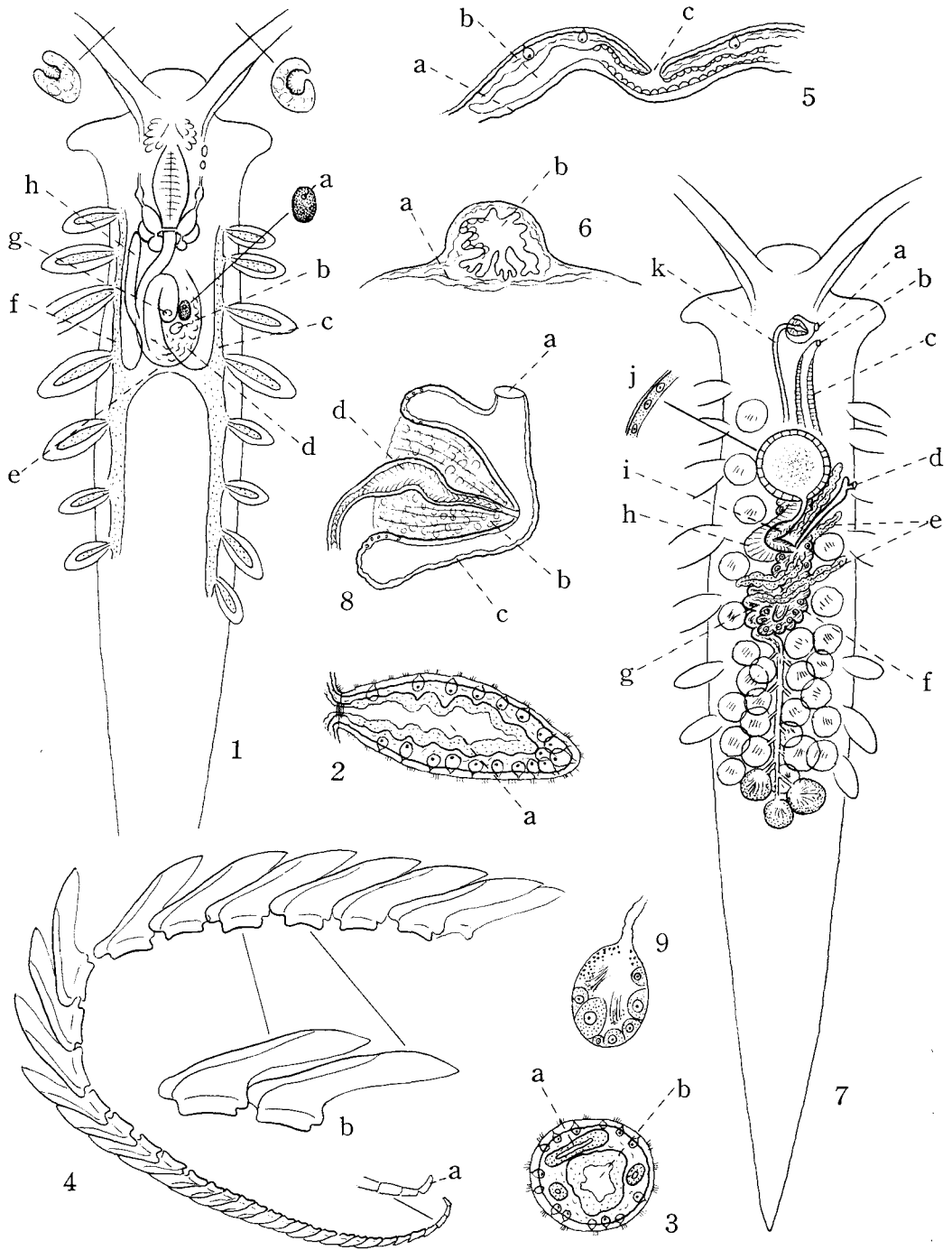
- Fig. 1. Live animal actively crawling. Length (Ac) 4 mm. Sp. No. 2.
 Fig. 2. Ventral view of head and foot. Sp. No. 2.
 Fig. 3. Branchial papillae in contracted (a) to extended (c) states. Sp. No. 2.
 Fig. 4. A typical colour pattern of a branchial papilla. Sp. No. 2. a. indigo blue cell, b. orange yellow cell, c. indigo blue cell, d. yellowish integument, e. yellow gland cells of the integument, f. opaque white gland cell of the same, g. liver diverticulum.
 Fig. 5. Liver cells freshly isolated from the diverticulum. Sp. No. 2. a-b. liver cells with slightly yellowish ferment granules, c. liver cell with dark brown pigment grains.
 Fig. 6. Different aspects (a-c) of the branchial papillae, in which an indigo blue band fades proximally into yellow without any clear demarcation. Sp. No. 1.
 Fig. 7. Protruded penis ready for copulation. Fresh Sp. No. 5. a. penis proper, b. everted penial sac, c. vas deferens.

Plate IV

- Fig. 1. Digestive system, diagrammatic. Sp. No. 3. a. melanin black vesicle with an excretory pore, b. nephroproct, c. right liver, d. kidney overlaying the pericardium, e. stomach, f. left liver, g. anus, h. oesophageal diverticulum.
 Fig. 2. Branchial papilla in longitudinal section ($\times 70$). Sp. No. 3. a. liver diverticulum.
 Fig. 3. Branchial papilla in cross section ($\times 70$). Sp. No. 1. a. branch of albumen gland, b. liver diverticulum.
 Fig. 4. Entire radular ribbon from left side ($\times 270$). Sp. No. 2. a. pre-radular tooth at the end of the descending series, b. newly formed teeth in the ascending series.
 Fig. 5. A part of cross section of the body passing through the nephroproct ($\times 70$). Sp. No. 1. a. pericardial wall, b. lumen of kidney, c. nephroproct.
 Fig. 6. A part of cross section of the body passing through the posterior end of the kidney ($\times 25$). a. subcutaneous muscle layer, b. kidney.
 Fig. 7. Genital system, diagrammatic. Sp. No. 3. a. penial orifice, b. oviducal orifice, c. oviduct, d. vaginal orifice, e. albumen glands, f. prostate gland, g. ampulla, h. mucous gland, i. membrane gland, j. spermatheca, k. vas deferens.
 Fig. 8. Details of the penial organ ($\times 130$). Sp. No. 3. a. penial orifice, b. penis proper, c. penial sac, d. ejaculatory vesicle.
 Fig. 9. Gonadial follicle ($\times 90$). Sp. No. 1.



K. BABA and I. HAMATANI: *Opisthobranchs Presumably Identifiable with Stiliger ornatus*



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