

OPISTHOBRANCHIATE MOLLUSCA FROM GHANA: FACELINIDAE

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Abstract Descriptions are given of twelve species of nudibranch aeolid from Ghana belonging to the family Facelinidae. Two of the species are new: *Cratena tema* n. sp., and *Godiva brunnea* n. sp., while three more, Facelinidae species A, B and C, appear to be currently undescribed species. Many of the twelve species are capable of living among the fouling community in harbours and on boat hulls; as a consequence several of these have an amphiatlantic geographical range while one species, *Godiva quadricolor*, also occurs widely in the Indian Ocean.

Key words Facelinidae, aeolids, taxonomy, west Africa

INTRODUCTION

Aeolid nudibranchiate molluscs from Ghana are poorly known (Edmunds, 1968a, b, 1989) but thirteen species have recently been described belonging to the families Aeolidiidae, Flabellinidae, Piseinotecidae, Eubranthidae and Embletoniidae (Edmunds, 2015a, b). This paper deals with the most species rich family from Ghana, the Facelinidae.

MATERIAL AND METHODS

All of the material described here was collected near to Accra and Tema in Ghana, close to longitude 0 latitude 5.7 by the author and by Mr Walter Pople. The method of collection, processing and preservation of specimens is described by Edmunds (2007, 2011, 2015a). Body measurements and drawings of entire animals are from life unless otherwise stated.

In the Tables and in the text numbers of cerata are given in the form: 2, 4, 5; 7, 5, 3, 2, 1. Cerata in each group (either a row or an arch) are separated from the next group by a comma; the semi-colon separates ceratal groups anterior to the heart from those posterior to the heart (precardiac and postcardiac cerata). The anterior digestive gland supplies the cerata on the right side anterior to the heart, all the other cerata are supplied by the posterior digestive gland.

The material collected and described in this paper, including microscope slides of radulae but excluding severely damaged specimens, is deposited in the Natural History Museum, London.

SYSTEMATIC DESCRIPTIONS

Family Facelinidae Bergh, 1889

Diagnosis (based on Thompson & Brown, 1984) Usually large aeolids with anus in cleioproctric position (i.e. amongst the cerata of the posterior digestive gland); long oral tentacles; usually tentacular foot corners; rhinophores lamellate or occasionally tubercular or smooth; cerata arranged in rows or in arches; jaws smooth or denticulate; radula uniseriate, each tooth with prominent cusp and several pointed lateral denticles; penis simple, unarmed or with one or many spines or hooks; one or two receptacula; larval shell not inflated.

Remarks Marcus (1958) restricted the Facelinidae to those genera with anterior cerata arranged in rows and placed genera with anterior cerata arranged in an arch into the family Favorinidae with two subfamilies: the Favorininae with one row of cerata in each arch and the Facalaninae with two or more rows of cerata in each arch. However each of these taxa contains a diverse array of genera and species with a variety of different arrangements in their reproductive systems that have been discussed by several workers (e.g. Edmunds, 1970; Miller, 1974; Gosliner, 1979). In this paper I am following Schmekel & Portmann (1982), Cervera, Calado, Gavaia, Malaquias, Templado, Ballesteros, García-Gómez & Megina (2006) and others in retaining all of these genera in the family Facelinidae pending a thorough phylogenetic analysis using both morphological and molecular characters to clarify the relationships between the genera and species.

Genus *Phidiana* Gray, 1850

Type species *Cavolina patagonica* d'Orbigny, 1837=*Eolidia patagonica* d'Orbigny, 1837 by subsequent designation (d'Orbigny used both names in consecutive lines on page 192 with *Cavolina* first).

The author of *Phidiana* is usually given as "Gray" but there are two Grays involved in the 1850 publication, a husband (J.E.) and wife (M.E.) team, a second edition being published in 1859. The massive work was compiled by M. E. Gray: "*Figs of molluscous animals selected from various authors*", but the fourth volume contains J. E. Gray's list of genera and species with *Phidiana* appearing on page 108 as follows:-

"PHIDIANA=*Cavolina*, D'Orb. Tentacula clavate, perfoliate; labial feelers subulate; gill in cross rows.

*Foot rounded in front.

1. *P. patagonica*. *Cavolina* p., D'Orb. t. 191. f. 3.
2. *P. Inca*. *Cavolina* l., D'Orb. t. 191. f. 1, 2, t. 194. f. 8.
3. *P. longicauda*. *Eolidia* 1., Quoy, t. 194. f. 11.
4. *P. northumbrica*. *Eolis* n., Alder & Hanc. t. 108. f. 1.

**Foot subulate in front.

5. *P. ? caerulescens*. *Eolidia* c., Laurillard, t. 194. f. 4."

Although not specifically stated by Gray, the genus *Cavolina* had been created for a pteropod mollusc so a new name was required for aeolids assigned by D'Orbigny to *Cavolina*. *Phidiana patagonica* is the first on the list and is the type species of *Phidiana*. The next two species probably belong to *Phidiana*, but the last two are today assigned to other genera: *northumbrica* to *Cuthona* and *caerulescens* to *Berghia* (Thompson & Brown, 1984; Tardy, 1962).

Miller (1974) gives a thorough review of the genera of the Facelinidae and of the remarkable diversity of penial structure in the family which previous authors have used to define genera. He concludes that this penial variation should not be used for generic separation and synonymises most of the genera into the oldest one, *Phidiana* Gray, 1850. However, until these genera are subject to a thorough phylogenetic review taking account of molecular characters, I prefer to retain some of these old generic names with *Phidiana sensu stricto* based on its hollow penial stylet

which separates it from *Facelina* and other genera which lack this character.

Diagnosis Facelinids with cerata arranged in numerous rows, lamellate rhinophores and penis armed with a hollow stylet.

Phidiana lynceus Bergh, 1867

Figs 1A, B; 2; 3

Phidiana lynceus Bergh, 1867: 104–116, Pl. 3 Fig. B, Pl.4 Fig. A.

Phidiana selencae Bergh, 1879: 560–563, Pl. 6 Figs 10–18.

Phidiana brevicauda Engel, 1925: 35–38, Figs 4–6.

Material examined Among *Zoobotryon* with hydroids on Tema wharf 2 spec. 7 & 4mm long 6 December 1968 Reg. no. NHMUK 20150382; among *Zoobotryon* from boat hull at Tema 7 spec. 42, 40, 33, 29, 16, 12, 3.5mm long 15 February 1969, 17 spec. 30, 27, 25, 23, 23, 21, 19, 17, 15, 10 (x 3), 7.5, 7, 5.5, 4, 4mm long 17 February 1969, 31 spec. 44, 41, 39, 32, 32, 30, 29, 25, 23, 21, 20, 20, 18, 15, 14, 14, 12 (x 3), 10, 10, 7 (x4), 6, 5 (x 3), 4, 3mm long 10 March 1969, 74 spec. 16, 14, 14, 13, 12, 11, 11, 10.5, 10, 10, 9.5, 9 (x 5), 8.5 (x 4), 8 (x 6), 7.5, 7 (x 10), 6.5, 6 (x 8), 5.5, 5.5, 5 (x 11), 4 (x 4), 3.5 (x 4), 3 (x 3), 2 (x 3)mm long 18 June 1969, 1 spec. 23mm long 12 October 1969, 1 spec. 28mm long 22 February 1973, 1 spec. 30mm long 8 March 1973 Reg. no. NHMUK 20150383.

External features Body tapering to a long, slender pointed tail, foot rounded anteriorly with blunt or angled corners but not tentaculiform (Figs 1A, B, 2A, B); oral tentacles long, 10mm in a 42mm specimen; rhinophores annulate, 5mm long with 25 rings in same specimen; large specimens can have up to 30 annulations, but many of them incomplete; cerata arranged in rows with up to 8 diagonal precardiac rows (although sometimes the first few cerata appear to be in a horizontal rather than a diagonal row), up to 4 rows to the first group of postcardiac cerata, the remaining cerata in one or two rows per digestive gland branch on each side, exactly as in Fig. 11A of Edmunds, 1964; the 23mm preserved specimen had the following numbers of cerata:

Left: 1, 3, 4, 5, 7, 8, 7, 9; 1, 2, 6, 7, 5, 6, 4, 3, 1, 1

Right: 3, 4, 6, 7, 8, 9, 12; 1, 6, 6, 9, anus, 4, 6, 4, 2, 1.

There were also 4 minute cerata arising just lateral to the pericardium in the interhepatic

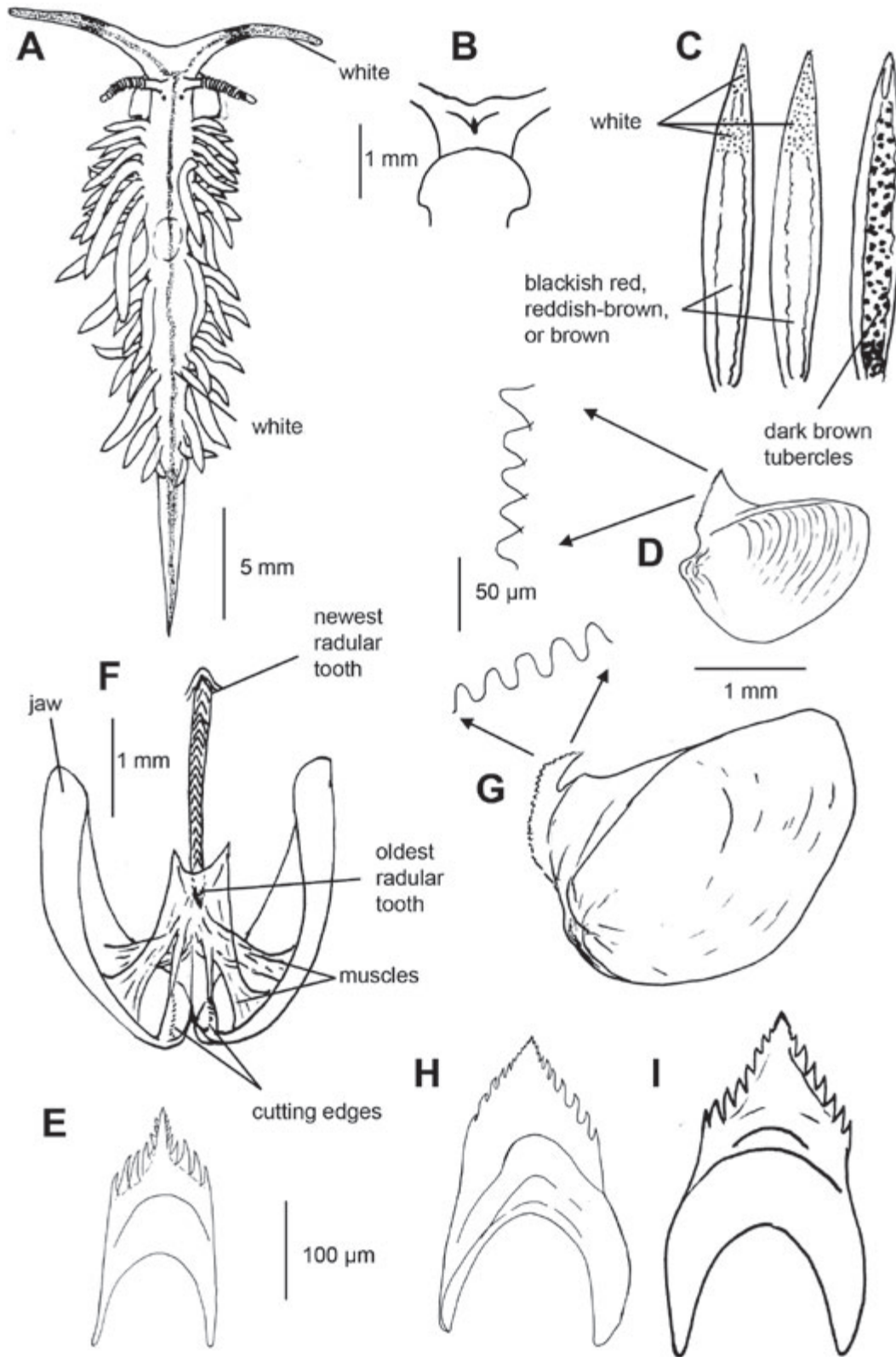


Figures 1A–B *Phidiana lynceus* Bergh, 1867: **A** from Tema, Ghana, 44mm long, February 1969; **B** from Port Royal, Jamaica, c50mm long, March 1962. **Figs 1C–D** *Facelina coenda* Marcus, 1958: **C** Tema, 10mm long, February 1969; **D** Kpone Bay, 6.5mm long, March 1971.

space, but I could not confirm whether or not they contained branches of the digestive gland. Three 9mm specimens had totals of 34, 40 and 44 cerata compared with 168 in the large specimen described above and 200–250 in the largest specimens. Cerata long, slender and pointed; anus low down within first group of cerata of posterior digestive gland on right side, in large specimens between the third and fourth rows of this group (as in Edmunds 1964 Fig. 11A); gonopore below the first rows of the first group of cerata (anterior digestive gland). Two large specimens have the penis everted with a minute black stylet at its tip.

Colouration Body greyish white, sometimes suffused pale orange anteriorly, mid-dorsal white line running from tail tip forwards, bifurcating in front of rhinophores and ending half way

up oral tentacles (Figs 1A, 2A), anterior margin of head often suffused pink, buccal mass and oesophagus usually visible through dorsal body wall bright pink; pink band half-way along oral tentacles, distal half white, sometimes continuous with the white line up the basal half; rhinophores greyish white, sometimes faintly tinged pink in basal half, with pink band half way up, distal half white; in young specimens pink bands on oral tentacles, basal half of rhinophores and buccal mass often orange; digestive gland in cerata brown or reddish brown with many dark brown spots, or more uniformly blackish red (Fig. 2C); cnidosac white, superficial white band often present in distal part of cerata or restricted to cnidosac region; sides of body and foot greyish white with a few white spots below cerata sometimes forming a broken lateral line.



Figures 2A–I *Phidiana lynceus* Bergh, 1867. From Ghana: **A** dorsal view of 27mm specimen; **B** ventral view of head of 7mm specimen; **C** three cerata from different specimens showing variation in colour markings; **D** Jaw from specimen approx 30mm long with detail of cutting edge; **E** 17th radular tooth from same specimen. From Jamaica: **F** Buccal mass dissected from specimen about 30mm alive; **G** jaw from specimen about 40–50mm long with detail of cutting edge of specimen about 35mm long for comparison with Ghanaian specimen; **H** 21st radular tooth from specimen c40mm long; **I** radular tooth from 35mm specimen.

Internal morphology The buccal mass of one of the larger specimens (about 30mm alive) was removed for examination. The jaws have clear growth rings and the cutting edge has about 20 denticles (Fig. 2D), the earliest ones rather worn and deformed. There are 17 teeth in the radula each one with slender basal processes and a prominent cusp. There are 7 or 8 denticles on each side of the cusp, with the inner 3 or 4 on the cusp itself (Fig. 2E).

The reproductive system of a large specimen from Ghana was dissected (Fig. 3E). The hermaphrodite duct leads out of the long ampulla before branching into a short oviduct leading to the female gland mass and a small receptaculum, and a long vas deferens leading to the large penis with a thorn-like stylet.

Geographical range Florida to Brazil including the Caribbean (Valdés *et al.*, 2006), Canaries (Cervera *et al.*, 2006), Azores (Peter Wirtz, Mediterranean Slug Site, 2015; Borges, Costa, Cunha, Gabriel, Gonçalves, Martins, Melo, Parente, Raposeiro, Rodrigues, Santos, Silva, Vieira & Vieira, 2010), Ghana (Edmunds, 1975, 1977, this paper).

Remarks *Phidiana lynceus* is a common tropical West Atlantic species that has more recently been recorded from the Azores and from Ghana. Descriptions of West Atlantic specimens have been given by Marcus (1957) and Edmunds (1964), and there are good photos of the living animal in Valdés *et al.* (2006) and on the Internet. Valdés *et al.* (2006) consider that *Phidiana adiuncta* Ortea, Caballer & Moro, 2004 is conspecific with *Phidiana lynceus* but I have now seen a large number of *P. lynceus* from both sides of the Atlantic and every specimen has a mid-dorsal white line bifurcating between the rhinophores and running up the oral tentacles. There is no trace of this white line on the head of *Phidiana adiuncta* (Ortea, Caballer & Moro, 2004, Plate 1E) and a red digestive gland in the cerata is also not usual for *P. lynceus*, so I conclude that it is a different species.

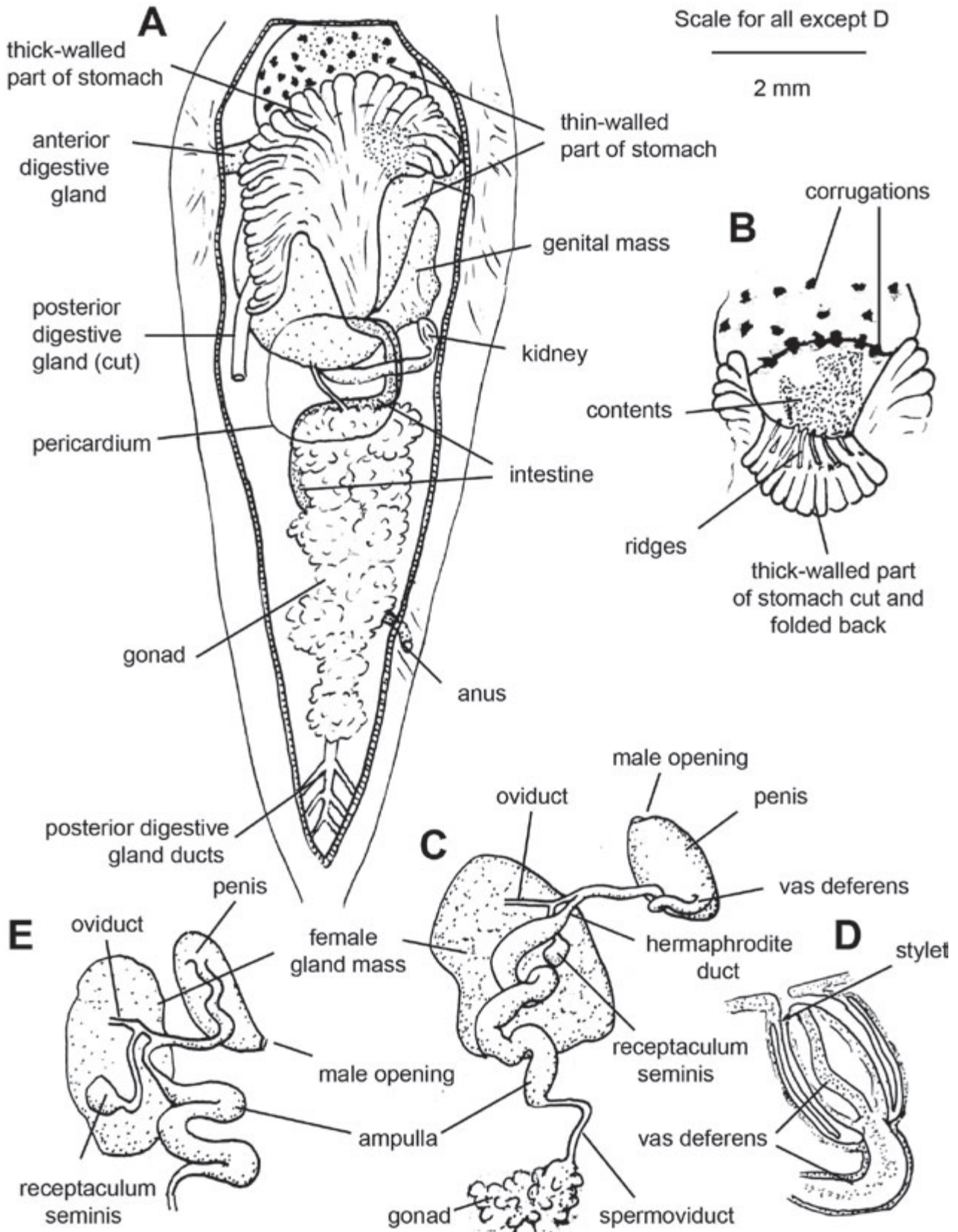
Further details of West Atlantic specimens from Jamaica are given here so that they can be compared with the new material from Ghana. The ranges of colouration of specimens from Jamaica and from Ghana are identical (Figs 1A & B). A 55mm specimen from Jamaica had 21 rows of cerata on the right side, 20 on the left with a

total of 253 cerata. Other large specimens from both Ghana and Jamaica (30–50mm) had similar numbers of cerata, but smaller ones such as the one in Fig. 2A have many fewer. A large specimen from Jamaica (c 30mm alive) was dissected by means of a dorsal incision and the internal organs exposed (Fig. 3A). The oesophagus leads into a two-chambered stomach, the first part is thin walled and lies in front of and beneath the thick walled region. Opening the stomach reveals that the darker spots on the thin-walled part are knobby corrugations (Fig. 3B) while the radiating lines on the thick-walled region mark internal ridges. The intestine leaves the stomach beneath the pericardium, runs to the left side of the body then back again to the anus on the right side. The kidney opens in the interhepatic space.

The buccal mass from a large Jamaican specimen (moribund but probably 40–50mm long) was removed and partly digested with KOH so that some of the muscles were still retained (Fig. 2F). The radula (as in all aeolids) is curved in the dorso-ventral plane with newly forming teeth furthest from the jaw hinge and the functional teeth close to the serrated edges of the jaw. The jaws are oval with (in large specimens) about 15 rounded denticles (Fig. 2G) of which the first are very worn and so difficult to count. Radulae from 7 specimens from Jamaica were examined: details of these together with the radula from a specimen from Ghana are given in Table 1 (two are shown in Figs 2H & I). The numbers of teeth in the radula, the sizes of the teeth and the number of lateral denticles all increase with the size of the animal.

The reproductive system of a Jamaican specimen is identical with the one from Ghana (compare Fig. 3C from Jamaica with Fig. 3E from Ghana).

Because of close similarities in external features, jaws, radula and reproductive system there can be no doubt that the specimens from Ghana reported here are conspecific with *Phidiana lynceus* from the Caribbean. All of the Ghanaian specimens were found among *Zoobotryon* in Tema harbour where they were feeding on the associated hydroids. There can be little doubt that *Phidiana lynceus* is native to Brazil and the Caribbean and that it has thrived amongst the fouling community so that it has been able to cross to the East Atlantic. With such a large population in Tema harbour it will probably begin to colonise other



Figures 3A–E *Phidiana lynceus* Bergh, 1867. From Jamaica: **A** dissection of large specimen by removing dorsal body wall (cerata not shown); **B** dissection of stomach with thick-walled part folded back to reveal ridges and corrugations; **C** reproductive system of same specimen; **D** penis opened to reveal vas deferens and stylet. From Ghana: **E** reproductive system of large specimen.

Table 1 Details of radulae from seven specimens of *Phidiana lynceus* from Jamaica and one from Ghana.

Body length (mm)	Number of teeth	Length of teeth (μm)	Number of denticles each side of cusp
4	11	89	5–8
11	13	146	5–7
14	12	149	5–6
14	12	160	4–6
22	13	183	6–8
c40–50	21	360	7–9
c40	21	340	7–11
30 (Ghana)	17	250	7–8

nearby habitats and also to spread to other sites on the African coast. Had *Phidiana lynceus* been crossing the Atlantic frequently over many hundreds of years, perhaps by means of planktonic larvae, then one would have expected it to occur in mid-Atlantic islands. So far, however, it has not been reported Ascension Island (although there is another species attributed to *Phidiana* on Ascension Island, *Phidiana mimica* Padula, Wirtz & Schrödl, 2014), but it has recently been reported from St Helena (V. Padula, personal communication). On balance I consider it likely that *Phidiana lynceus* is a recent colonist in the East Atlantic, but whether St Helena was colonised by planktonic larvae or by recent boats is not known.

Genus *Facelina* Alder & Hancock, 1855

Type species *Eolida coronata* Forbes & Goodsir, 1839 by original designation.

Diagnosis (based on Thompson & Brown, 1984) Facelinids with long oral tentacles, (usually) lamellate rhinophores and penis unarmed or armed with numerous hooked spines.

Facelina coenda Marcus, 1958

Figs 1C, D; 4; 5

Facelina coenda Marcus, 1958: 52–59, Figs 88–96.

Material examined From hydroids on buoy in Tema harbour 1 spec. 7mm long 10 March 1968; on *Zoobotryon* on boat hull at Tema 4 spec. 10, 3.5, 3.5 & 2mm long 15 February 1969; 10–12m reef Kpone Bay 1 spec. 3mm long 16 April 1969, 1 spec. 6.5mm long 11 March 1971 Reg. nos NHMUK 20150395, 20150396 & Slides 1–16 20150413.

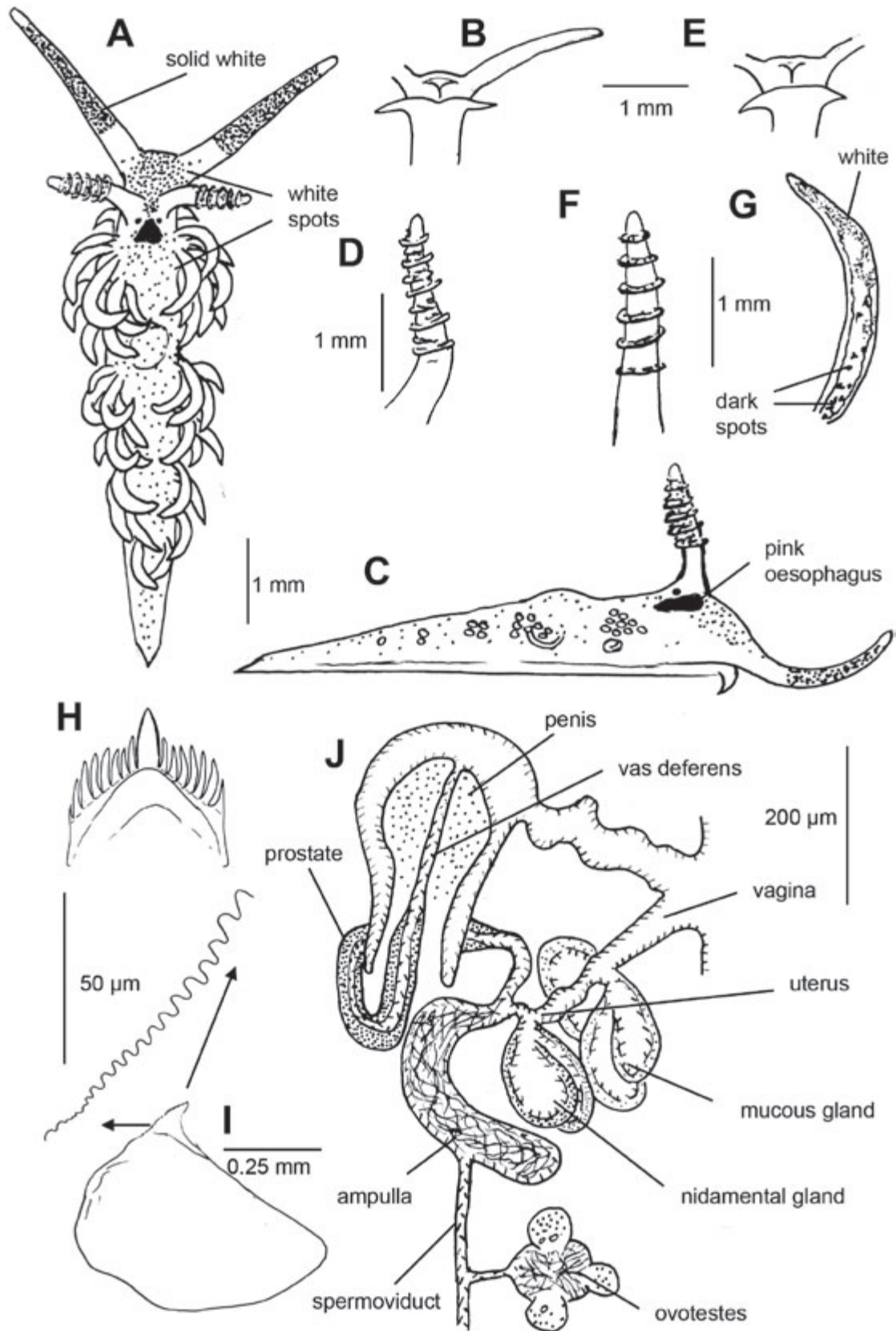
External features Body tapering to a slender pointed tail, but in most specimens it was shorter,

probably due to damage and subsequent partial regeneration, foot rounded anteriorly or with a slight indentation (Figs 1C, D, 4A, B, E), and pointed but not tentaculiform corners; oral tentacles long, rhinophores long with conspicuous rings: a 7mm specimen had 6 distinct rings (Fig. 4F), a 6.5mm specimen (with a short and probably damaged tail, so probably about 8mm if intact) had 5 complete rings with about 8 partial annular ridges (Fig. 4D), and a 10mm specimen had 10 complete rings with intermediate partial rings.

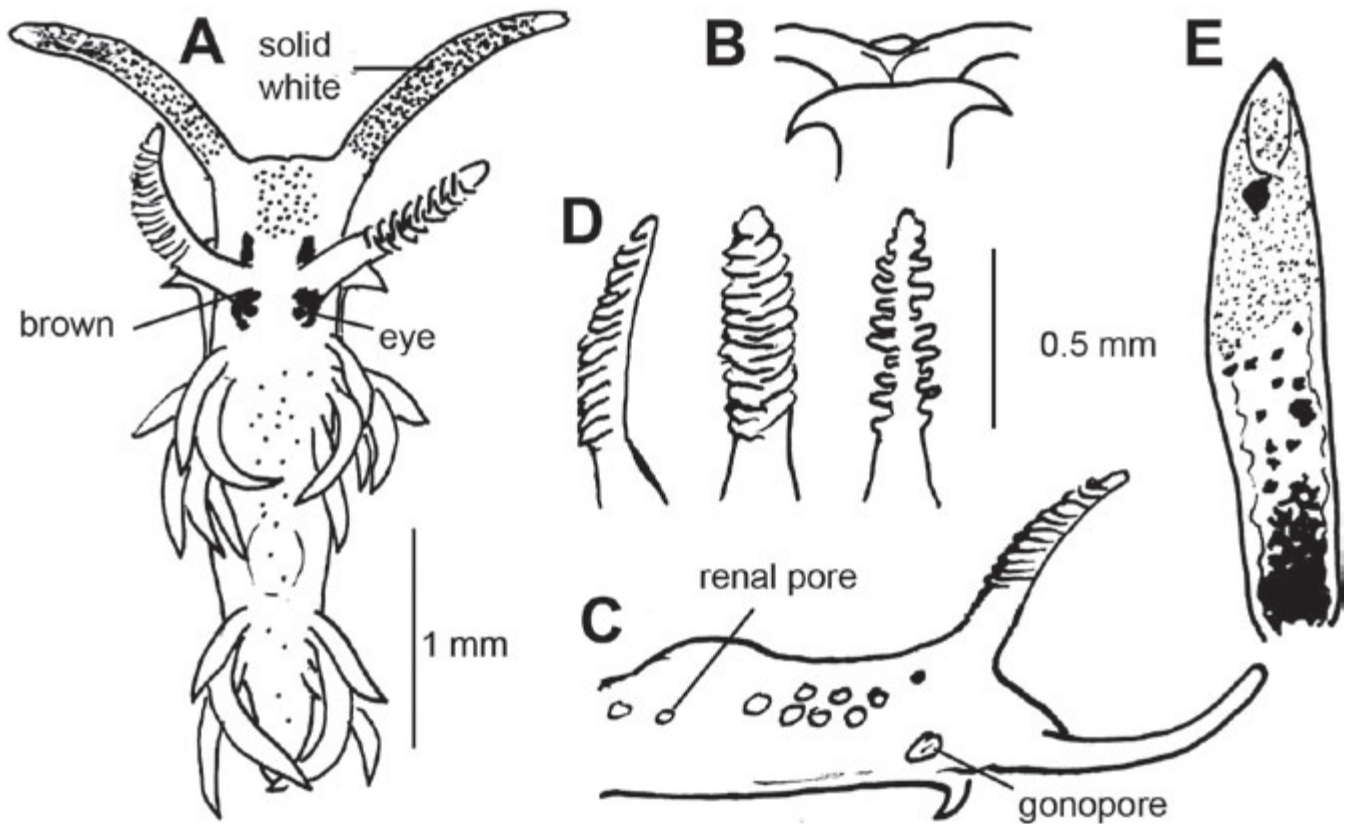
Each group of cerata comprises several rows which are so close together that the precise number in each row is difficult to count unless the animal is fully relaxed. A 7mm specimen had the following numbers of cerata in each group: Left: 9; 6, 4, 3; Right: 9; 7, 4, 2, 1. The 6.5mm specimen (probably 8 or 9mm but with a broken tail) had: Left: 13; 7, 5, 3, 1; Right: 13; 7, 6, 3, 1.

The cerata are long, slender and pointed. Anus high up in the first group of postcardiac cerata on the right side, gonopore below the first (pre-cardiac) group of cerata (Fig. 4C).

Colouration Body pale grey, more or less transparent so pink or orange-pink oesophagus visible in dorsal and lateral view (Figs 1C, D, 4A); circular white spots dorsally from head to tail, densest on head and between rhinophores, fewer on sides of body; oral tentacles with solid white in distal two thirds but tip clear; rhinophores suffused orange in basal half in largest specimens, grey in smaller ones, annulations creamy white, tip clear; digestive gland in cerata pale brown, with darker brown or dark grey-green spots basally, sometimes tinted red-brown below cnidosac (Fig. 4G), solid patch of white in distal third or more on the upper side of cerata, cnidosac white.



Figures 4A–J *Facelina coenda* Marcus, 1958: **A** dorsal view; **B** ventral view of head; **C** side view, semi-diagrammatic to show arrangement of cerata; **D** rhinophore; **E** ventral view of head; **F** rhinophore; **G** ceras; **H** 8th radular tooth; **I** jaw with detail of cutting edge; **J** semidiagrammatic reconstruction of reproductive system from serial sections. **A–C** & **F–G** from 7mm long specimen, March 1968; **D–E** & **H–J** from 6.5mm long specimen, March 1971.



Figures 5A–E *Facelina coenda* Marcus, 1958, 3mm long, April 1969: **A** dorsal view; **B** ventral view of head; **C** side view, semi-diagrammatic to show arrangement of cerata; **D** rhinophore from (left to right) side, back and front; **E** ceras.

Variation The specimen from April 1969 was just 3mm long, but the body behind the first group of cerata of the posterior digestive gland had been lost and was regenerating, yet the animal appeared to be healthy. It resembled the typical specimens in morphology of the oral tentacles, rhinophores, anterior cerata and foot as well as in the pattern of white markings on the head, back and cerata (Figs 5A, B, C). It differed in the following characters: no pink oesophagus; spots of brown in front of and behind rhinophores; rhinophores curved forwards with about 12 irregular annulations meeting at a frontal ridge so that none completely encircled it (Fig. 5D); gonopore below eye anterior to the first cerata instead of below the first group of cerata (Fig. 5C); digestive gland in cerata greyish brown with sparse black spots but solidly black basally and usually with a black spot just below the cnidosac (often obscured by superficial white pigment) (Fig. 5E).

Internal morphology The buccal mass from the 6.5mm specimen was removed before it was serial sectioned. The jaws have a slight indentation and

a single row of 14 denticles with a few more very worn ones (Fig. 4I). There were 12 teeth in the radula with one more developing. Each tooth is broad with 7 or 8 slender, pointed denticles on each side of the prominent cusp (Fig. 4H).

The specimen sectioned was very immature with just a single external opening for both the male and female organs (Fig. 4J). The testes and the ampulla both contained sperm but the glandular epithelium of the prostate was not fully developed and the large penis comprised undifferentiated cells with no trace of external cuticular spines. The glandular epithelia of both the nidamental and the mucous gland were not developed and there was no trace of a receptaculum – presumably this only develops as the animal matures.

Geographical range South-eastern Brazil (Marcus, 1958) and Ghana (Edmunds, 1977, this paper).

Remarks The damaged 3mm animal is surely the same species as the other specimens but it lacks the characteristic pink oesophagus. It is not

Table 2 Comparison of Brazilian and Ghanaian *Facelina coenda*.

Character	Brazil	Ghana
Body length	≤ 25mm	≤ 10mm
Body colour	White/pale orange	Grey
White areas	Patch on head, spots dorsally behind rhinophores	Patch on head and between rhinophores, spots further back to tail
Oral tentacles	Not described	Distal 2/3 white, tip clear
Rhinophores	Yellow	Orange in basal half of largest specimens, annulations white
Oesophagus	Red	Pink
Anterior cerata	6 rows	4 rows (7mm specimen)
Posterior cerata	7 groups each with several rows	3 groups of short rows
Total cerata	60–177	45 (7mm), 59 (6.5mm)
Ceratal colour	White tipped, brown digestive gland	White patch distally, pale brown digestive gland with darker spots basally
Jaw denticles	19	14
Radula teeth	17, 5–8 lateral denticles arise from side of short central cusp	12, 7–8 pointed lateral denticles, prominent cusp

known if this colour resides in the oesophagus itself or if it is derived from a coloured hydroid which the animal has been eating. Table 2 compares the Brazilian specimens with the new ones from Ghana. The arrangement of cerata and the colouration are almost identical if allowance is made for the considerably larger size of Brazilian specimens and that as animals grow larger they develop more yellow or orange pigment. The principal difference is the shape of the radular teeth. The tooth drawn by Eveline Marcus in Er Marcus (1958) is almost identical with that of European species of *Facelina* e.g. *Facelina coronata* (Forbes & Goodsir, 1839) with the lateral denticles arising from the V-shaped frontal edge and with the median cusp of much the same size as the lateral denticles (Thompson & Brown, 1984). In contrast the teeth of the Ghanaian specimen have a prominent central cusp, the front of the tooth is a much shallower V, and the lateral denticles are longer and slender. Comparable variation in the denticles of the radular teeth occurs in other aeolids e.g. *Cuthona perca* (personal observation). It is unfortunate that the reproductive system of the Ghanaian specimen proved to be so immature that it cannot be compared with the animals from Brazil, but the undifferentiated penial complex is large, as it is in the Brazilian specimen.

Because of the close similarity of the Ghanaian specimens with those from Brazil in all characters apart from the radular teeth (Table 2), I conclude that they are conspecific: there is unlikely

to be another species with identical colouration to the Brazilian animals but belonging to a different species. Because most of the Ghanaian specimens were found in Tema harbour among the fouling community it is probable that they have travelled from the West Atlantic by boat.

Genus *Pruvotfolia* Tardy, 1969

Type species *Acanthopsole pselliotes*, Labbé, 1923 by original designation.

Diagnosis (based on Tardy, 1969) Facelinids with lamellate rhinophores, unarmed penis, and a flange adjacent to the genital openings with several modified cerata.

Pruvotfolia pselliotes (Labbé, 1923)

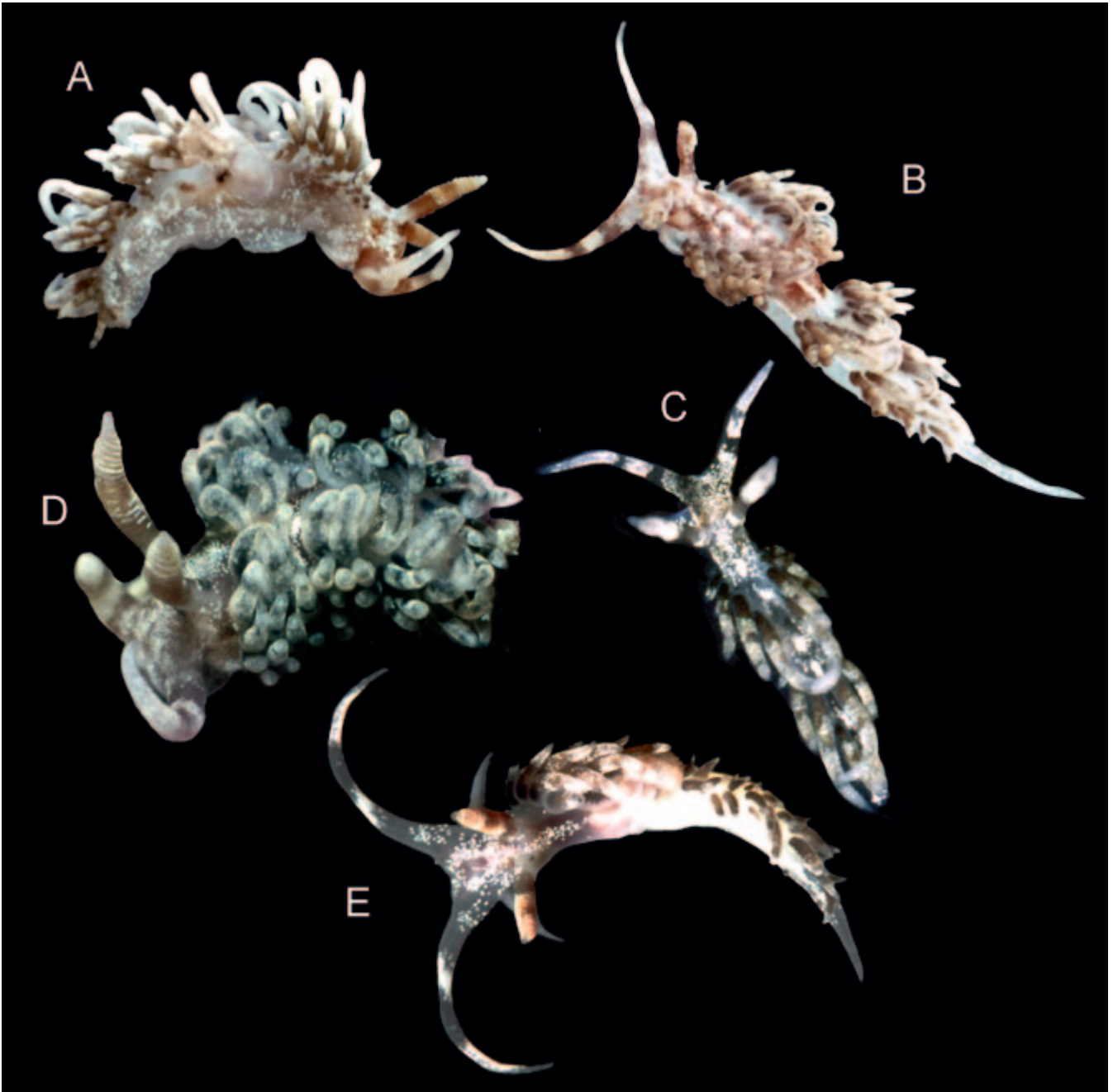
Figs 6; 7; 8

Acanthopsole pselliotes Labbé, 1923: 266.

Pruvotfolia pselliotes – Tardy, 1969: 330–342, Pl. 1–6.

Rolandia hispanica Pruvot-Fol, 1951: 58–60.

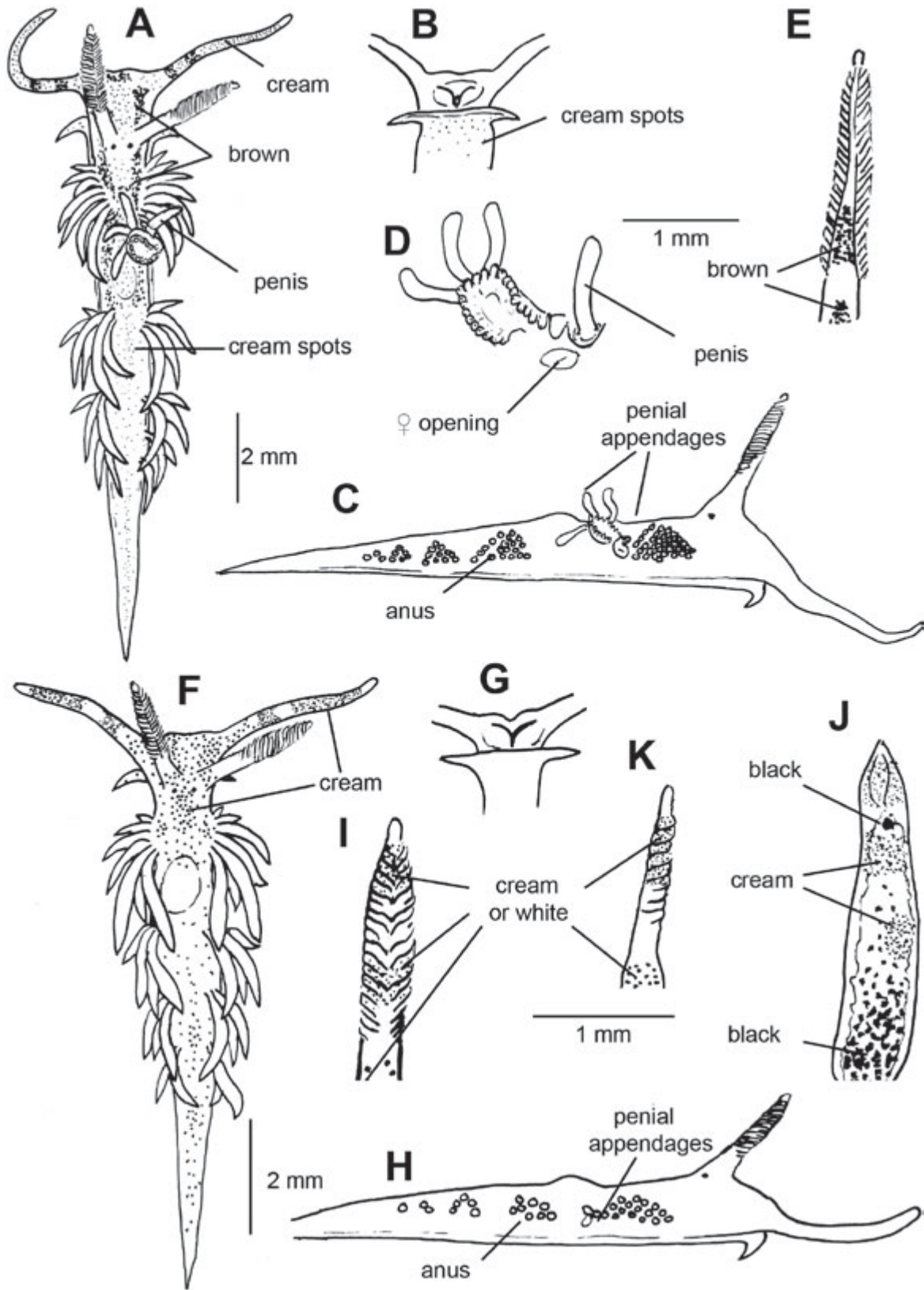
Material examined 10m reef Kpone Bay 4 spec. 16, 13, 9 & 9mm long 24 November 1967; 1 spec. 4mm long 2 October 1969; 1 spec. 17mm long 11 March 1971 Reg. nos NHMUK 20150392 & 20150393; dredged from Tema Bay at 45m depth 2 spec. 8 & 7mm long 6 December 1968; at 40m depth 1 spec. 10mm long 28 November 1969; at 25m depth 1 spec. 9mm long 13 June 1970 Reg. nos NHMUK 20150390 & 20150391.



Figures 6A–E *Pruvotfolia pselliotes* (Labbé, 1923). From Kpone Bay **A** 16mm long, November 1967; **B** 13mm long, November 1967; **C** 4mm long, October 1969; **D** 17mm long, March 1971. From Tema Bay **E** 10mm long, November 1969.

External features Body tapering to a long tail, foot straight anteriorly or with slight indentation and slender, pointed but not tentaculiform corners, broader than body (Figs 6A–E, 7A, B, F, G); oral tentacles long; rhinophores long with up to 24 lamellae sloping from front, which is smooth, to posterior ridge or groove, several lamellae much shorter (Figs 7E, I, K); first group of cerata in close set rows (Figs 7C, H), second group

also appear to be in rows but with the anus just anterior to the most posterior row. More posterior ceratal groups also in short rows but with many fewer cerata. Ceratal numbers in 6 specimens are given in Table 3. The 13mm specimen had a broken tail so was probably originally 16 or 17mm. The 7 and 8mm specimens had similar numbers and arrangements of cerata to the 9mm specimen. Cerata slender, tapering gradually;



Figures 7A–K *Pruvotfolia pselliotes* (Labbé, 1923). 13mm long, November 1967: **A** dorsal view; **B** ventral view of head; **C** side view, semi-diagrammatic to show arrangement of cerata; **D** detail of penial appendages in live animal with penis protruded; **E** rhinophore from front. 9mm long, June 1970: **F** dorsal view; **G** ventral view of head; **H** side view, semi-diagrammatic to show arrangement of cerata; **I** posterior view of rhinophore; **J** cerata (contracted: in life they are usually very slender and twice this length). 4mm long, October 1969: **K** side view of rhinophore.

Table 3 Ceratal numbers in specimens of *Pruvotfolia pselliotes* from Ghana. The precardiac cerata are in numerous close-set rows e.g. the 37 cerata in the 10mm animal had the following numbers in each row: 1, 3, 5, 6, 6, 6, 5, 5.

Body length (live)	Left side	Right side	Total
17mm	28; 16, 7, 5, 4	27; 19, 9, 7, 4, 1	127
13mm	31; 13, 10, 6, 2, 1	33; 17, 11, 6, 2, 1	133
10mm	All cerata lost	37; 13, 8, 5, 3, 2, 1	69
9mm	14; 7, 4, 3	16; 7, 4, 3	58
4mm	9; 4, 2, 1	9; 4, 2, 1	32

gonopore just below and behind the last cerata of the first group. The male and female genital openings are just below and behind the first group of cerata (Figs 7C, H). Above and behind them is a U-shaped penial flange fringed with 20–25 short papillae each with a terminal opening. Just in front of this flange are three or four blunt cerata which appear similar to all of the other cerata (Fig. 7D). Above and behind the flange are a variable number of long or short papillae which are blunt unlike typical cerata. All of these unusual papillae are probably modified cerata. In immature animals all that can be seen of these structures are two or three small tubercles (Figs 8C & D shows them in 9 and 10mm specimens, while in a 7mm specimen they are very similar). Figs 8A & B show the structures in much larger specimens. While it was still alive the 13mm specimen was observed to protrude its penis (Fig. 7D).

Colouration Body pale grey, larger specimens with dark brown reticulation dorsally on head and dorso-laterally back to the rear of the pericardium, pale brown anteriorly on sides (Figs 6A, B, 7A); smaller specimens have pale brown suffusion from basal part of oral tentacles and head back to first group of cerata, sometimes with a faint pink tinge from internal organs in front of and behind rhinophores (Fig. 6C); dense circular cream or white spots on head and bases of oral tentacles, with scattering of spots on back and sides from eyes to tail tip and sometimes on upper surface of foot, two specimens with circular patch in front of rhinophores without spots; one large specimen with two white patches mid-dorsally behind rhinophores, smallest specimen

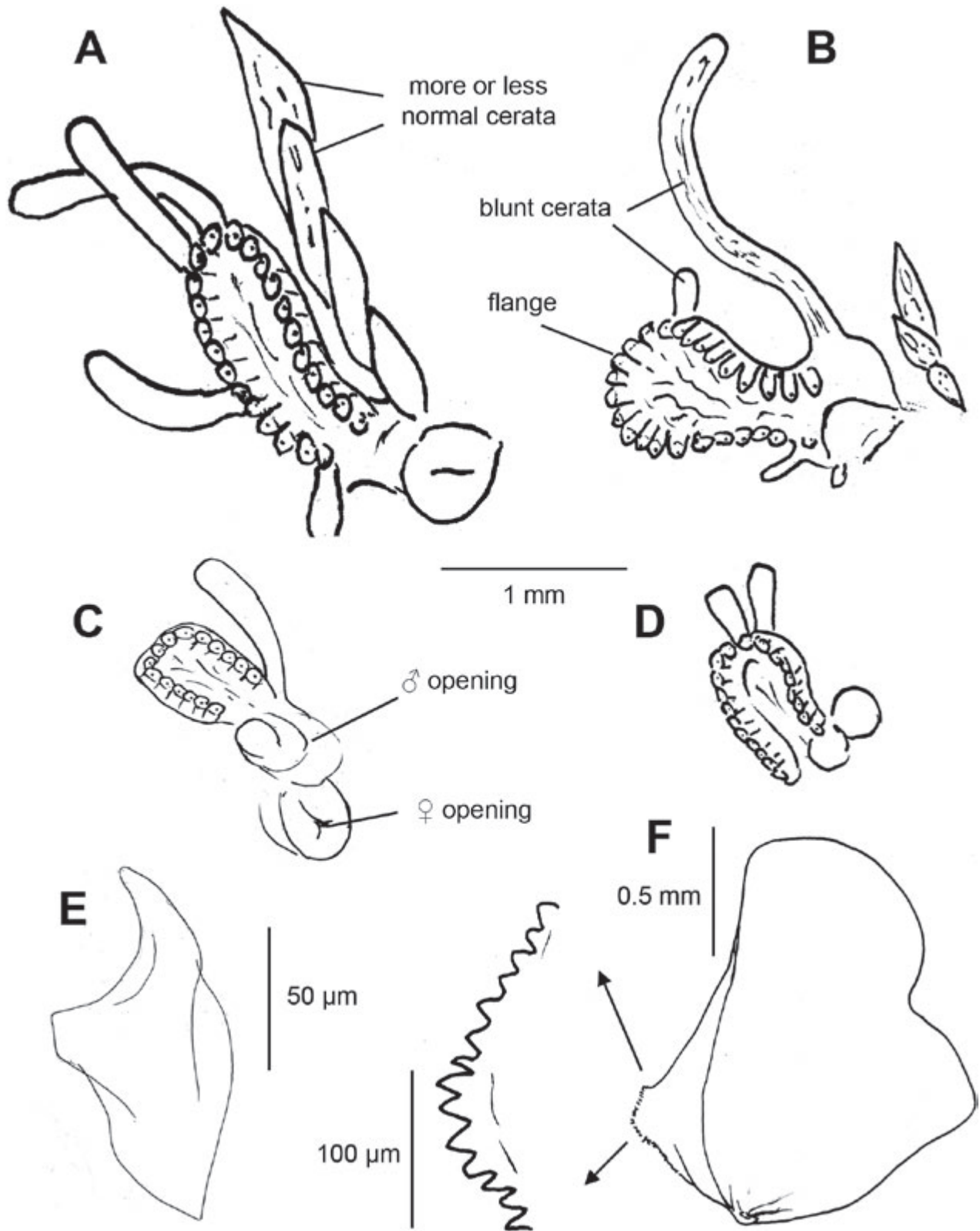
with four patches of white in dorsal mid-line, two in front of and two behind heart; oral tentacles with two white bands and clear tip. Rhinophores suffused brown, pale in smaller specimens, dark and covering central three-quarters in largest, tip and base grey but base of three specimens with one or two brown spots (Figs 7E, I), smallest specimen with base and upper 6 rings densely dotted white (Fig. 7K), larger specimens with two cream bands, cream spots between them and at base. External genitalia grey with some pale brown. Digestive gland in cerata buff to yellow-brown with black blotches concentrated basally and often a larger black spot just below cnidosac, patches of white distally and in cnidosac region and scattered spots lower down (Fig. 7J). In some specimens there is a tinge of pink in the distal cream band of the rhinophore and below the cnidosac of some of the cerata. The largest specimen (Fig. 6D) had pale brown suffusion on the front part of the body, darker on the rhinophores, and the digestive gland in the cerata was dark grey.

Internal morphology The buccal mass was removed from the 16mm specimen. The jaws are deeply indented with about 14 denticles on the cutting edge, the last two not fully hardened (Fig. 8F). The radula was mounted in side view and has 26 teeth but I could see no trace of any denticles on the sides of the cusp (Fig. 8E).

Geographical range English Channel, Atlantic coast of France, Spain and Portugal, Mediterranean, Canary Islands, Senegal, Ghana (Tardy, 1969; Yokes, 2001; Poddubetskaia, 2003; Cervera *et al.*, 2006; Mifsud, 2006; Ballesteros, Madrenas, Pontes *et al.*, 2013a; this paper).

Remarks The external genitalia of *Pruvotfolia pselliotes* are unique among aeolids in their complexity; Tardy (1969) has described how they are involved in the process of copulation.

Tardy's (1969) description of *Pruvotfolia pselliotes* includes a translucent body tinted brown on the oral tentacles, rhinophores and back; numerous opaque white spots on the body; brown oesophagus and stomach; oral tentacles and rhinophores with yellow-ochre pigment in a band and at the tips; cerata with two yellow-ochre bands and a yellow-ochre tip; and dark brown digestive gland diverticula becoming slender and curled below the cnidosac. Some photos



Figures 8A–F *Pruvotfolia pselliotes* (Labbé, 1923): accessory reproductive structures showing variation between individuals and at different ages; all have a horseshoe of short papillae each with a terminal pore. All are drawn from preserved animals at approximately the same scale. **A** 17mm specimen with 4 normal cerata on right and 4 abnormal ones; **B** 16mm specimen with 3 normal cerata on right, two long abnormal papillae and two minute ones (bottom left); **C** 8mm specimen; **D** 10mm specimen; **E** 3rd radular tooth from 16mm specimen in side view; **F** jaw from same animal with inset of denticles on cutting edge.

of this species on the internet have this colour pattern (e.g. Sohler, 2008; Rudman, 2008), but others from the Mediterranean are more orange-brown (e.g. Ballesteros *et al.*, 2013) or pinkish brown (Yokes, 2001; Picton, 2001; Mifsud, 2006; Rudman, 2006). The colouration of some of my specimens from Ghana is similar to that of the French animals, but other specimens show wide variation in the amount of brown and white pigment (see above and Figs 6A–E). Specimens from Senegal are very similar to my ones from Ghana (Poddubetskaia, 2003; Rudman, 2003b). The structure of the penial flange and the indented jaws of my Ghanaian specimen are almost identical with those of specimens described by Tardy (1969). However, the radular teeth of my specimen appear to lack the lateral denticles illustrated by Tardy, but this may be because I mounted the radula in side view where any small lateral denticles could easily be overlooked. I conclude that my Ghanaian specimens are conspecific with Tardy's *Pruvotfolia pselliotes*.

Three other Atlantic species of *Pruvotfolia* need to be considered: *P. rochebruni* Ortea, Moro & Caballer, 2002 and *P. longicirrha* (Eliot, 1906) from Cape Verde, and *P. faurei* (Barnard, 1927) from South Africa. *P. rochebruni* has a reddish tint to the head, dorsum and rhinophores with a mid-dorsal white line which bifurcates between the rhinophores, one branch running to each oral tentacle. It also lacks the dorsal indentation in the jaw which characterises *P. pselliotes*, so it appears to be distinct from *P. pselliotes*.

P. longicirrha has been refound and described by Ortea & Moro (1997): its body is cream-beige with pink oesophagus visible below the eyes, white line over the heart and white dots or patches from rhinophores to tail; oral tentacles and rhinophores orange-brown basally, tip clear; cerata with white dots below tip and chestnut digestive gland. A specimen from Cape Verde shows dense white dots forming a mid-dorsal line from rhinophores to half way down the dorsum and the body is tinted orange, much brighter on the head, rhinophores and digestive gland diverticula in the cerata (Wirtz, 2010). Although the jaws and radular teeth are very similar to those of *P. pselliotes*, the phylogenetic analysis of Carmona, Pola, Gosliner & Cervera (2013) confirms that the two species are distinct.

P. faurei has been described by Macnae (1954) and there is a colour photo of it in Gosliner

(1987). It lives in Saldanha Bay on the Atlantic coast of South Africa but also occurs further east on the Indian Ocean coast at Port Elizabeth. It differs from *P. pselliotes* in having sparse white dots on the head and the base of the oral tentacles and very black digestive gland diverticula in the cerata. The radular teeth have 7 lateral denticles compared with 3–4 in *P. pselliotes*, and “The jaws show no peculiarities” (Macnae, 1954) which implies that they lack the deep indentation of *P. pselliotes*. I therefore conclude that *P. faurei* is probably not conspecific with *P. pselliotes*. However, if further research shows that either *P. longicirrha* or *P. faurei* is conspecific with *P. pselliotes* then these two names will have priority over *P. pselliotes*.

Genus *Learchis* Bergh, 1896

Type species *Learchis indica* Bergh, 1896 by monotypy.

Diagnosis (based on Marcus & Marcus, 1960) Facelinids with annulate rhinophores, pointed foot corners, jaw with denticulate cutting edge without dorsal indentation, radula with at least 3 denticles on each side of cusp, and unarmed blunt or conical penis.

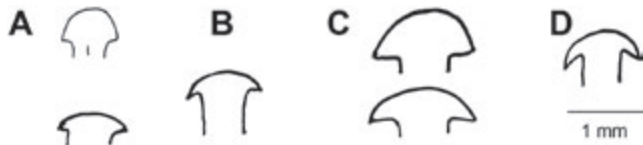
Learchis poica Marcus & Marcus, 1960

Figs 9; 10A, B; 11

Learchis poica Marcus & Marcus, 1960: 183–186, Figs 82–86.

Material examined Rock pools at Teshie on hydroid *Halocordyle disticha* (Goldfuss): 1 spec. 14mm long 30 December 1970, 2 spec. 13 & 9mm long 1 January 1971, 7 spec. 12, 9, 8 (x4) & 6mm long 4 April 1973 Reg. no. NHMUK 20150380.

External features Foot longitudinally grooved, rounded at front with short corners, but the shape of these corners is variable: Fig. 9A shows the appearance of the foot in two different 6mm long specimens alive. The rhinophores have irregular lamellae, many of them incomplete: one 13mm animal has 17 partial or complete lamellae. Precardiac cerata arranged in rows, postcardiac cerata in arches towards the front, in rows further back. Table 4 gives the numbers of cerata in each row or group for six animals of different sizes.



Figures 9A–D *Learchis poica* Marcus & Marcus, 1960 showing variation in the shape of the foot: **A** two 6mm animals from Ghana drawn from life; **B** preserved specimen from Ghana; **C** two views of a 12mm animal from Jamaica, drawn on the same day from life; **D** preserved specimen from Jamaica.

Colouration Body pale grey sometimes suffused pale orange especially anteriorly but in some specimens also to tip of tail (Figs 10A, B); broad white line from front of head to last cerata, narrower between cerata, wider in interceratal regions, and a few white spots on tail, but in specimen illustrated by Edmunds (1968a) white dorsally reduced to a series of spots; orange streak from base of rhinophores to base of oral tentacles where it is paler and more diffuse, sometimes streak reduced to an orange suffusion; orange streak on side of head and white stripe or series of elongated patches from below this streak to tail, edge of foot laterally grey or

suffused orange or yellow from head to tail tip; oral tentacles suffused orange or yellow at base, spotted with white distally; rhinophores often with orange streak on forehead extending a short distance up anterior surface, basal half suffused pale orange or yellow, distal half white, tip clear; gonopore in large specimens orange, renal pore often orange or red; digestive gland partly visible through dorsal body wall in specimens with sparse white markings which obscure it; digestive gland in body and in cerata cream or pinky cream but largely or completely obscured by indigo or blackish marks, white spots scattered over surface with a band of pale orange in cni-dosac region (missing in some cerata) then a few white dots often forming a partial ring, tip clear.

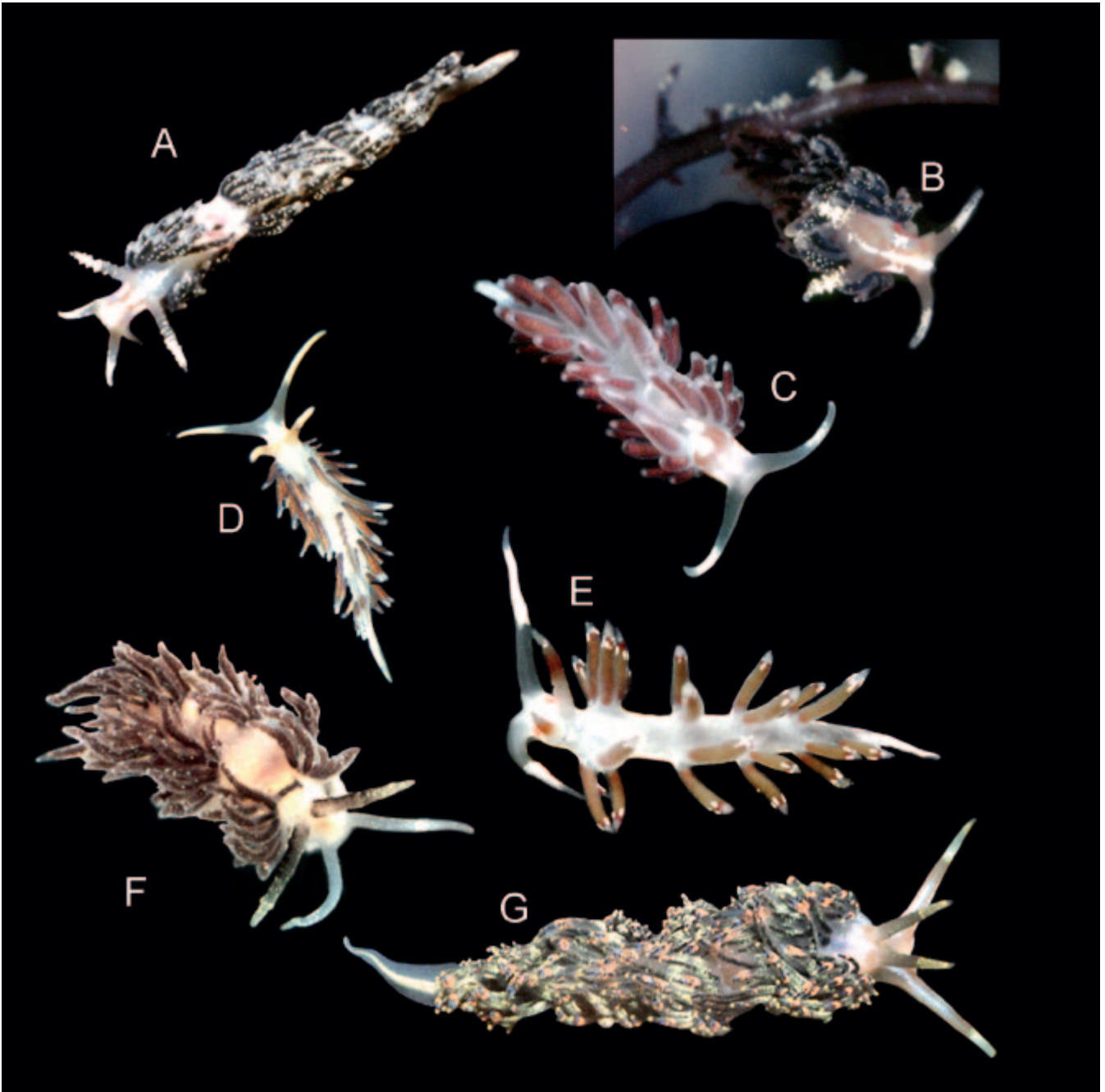
Internal morphology The radula and reproductive system of specimens from Ghana has already been described (Edmunds, 1968a).

Behaviour Some of the specimens fed on *Halocodyle disticha* in the laboratory.

Geographical range North Carolina south to Caribbean and Curaçao, Madeira & Azores,

Table 4 Ceratal numbers in specimens of *Learchis poica* from Ghana and from Jamaica.

Body length (live)	Side	Numbers of cerata per row or arch	Total	
Ghana: 14mm	Left	1, 3, 5, 3, 4, 6; 13, 11, 8, 5, 3, 2, 1	144	
	Right	2, 4, 5, 5, 5, 9; 16, 11, 8, 7, 3, 3, 1		
	13mm	Left	2, 4, 4, 5, 7; 12, 11, 9, 8, 7, 5, 3, 2	152
		Right	1, 3, 4, 5, 4, 8; 5, 10, 9, 8, 7, 5, 3, 1	
	12mm	Left	4, 3, 4, 4, 5; 11, 10, 8, 8, 7, 5, 1	129
		Right	4, 2, 2, 4, 3; 7, 10, 8, 7, 7, 3, 2	
	11mm	Left	2, 2, 2, 2, 4, 3; 6, 4, 9, 8, 6, 5, 3	113
		Right	1, 2, 4, 4, 6; 10, 8, 6, 6, 5, 3, 2	
	9mm	Left	2, 4, 4, 4, 7; 11, 9, 7, 5, 4, 2	135
		Right	2, 2, 4, 4, 4, 6; 16, 13, 10, 8, 5, 2	
6mm	Left	2, 2, 3, 4; 6, 5, 5, 3, 2, 1	69	
	Right	2, 3, 3, 4; 6, 5, 5, 4, 3, 1		
Jamaica: 16mm	Left	2, 3, 4, 5, 5, 7; 10, 8, 7, 6, 4, 1	127	
	Right	1, 3, 3, 5, 5, 7; 12, 10, 8, 5, 4, 2		
12mm	Left	2, 3, 4, 4, 5; 9, 8, 6, 5, 3, 2	104	
	Right	2, 3, 4, 4, 5; 9, 9, 7, 5, 4, 1		
9mm	Left	2, 2, 3, 3, 4; 9, 7, 5, 4, 3, 1	89	
	Right	1, 2, 4, 4, 5; 9, 7, 5, 5, 3, 1		
7mm	Left	2, 3, 4, 5; 7, 7, 5, 5, 2, 1, 1	84	
	Right	1, 2, 4, 4; 9, 7, 5, 5, 3, 1, 1		
4.5mm	Left	2, 2, 2, 3; 5, 3, 3, 1, 1	46	
	Right	1, 2, 3, 4; 5, 4, 3, 1, 1		



Figures 10A–B *Learchis poica* Marcus & Marcus, 1960 from Teshie, Ghana: **A** 13mm long, January 1971; **B** 12mm long, April 1973. **Figs 10C–D** *Learchis evelinae* Edmunds & Just, 1983: **C** Kpone Bay, 7mm long, December 1968; **D** Barbados, 1979, photo by Hanne Just. **Fig. 10E** *Cratena tema* n. sp.: Tema Bay, 9mm long, February 1970. **Fig. 10F** *Favorinus ghanensis* Edmunds, 1968: Tema harbour, 13mm long, February 1968. **Fig. 10G** *Godiva quadricolor* (Barnard, 1927): Tema harbour, 59mm long, September 1969.

Ghana (Marcus & Marcus, 1960; Edmunds 1964, 1968a; Eyster, 1980; Valdés *et al.*, 2006; Cervera *et al.*, 2006; this paper).

Remarks The specimens from Ghana described here and in Edmunds (1968a) are almost identical with those from Jamaica in external

features, radular teeth and reproductive systems (Edmunds, 1964). Fig. 9C shows two views of the foot of a 12mm long specimen from Jamaica for comparison with Ghanaian specimens in Fig. 9A. However, in preserved specimens that were fully narcotized before fixation, there is less variation in the anterior margin of the foot, but 8 Ghanaian

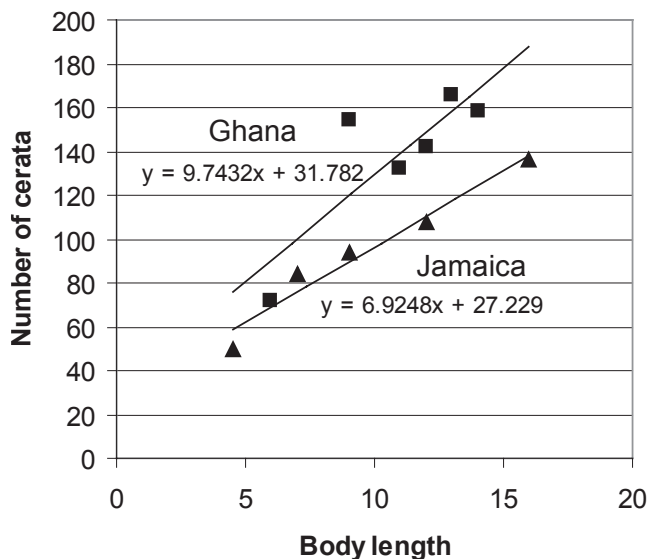


Figure 11 Relationship between body length and total number of cerata in *Learchis poica* from Ghana and from Jamaica. The number of cerata allows for some having been lost by autotomy: e.g. where there are 13 cerata in an arch on one side of the body and 16 on the other it assumes that the total number is $2 \times 16 = 32$.

specimens all have shorter less tentaculiform corners than 7 specimens from Jamaica (Figs 9B, D). Whether this difference is consistent in a wider range of specimens from the two sides of the Atlantic is not known. There are two other differences between Ghanaian and Jamaican animals: colour of the digestive gland in the cerata and numbers of cerata in animals of different sizes. The digestive gland of Jamaican specimens was creamy yellow with brownish red spots, much paler than in Ghanaian animals. Colour of digestive gland in many aeolids varies with the species of hydroid eaten and the hydroids present on the two sides of the Atlantic are likely to be different. Table 4 and Fig. 11 show that the relationship between body length and numbers of cerata is different in Ghanaian and Jamaican animals: for a given body length Ghanaian specimens have many more cerata than Jamaican specimens. I conclude that *Learchis poica* is an amphiatlantic species with only minor differences between specimens from east and west. Specimens from both Ghana and Jamaica were found in natural habitats, but the type locality was among the fouling community in Miami, and Valdés *et al.* (2006) report it from hydroids growing on *Sargassum*. This species could therefore easily cross the Atlantic and it has recently

been reported from St Helena in the mid-Atlantic (V. Padula, personal communication).

Learchis evelinae Edmunds & Just, 1983

Figs 10C, D; 12

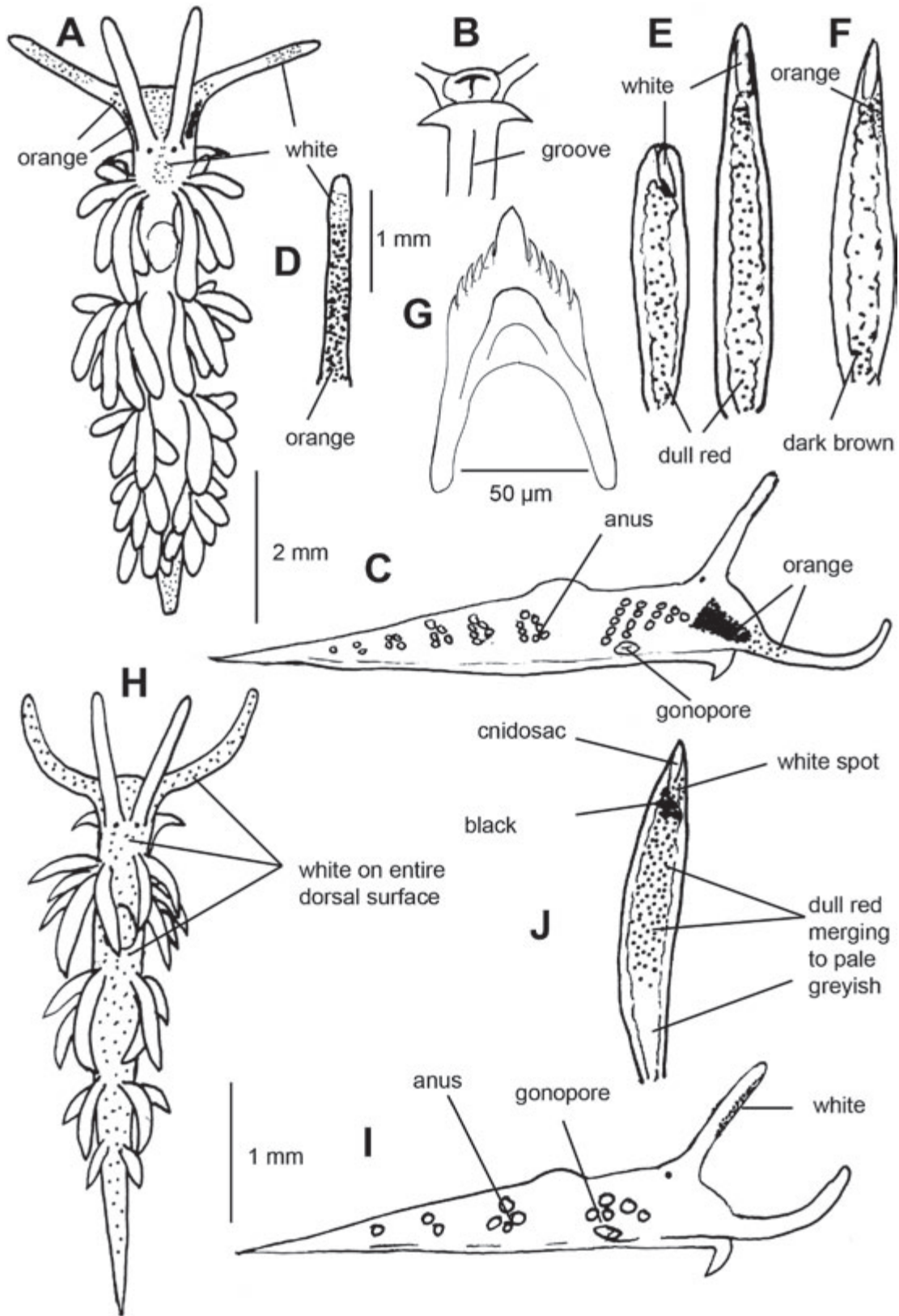
Learchis evelinae Edmunds & Just, 1983: 195–197, Figs 5A, 7, 8D.

Material examined 10m reef Kpone Bay 1 spec. 7mm long 2 December 1968 Reg. no. NHMUK 20150397; 1 spec. 7mm long 11 March 1971 Reg. no. NHMUK 20150398. Dredged from 30m Tema Bay 1 spec. 4mm long 12 June 1970 Reg. no. NHMUK 20150400.

External features The 1971 specimen had a broken tail so would probably have been 9mm when intact. Body tapering to a slender pointed tail, foot rounded anteriorly with narrow pointed corners and longitudinal groove (Figs 10C, 12A, B); oral tentacles and rhinophores 2mm long in larger specimen, smooth; anterior cerata in five rows (Fig. 12 C), posterior cerata in arches as follows: 1968 specimen, Left: 1, 2, 3, 4, 4; 6, 5, 4, 3, 1, 1; Right: 1, 2, 3, 4, 5; 7, 6, 5, 4, 2, 1
1971 specimen, Left: 2, 3, 4, 4, 5; 7, 7, 5, 4, 3, 1; Right: 1, 2, 4, 4, 5; 8, 7, 4, 3, 3, 1

Cerata shorter than in many other facelinids, blunt at tip, but when MS222 was added to anaesthetize the animal the cerata were extended to more than 2mm and waved about (Fig. 12E); anus below first arch of postcardiac cerata, gonopore below fourth row of first group of (pre-cardiac) cerata (Fig. 12C).

Colouration Body greyish white, with broad white patch on head narrowing between rhinophores to end between eyes and cardiac hump (Figs 10C, 12A), tail white in one specimen, with medial dorsal white line in the other, no white on rest of dorsal surface but creamy white viscera show through; sides of head with elongated patch of bright orange, only visible in dorsal view as a narrow line at the edge of the head (Figs 10C, 12A); basal half of oral tentacles suffused pale orange, distal half white, tip clear; rhinophores bright orange, with a distal band of white and tip clear (Fig. 12D); digestive gland in cerata of 1971 specimen brown with dark brown spots concentrated basally and a spot of pale orange in cnidosac region (Fig. 12F), but in 1968 specimen dull red with darker spots, cnidosac white



Figures 12A–J *Learchis evelinae* Edmunds & Just, 1983. 7mm long: **A** dorsal view; **B** ventral view of head; **C** side view, semi-diagrammatic to show arrangement of cerata; **D** rhinophore; **E** two cerata, left in crawling or resting animal, right extended when animal is agitated; **F** extended cerata of other specimen; **G** 14th radular tooth. **A**, **D** & **F** are the 1971 specimen, **B**, **C**, **E** & **G** are the 1968 specimen. 4mm long: **H** dorsal view; **I** side view, semi-diagrammatic to show arrangement of cerata; **J** cerata.

(Fig. 12E); sides of body and foot greyish white without any white markings.

The small 1970 specimen has the anterior cerata in short rows, posterior cerata in arches as follows: L 2, 2, 1; 3, 2, 1; R 1, 2, 2; 3, 2, 1. Its colouration differs from that of the two larger specimens: body greyish with almost continuous superficial white dorsally from head to tail, but white not visible from some angles (Fig. 12H); oral tentacles white; rhinophores grey with white stripe on front (Fig. 12I); digestive gland in cerata pale grey at base, then dull red terminating in black spot just below pale grey cnidosac (Fig. 12J), the spot composed of about 6 small black dots close together, superficial white spot in cnidosac region. There was no trace of any orange pigment, but because small specimens of many aeolids often lack the bright colours of mature specimens I consider that it belongs to the same species as the two specimens described above.

Internal morphology The jaws were damaged during processing but the radula is intact with 16 typical facelinid teeth, each with 5 denticles on each side flanking the cusp (4 in the oldest tooth) (Fig. 12G).

Geographical range Barbados (Edmunds & Just, 1983), Belize & Martinique (Valdés *et al.*, 2006), Costa Rica (Camacho-Garcia, Pola, Carmona, Padula, Villani & Cervera, 2014), Ghana (this paper).

Remarks The anterior group of cerata in rows and the posterior groups in arches place this species in the genus *Learchis*. The external features and radular teeth of my Ghanaian specimens agree closely with the original description of *Learchis evelinae* from Barbados (Table 5) as well as those from Martinique and Belize (Valdés *et al.*, 2006) in the position of the orange cheek mark low down on the side of the head (Figs 10C, 12A). A photo of one of the type specimens from Barbados is published here for the first time (Fig. 10D). The main differences between Figs 10C and 10D are the slender body, white over heart, pointed cerata and brown digestive gland of the specimen from Barbados compared with the broader body, no white over heart, rounded cerata and dull red digestive gland in the one from Ghana (Table 5). However, other photos of specimens from the two sites (of too poor quality to publish) show similar body shape and much

Table 5 Comparison of Caribbean and Ghanaian *Learchis evelinae*.

Character	Caribbean	Ghana
Body length	9mm	7mm
Foot	Longitudinally grooved short pointed corners	Longitudinally grooved short pointed corners
Body colour	Semitransparent beige or pale orange	Greyish white
White areas	Broad patch on head extending between rhinophores, several patches on dorsum, white stripe on tail	Broad patch on head extending between rhinophores, white stripe on tail
Oral tentacles	White distally to tip	Basal half suffused pale orange, distally white, tip clear
Rhinophores	Pale orange basally, white distally	Bright orange basally, distal half white, tip clear
Cheek stripe	Orange-red from base of oral tentacle to base of rhinophore	Orange from base of oral tentacle to base of rhinophore
Ceratal arrangement	4–5 rows to anterior group, 4–5 arches or rows behind heart	5 rows to anterior group, 6 arches or rows behind heart
Digestive gland in cerata	Orange-brown with dark brown tubercles, or dark red*, or blackish brown	Brown or orange-brown or dull red with darker spots
Ceras shape and colour	Slender, pointed; transparent, no white spots but cnidosac white	Rounded at tip, transparent, no white spots but cnidosac white
Radula lateral denticles	4–5 each side	4–5 each side
Jaws	Delicate & easily crushed, denticles on cutting edge	Delicate & easily crushed, too damaged to check denticles

References. Edmunds & Just, 1983; *Valdés *et al.*, 2006, This paper.

darker, blackish-brown digestive glands in the cerata. The body colour of Barbados specimens is reported to be beige or pale orange compared with greyish white in those from Ghana, but the latter have pale orange at the bases of the oral tentacles including the frontal corners of the head, so this difference may be trivial. The juvenile specimen from Ghana has much more white on the body than the two larger specimens so the extent of white can vary. Thus the only remaining difference between East and West Atlantic animals is the shape of the cerata. I am reluctant to erect a new species on the basis of rounded versus pointed cerata because in other aeolids there can be considerable variation in ceratal shape depending on whether the animal is moving or resting and whether it is under attack (see e.g. *Spurilla neapolitana* in Edmunds, 2015a). I therefore conclude that my specimens from Ghana are *Learchis evelinae*, but this conclusion should really be checked by means of a species delimitation analysis including molecular data. Although Ghana represents a massive range extension the congeneric *Learchis poica* as well as several other species of facelinid are now known to have an amphiatlantic distribution facilitated by their habit of living in fouling communities in harbours and on boats.

In addition to its occurrence in Barbados, *Learchis evelinae* has been reported from several other sites in the Caribbean, but photos identified as *Learchis evelinae* on the Internet differ in the position of the orange markings on the head. In the type material Edmunds & Just (1983) write "There is an orange-red line on the cheek from the base of the oral tentacles to the base of the rhinophores". This mark is on the side of the head: Fig. 7A in Edmunds & Just (1983) is a drawing of *Learchis evelinae* in dorsal view and the sides of the head just in front of the rhinophores were drawn by Hanne Just with a thicker line than the rest of the body outline, this line being all that can be seen of the orange mark in a dorsal view. At high magnification this orange is just discernable in Fig. 10C as well as in another dorso-lateral photo of the same specimen from Ghana. The two photos by Jeff Hamann of *Learchis evelinae* in Valdés *et al.* (2006 page 258) also show this orange mark; the specimen from Martinique has brownish red cerata (intermediate between the colour of Barbadian and Ghanaian specimens) while the one from Belize resembles the small

specimen from Ghana in having a dark spot below the cnidosac.

However the photos of specimens identified as *Learchis evelinae* in Sea Slug Forum (DuPont, 2000; Gillette, 2005; Millen, 2000; Rudman, 2000a; Rudman, 2005a) have very bright orange triangular marks running transversely from the side of the head just below the rhinophores and broadening out in front of the rhinophores dorsally. Some of these images also appear to have the anterior cerata in an arch rather than in rows so these specimens are not *Learchis evelinae* and some may belong to a different genus.

Genus *Cratena* Bergh, 1864

Type species *Doris peregrina* Gmelin, 1791 by original designation.

Bergh (1864 page 214, translation by Dr Kathe Jensen) describes why he is creating a new genus, *Cratena*:

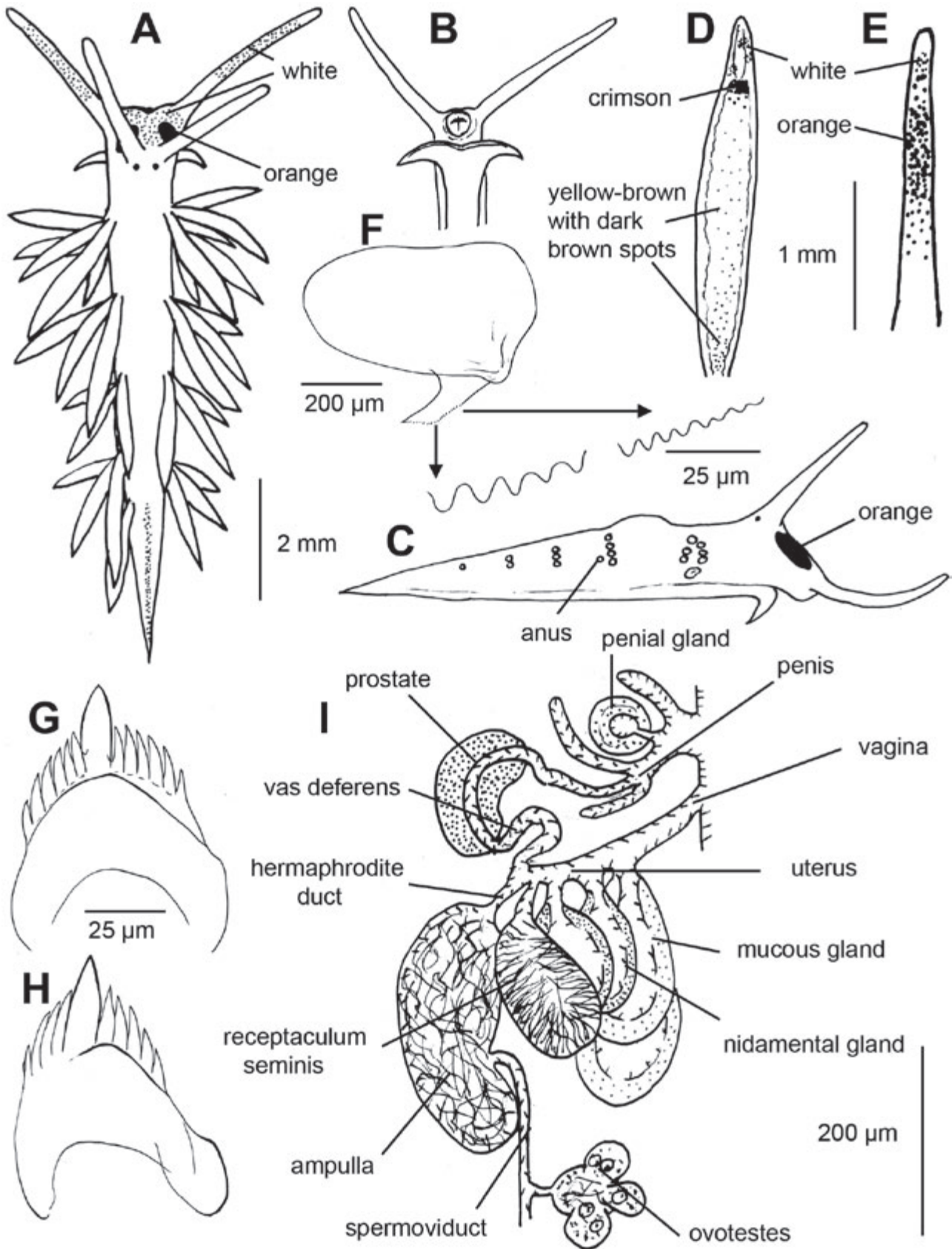
"Cuvier had (R. an. 2nd ed. (1830) III. p. 55), probably without knowledge of Fleming's genus name, shortly after Fleming created a new genus, *Flabellina*, for one of the Cavolinan forms (*Doris affinis*, Gm), while he maintained Bruguière's *Cavolina* restricted to the group that has *Ae. peregrina*, as the type, which makes the subsequent authors' Montaguas identical to Cuvier's *Cavolina* [Here Bergh has a long foot-note]. It may now be assumed that *Ae. peregrina* really is the type of a distinct genus form, and most investigators of this part of the animal kingdom seem to agree about this. But when they have retained Cuvier's (Bruguière's) name for them, this cannot be accepted for the above reasons; the genus must be renamed, and I have for this proposed the name *Cratena*."

Diagnosis (based on Macnae, 1954; Marcus, 1957 & Schmekel & Portmann, 1982) Facelinids with anterior cerata in arch, posterior cerata in rows with just one row of cerata in each group. Rhinophores smooth, unarmed penis but with accessory gland.

Cratena tema n. sp.

Figs 10E; 13

Material examined Among *Zoobotryon* with hydroids on Tema wharf 1 spec. 5mm long 2 December 1968, 1 spec. 9mm long 6 December



Figures 13A-I *Cratena tema* n. sp. 9mm long, March 1971: **A** dorsal view; **B** ventral view of head; **C** side view, semi-diagrammatic to show arrangement of cerata; **D** ceras; **E** rhinophore; **F** jaw with detail of cutting edge; **G** 8th radular tooth; **H** 1st radular tooth; **I** semi-diagrammatic reconstruction of reproductive system from serial sections.

1968; dredged from 27m Tema Bay 1 spec. 9mm long 6 February 1970; 10m reef Kpone Bay 2 spec. 4 & 2mm long 2 March 1970, 1 spec. 3mm long 11 March 1971, 2 spec. 9 & 6mm long 7 April 1971 Reg. no. NHMUK 20150377 & Slides 2–16 Reg. no. NHMUK 20150411.

Holotype Dredged from 27m Tema Bay by Walter Pople, 9mm long 6 February 1970 Reg. no. NHMUK 20150378.

External features Body tapering to a slender pointed tail, foot notched anteriorly with narrow pointed corners (Figs 10E, 13A, B); oral tentacles long, 3mm in a 9mm specimen, rhinophores up to 2mm long, smooth; precardiac cerata arise on each side from an arch with one row of cerata in each arm of the arch, postcardiac groups are in rows (Fig. 13C); three 9mm specimens had the following arrangements:

Left: 6; 3, 3, 3, 1; Right: 7; 4, 4, 3, 0.

Left: 7; 4, 3, 2, 2; Right: 8; 5, 4, 3, 2.

Left: 8; 4, 3, 2, 2, 2; Right: 9; 5, 4, 3, 1, 1.

Cerata long, slender and pointed; anus low down just behind first group of cerata of posterior digestive gland on right side, gonopore below the first group of cerata (anterior digestive gland) (Fig. 13C).

Colouration Body whitish grey, usually with white patch on head in front of rhinophores and white line medially on tail, a pair of bright orange oval patches between rhinophores and oral tentacles, sometimes parallel sided, sometimes angled obliquely (as in Fig. 13A); oral tentacles white apart from tip and base, latter occasionally tinged orange; rhinophores suffused orange with increasing intensity distally but tip clear above a narrow white ring (Fig. 13E); digestive gland in cerata yellow-brown or orange-brown with small darker or red-brown spots, often very reddish brown basally and crimson just below cnidosac (Figs 10E, 13D), a few superficial white spots or streaks distally occasionally extending half-way down ceras, cnidosac also white; sides of body and foot pale grey but one animal had a thick white line just above the foot from the head through the gonopore to the tail.

Internal morphology The buccal mass from a 9mm animal was removed for examination before the specimen was serial sectioned. The jaws each have about 28 rounded denticles, the oldest ones

small and worn (Fig. 13F). There are 11 teeth in the radula, the last two not fully chitinised, each with a prominent cusp and 5 or 6 slightly curved lateral denticles (Figs 13G, H).

In the reproductive system the vas deferens passes through a short glandular prostate before entering the penis (Fig. 13I). There is a small spherical accessory or penial gland opening into the male atrium. The oviduct branches off the hermaphrodite duct and almost immediately receives a duct from the receptaculum (with sperm attached by their heads to its wall) and it then opens into the nidamental gland and, further on, the mucous gland, as in other aeolids.

Behaviour In the crawling animal the cerata typically slope backwards at an angle of about 120° with the uppermost ceras in each group pointing up and succeeding cerata at increasing angles laterally (approximately 30, 60 and 90° to the vertical). When put into seawater with the narcotising agent MS 222 (Tricaine methanesulfonate or TMS) one specimen ejected copious nematocysts from the cnidosacs.

Geographical range Known only from Ghana (this paper) with possible records from Portugal, São Tomé and Príncipe in the Gulf of Guinea, and South Africa (see below).

Etymology The species is named from its occurrence in Tema, Ghana.

Remarks Two species of *Cratena* that are similar to my specimens from Ghana are *Cratena peregrina* (Gmelin, 1791) from the Mediterranean, the East Atlantic from Portugal to the Canaries, and Senegal (Rudman, 1999), and *Cratena capensis* Barnard, 1927 from South Africa (Gosliner, 1987). These both grow to a large size so I doubt if they would be sexually mature at just 9mm long; some of the similarities and differences from my Ghanaian specimens are summarised in Table 6. *C. capensis* has white or translucent rhinophores and largely translucent oral tentacles while *C. tema* has orange rhinophores and predominantly white oral tentacles so the two species are clearly different. *C. peregrina* has bluish tips to the cerata but, because of the small size of my Ghana specimens, comparison needs to be made with small specimens of *C. peregrina* rather than with large ones because it is possible that the blue colouration only develops in older and larger animals.

Table 6 Comparison of *Cratena tema* n. sp. with *C. peregrina*, *C. capensis* and *C. scintilla*.

	<i>C. peregrina</i>	<i>C. capensis</i>	<i>C. scintilla</i>	<i>C. tema</i> n. sp.
Body length	50mm	30mm	7mm	9mm
Body colour	Translucent white/ grey	Translucent white/ grey	Translucent white & orange, lateral orange stripe	Translucent white/ grey
White areas		Scattered white spots on body	Head white	White on head & tail
Oral tentacles	Long, white distally	White spotted	Basal half orange, distal half white	White except tip and base
Rhinophore	Orange-red, intense in distal $\frac{1}{3}$ to $\frac{2}{3}$, white tip	White spotted	Mostly orange, tip white	Suffused orange, brighter distally, tip clear above white ring
Cheek stripe	Orange	Orange-yellow	Orange	Orange
Foot corners	Shortly tentaculiform	Short, pointed		Short pointed
Digestive gland in cerata	Red to dark brown	Red to dark brown	Brownish orange, yellow distally	Brownish with darker reddish spots, crimson spot below cnidosac
Ceratal colour	Bluish white distally, white cnidosac	Scattered white spots and white tip	A few white lines, white cnidosac	White spots or streaks distally
Radula lateral denticles	5–6	5–7		5–6
Accessory Male gland	Present	Present		Present

The Mediterranean Slug Site (2015) has more than 50 images of *C. peregrina* including several that are less than 20mm long. Four of these (10, 10, 15 and 20mm long) have blue tips to the cerata just like the larger animals, while six (6, 8, 10, 19, 20 & 25mm long) have no trace of blue but do have the terminal part of the digestive gland diverticulum just below the cnidosac a different shade of red, which is similar to *C. tema*. However, only one of these (a 10mm specimen by João Pedro Silva (2011) from Sesimbra, Portugal) has small white spots or streaks in the cnidosac region of the cerata exactly like my specimens from Ghana. I conclude that my specimens from Ghana are distinct from *C. peregrina*. The Mediterranean specimens lacking blue tips to the cerata are probably *C. peregrina*, but the one from Portugal with white spots at the cerata tips is quite possibly conspecific with *C. tema*.

The third east Atlantic species of *Cratena* which needs to be compared with my Ghanaian specimens is *C. scintilla* Ortea & Moro, 1998 from Tenerife. This is a small species but differs from Ghanaian animals in the lateral orange line, orange base to oral tentacles, colour of digestive gland and white stripes on cerata (Table 6). Professor Peter Wirtz has kindly sent me a photo

of a specimen of *C. scintilla* from Tenerife with orange-tinged body, basal two thirds of oral tentacles and rhinophores orange, rhinophores brightest distally, digestive gland in cerata red, ceratal epithelium tinged orange with no white marks, most cnidosacs orange, but a few white. Assuming this specimen is indeed *C. scintilla*, then it very considerably extends the known colour variation of this species. It also has very long oral tentacles, about 48% of body length. My specimens from Ghana have no orange on the oral tentacles or body, white spots or short streaks in the cnidosac region of the cerata, and shorter oral tentacles, about 40% of body length. Pending further information on *C. scintilla* including its radula and reproductive system I consider these differences are sufficient to justify creating a new species for my specimens from Ghana: *Cratena tema*.

A photo of a specimen identified as *C. scintilla* from São Tomé and Príncipe by Marta Pola (2009) has oral tentacles with an orange base, rhinophores orange almost to the tip with orange overlying white just below tip, red-brown digestive gland becoming bluish just below the cnidosac, white cnidosacs, no trace of white epithelial markings on the cerata. This could be a

colour variant of either *C. scintilla* or of *C. tema* or perhaps an undescribed species.

In South Africa three species of *Cratena* with similar colouration to *C. tema* have been described briefly by Gosliner (1987): *C. capensis* with white rhinophores (discussed above), *Cratena* sp. 1 with a black spot just below the cnidosac and *Cratena* sp. 2. There are several images on the Internet of species of *Cratena* from South Africa which may be one of these three species. Rowe (2005) had a 10mm specimen with orange rhinophores which he and Rudman (2005b) identified as *C. capensis* but which is more similar to *C. tema* than it is to *C. capensis* as it also has white oral tentacles.

Fraser (2000), Rudman (2000b, 2001), Gosliner (2000) and Miller (2001) discuss two specimens of *Cratena* with orange rhinophores and red digestive gland diverticula which are probably either Gosliner's *Cratena* sp. 1 or sp. 2, but neither of these has white spots in the cnidosac region of the cerata, so they appear to be distinct from *C. tema*. Two other similar specimens of *Cratena* sp. have been posted in Nudipixel by Johan Swanepoel (2010), and by Jaco Engelbrecht (2010) from Port Elizabeth and Cape Town respectively, which may be Gosliner's sp. 1 or sp. 2, but again, neither of these has white spots near the tips of the cerata as occur in *C. tema*. Debelius & Kuiter (2007, page 322) illustrate a *Cratena* (labelled "sp 2") which has orange rhinophores and orange digestive gland in the cerata merging to red just below the cnidosac, as in *C. tema*. However, they came from the Indian Ocean side of the Cape near Durban and are large (up to 35mm in length) so are unlikely to be *C. tema*. Clearly further research is required to sort out species in these small specimens of *Cratena*.

A recently described species of *Cratena* from Brazil, *Cratena minor* Padula, Karla, Araújo, Matthews-Cascon & Schrödl, 2014, is only slightly larger than *C. tema* (up to 17mm compared with 9mm) but differs in lack of white on oral tentacles and cerata, and shape of the orange cheek mark.

I conclude that *Cratena tema* n. sp. occurs in Ghana and possibly also in Portugal, islands in the Gulf of Guinea and South Africa.

Genus *Favorinus* J.E. Gray, 1850

Type species *Eolis alba* Alder & Hancock, 1844 by monotypy.

Diagnosis (based on Thompson & Brown, 1984) Facelinids with cerata arising in arches with one row in each arch, usually with one to three bulbs on rhinophores, lateral denticles on radular teeth weak or absent, and (usually) unarmed penis.

Favorinus ghanensis Edmunds, 1968

Figs 10F; 14

Favorinus ghanensis Edmunds, 1968b: 95–99, Figs 10–12.

Material examined On *Zoobotryon verticillatum* on boat hull Tema 206 spec. from 1.5 to 13mm long 15 February 1969, 2 spec. 5 & 7mm long 17 February 1969, 21 spec. 11, 10, 10, 9 (x 4), 8, 8, 7, 7, 6 (x 6), 5 (x 4) mm long 10 March 1969, 4 spec. 15, 14, 12, 12mm long 25 September 1969, 7 spec. 16, 12, 11 (x 3), 8, 2mm long 12 October 1969, 2 spec. (not measured) 23 November 1970, 8 spec. 11, 8, 6, 6, 5, 4, 4, 2mm long 22 February 1973, 1 spec. 10mm long 8 March 1973, 6 spec. (not measured) 19 June 1973; on *Zoobotryon* on buoy in Tema harbour 8 spec. 8–13mm long 1 February 1968; Tema wharf 1 spec. 6mm long 2 December 1968 Reg. nos NHMUK 20150385, 20150386, 20150387 & 20150388.

External features This species has been fully described by Edmunds (1968b) and Tamsouri, Carmona, Moukrim & Cervera (2014) so only a few details need to be added with the abundant new material together with a colour photo of the living animal (Fig. 10F). The largest specimen was 16mm long with a slender body, tapering to

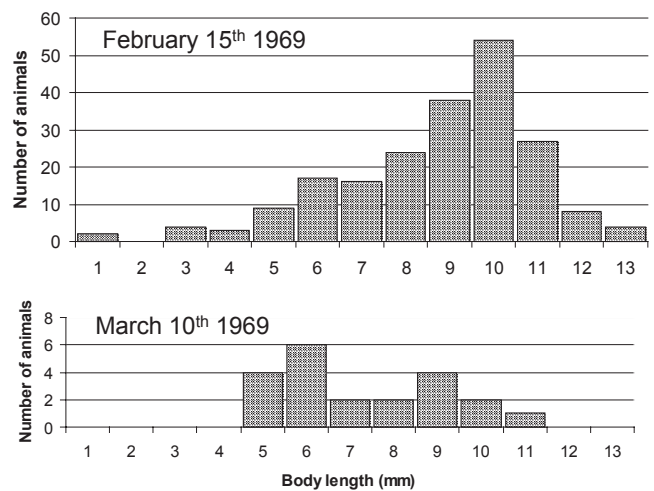


Figure 14 Size distribution of *Favorinus ghanensis* Edmunds, 1968 on February 15th and March 10th 1969 from the same boat hull in Tema harbour.

a pointed tail, and pointed foot corners; rhinophores with three swellings ('bulbs'), but when the animal is fully stretched these are indistinct, and the lowest is sometimes barely noticeable; the first two or occasionally three groups of cerata arranged in arches with one row in each arm of the arch, posterior cerata in rows, anus beneath first arch of postcardiac cerata.

Colouration Body transparent greyish white with scattered white dots on head, oral tentacles, dorsum and tail (Fig. 10F). Rhinophores purple-brown or maroon, tip clear with white dots. Dark brown digestive gland ducts visible in body of oldest animals. Digestive gland ducts in cerata cream or brown with dense purple-brown blotches so general appearance is purple-brown. Cnidosac minute and not visible in living animal; scattered white dots on cerata and tip has minute white glands.

Internal morphology Details of the jaws, radular teeth and reproductive system have already been published (Edmunds, 1968b; Tamsouri *et al.*, 2014).

Behaviour Several of the animals were observed eating the polypides of *Zoobotryon verticillatum* (Delle Chiaje, 1822) including sucking some of the contents from the broken tubes, and they also ate some of the sessile ciliates *Vorticella* and *Stentor* growing on the *Zoobotryon* (Edmunds, 1975). Other bryozoans growing amongst the *Zoobotryon* included *Bugula neritina* (Linnaeus, 1758) and *Bugula stolonifera* Ryland, 1960, but I did not observe them feeding on these species. The specimen of *Favorinus ghanensis* which was sectioned had no nematocysts in the cnidosac, consistent with its observed diet of bryozoans, but it does have epidermal defensive glands in the cnidosac region of the cerata (Edmunds, 1968b). Cerata are readily autotomised if an animal is prodded in a simulated attack.

The size distribution of the large collection of 15 February 1969 is consistent with it representing a single cohort hatched at about the same date, and implying that this was a new colonisation of this patch of *Zoobotryon*. However, by 10 March all of the largest animals had died and this synchrony had broken down (Fig. 14).

Geographical range First recorded from Ghana (Edmunds, 1968b) *F. ghanensis* has since been

recorded from the Canaries in 1995 (Cervera *et al.*, 2006), Tunisia in 2003 (Ben Souissi, 2003; Rudman, 2003a) and Morocco (Atlantic coast) in 2012 (Tamsouri *et al.*, 2014).

Remarks This species thrives on fouling communities dominated by its principal food, *Zoobotryon*, so can now be found widely in the East Atlantic and the Mediterranean. Further details of its morphology have been given by Tamsouri *et al.* (2014) who confirm that it appears to be distinct from other Atlantic species of *Favorinus*. They dissected the reproductive system of one of the specimens but did not find a penial stylet, which Edmunds (1968b) illustrated. However, the stylet is extremely small, just 3µm long, and I could only find it in one of the two specimens, which I examined.

Genus *Godiva* Macnae, 1954

Type species *Hervia quadricolor* Barnard, 1927 by original designation.

Diagnosis (based on Macnae, 1954) Facelinids with cerata in most groups arising from arches with more than one row to each arm of the arch, smooth or wrinkled rhinophores, anterior corners of foot often elongate (tentaculiform) and penis unarmed or with a terminal hook.

Godiva quadricolor (Barnard, 1927)

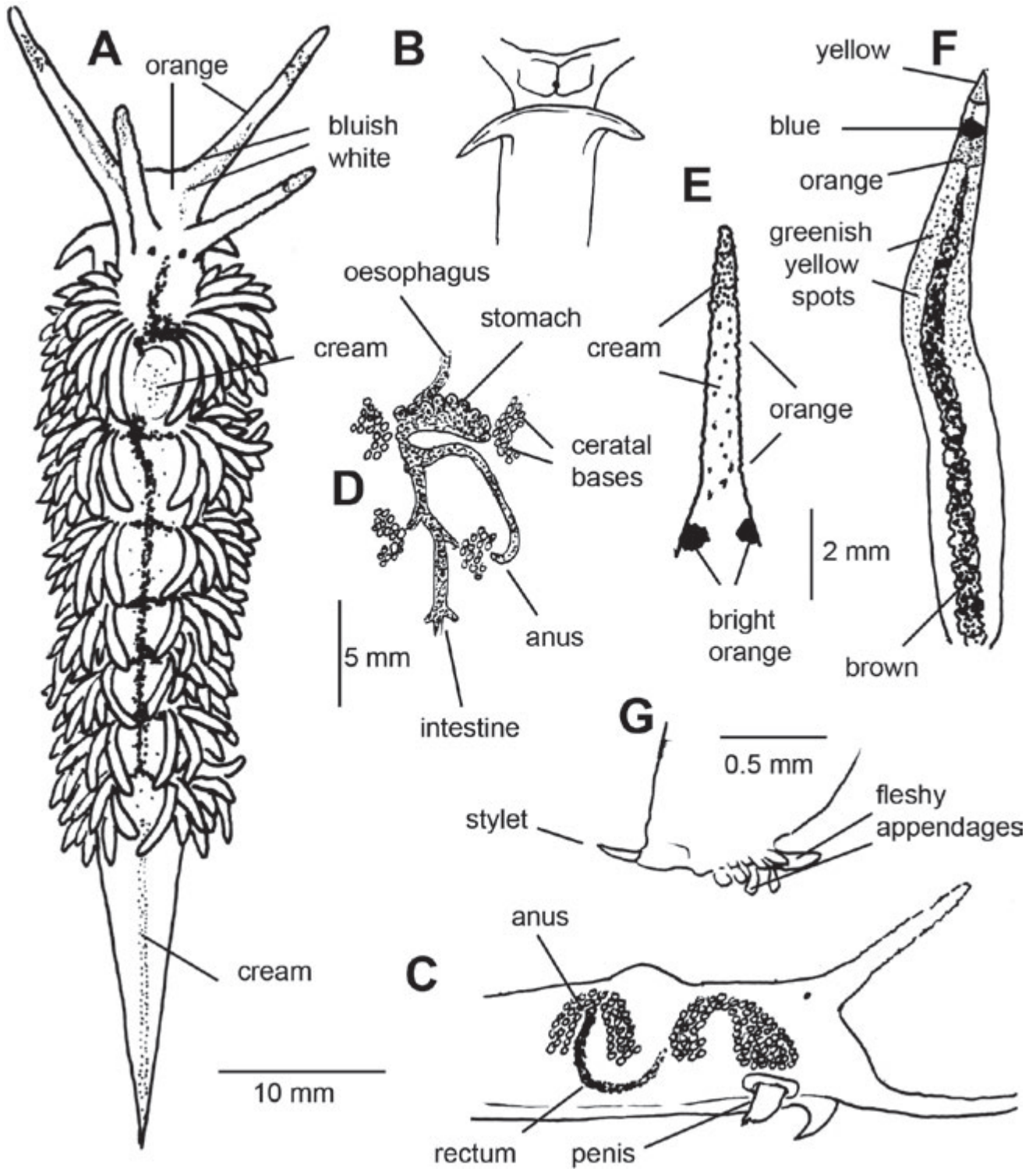
Figs 10G; 15

Hervia quadricolor Barnard, 1927: 203–204, Pl. 20 Figs 9, 10.

Godiva quadricolor Macnae, 1954: 23–25, Figs 14–16.

Material examined Among bryozoans and hydroids from boat bottom, Tema harbour 1 spec. 59mm long 26 September 1969 Reg. no. NHMUK 20150399.

External features Body broad, tapering to a 23mm long slender pointed tail, foot broad, bilabiate, rounded anteriorly with slender pointed corners (Figs 10G, 15A, B); oral tentacles 10mm long, rhinophores 8mm long with about 10 wrinkles and a faint posterior ridge; more than 400 cerata arranged in arches, the anterior digestive gland with 6 or 7 rows to the anterior arm of the arch and 2–4 rows to the posterior arm, posterior arches with fewer rows to each arm (Fig. 15C).



Figures 15A–G *Godiva quadricolor* (Barnard, 1927) 59mm long, September 1969: **A** dorsal view; **B** ventral view of head; **C** side view, semi-diagrammatic to show arrangement of first groups of cerata, specimen with penis protruding; **D** dark pigmented digestive system seen through the dorsal epidermis; **E** rhinophore, side view; **F** ceras; **G** tip of penis.

Approximate numbers of cerata in arches as follows with the first number relating to the anterior arm of the arch and the second number to the posterior arm:

Left: 50–20; 28–16, 17–15, 16–11, 9–9, 8–5, 5–2;
 Right: 50–28; 27–17, 20–12, 16–11, 8–6, 7–4, 5–2.
 Cerata up to 15mm long, flattened, pointed at tip, with thin digestive gland duct rugose

towards base and in young cerata, anus high up in the first arch of the posterior digestive gland, genital openings below the first arm of the anterior digestive gland (Fig. 15C). Protruded penis with stylet and fleshy appendages (Fig. 15G).

Colouration Body suffused orange, brightest on head, palest on foot; oesophagus, stomach, rectum and digestive gland ducts in body dark grey-brown (Figs 10G, 15A, D); there are cream spots over the heart and scattered bluish white spots from the heart to the last cerata, a medial creamy yellow line including some minute blue and orange dots runs from the last cerata to the tail tip; a creamy white line runs from in front of the rhinophores to half way up the oral tentacles and reflects blue or turquoise, there is also a creamy white band distally and a bluish white mark basally on the anterior face of the oral tentacles with the tip suffused pale orange; rhinophores with bright orange spots at front and back basally, cream spots on suffused orange shaft and creamy yellow tip (Fig. 15E); digestive gland in cerata dark brown with a few orange-brown tubercles, distal half of ceras with scattered superficial greenish yellow spots and patches merging into a band of orange followed by a band of blue spots and patches, then a clear band tinged orange and a ring of yellow just below the tip (Fig. 15F).

Internal morphology Not examined as this species is easy to recognise from its external colouration.

Geographical range Atlantic and Indian Ocean coasts of South Africa, Western Australia, Mediterranean, Granada (Spain), Morocco and Ghana (Barnard 1927; Macnae, 1954; Edmunds, 1977; Gosliner, 1987; Cattaneo-Vietti, Chemello & Giannuzzi-Savelli, 1990 (as *Facelina coronata*); Cervera, 2002; Cervera, Tamsouri, Moukrim & Villani, 2010; Ballesteros, Madrenas, Pontes *et al.*, 2013b; this paper).

Remarks The specimen from Ghana was found among the fouling community at Tema which supports the view of Willan (1987) that this species can travel widely on boats. It is one of the most colourful of the larger species of aeolid and so can be easily recognised.

Godiva brunnea n. sp.

Figs 16A, B; 17

Material examined Dredged from Tema Bay: 41m depth 1 spec. 7mm long 18 November 1968 Reg. no. NHMUK 20150389; 45m depth 1 spec. 5mm long 6 December 1968 Slides 1–26 Reg. no. NHMUK 20150412.

Holotype Dredged from Tema Bay 41m depth by Walter Pople, 7mm long 18 November 1968 Reg. no. NHMUK 20150389.

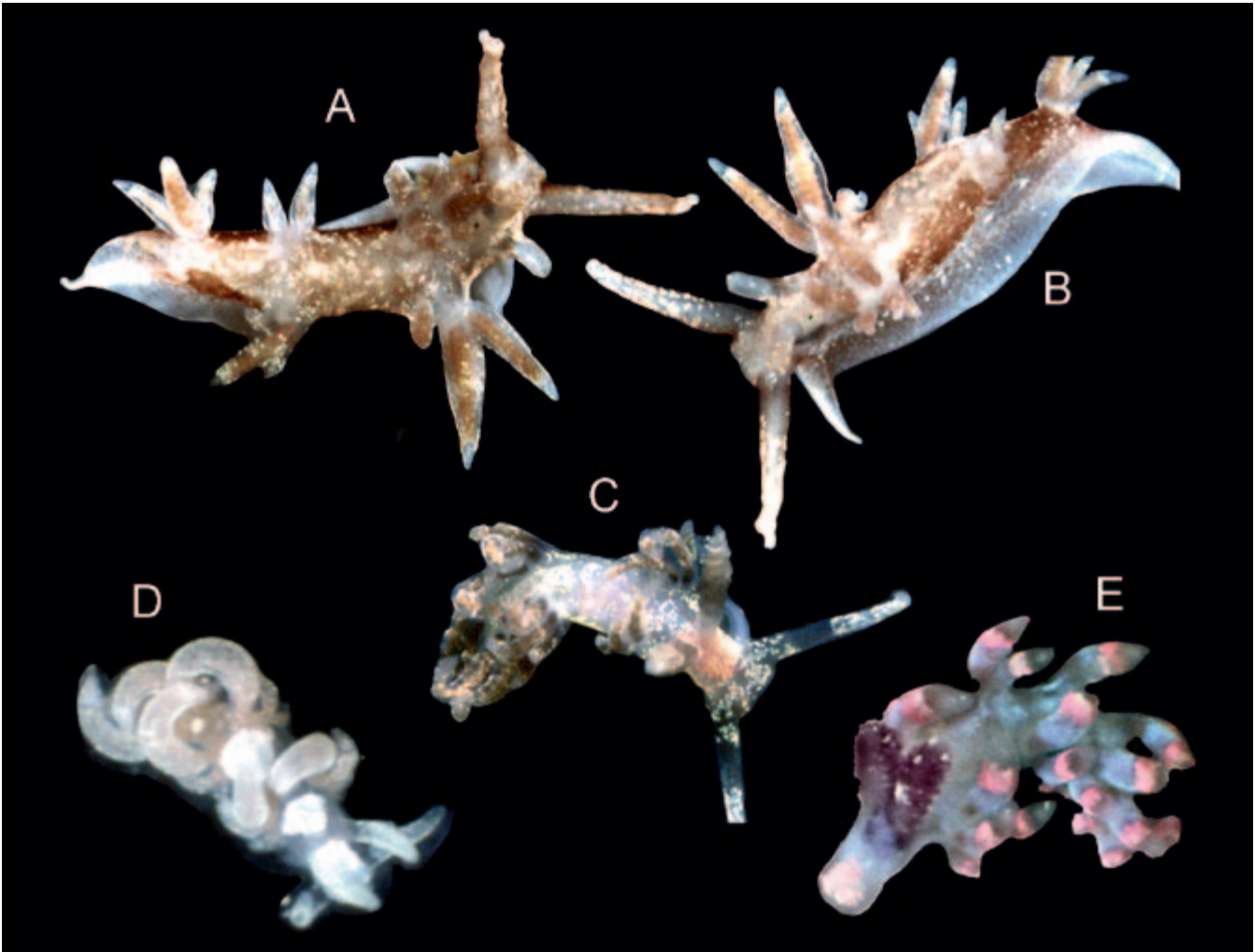
External features Body short, broad with a pointed tail, foot bilabiate and rounded anteriorly with slender pointed but not tentaculiform corners, broader than body (Figs 16A, 17A, B); oral tentacles shorter than in many other facelinids, both rhinophores in larger specimen broken, but smaller one has 9 annular rings with a similar number of incomplete ones (Fig. 17E), smaller specimen with broken tail so probably originally larger than the 7mm specimen; cerata in arches anteriorly, with two rows of cerata in anterior arm of first arch, with the following numbers of cerata in each group:

7mm specimen: Left: 6; 5, 3; Right: 7; 5, 2

5mm specimen: Left: 11; 8, 3; Right: 13; 8, 3.

Many cerata short and regenerating, but larger cerata long, slender tapering to a rounded tip. Anus below first arch of posterior digestive gland; gonopore below posterior arm of first arch; with a ridge on the right side in the inter-hepatic space (Fig. 17C).

Colouration Body pale grey, dorsal surface with pale brown suffusion and mottling from rhinophores to tail, dense minute white dots on head, irregular sized creamy white spots on back from behind heart to tail, fewer over heart, and concentrated dorsolaterally between heart and rhinophores (Figs 16A, B, 17A); sides of body from rhinophores to just beyond last cerata including angle between sides and foot with dark brown mottling and scattered irregular white spots; foot dorsally mottled pale brown but edge and ventral surface grey; black epithelium covering jaws visible from above and sides (Figs 17 A, C); oral tentacles suffused brown basally especially anterior and posterior edges, white spots concentrated distally including tip; rhinophores suffused brown with cream spots especially distally but tip clear; digestive gland in cerata pale



Figures 16A–B *Godiva brunnea* n. sp.: Tema Bay, 7mm long, November 1968. **Fig. 16C** Facelinidae species A: Tema Bay, 6mm long, July 1969. **Fig. 16D** Facelinidae species B: Tema, 3.5mm long, December 1970. **Fig. 16E** Facelinidae species C: Kpone Bay, 4.5mm long, February 1971.

brown with small darker brown spots, white spots in distal half of ceras and forming a ring below pale white cnidosac (Fig. 17D).

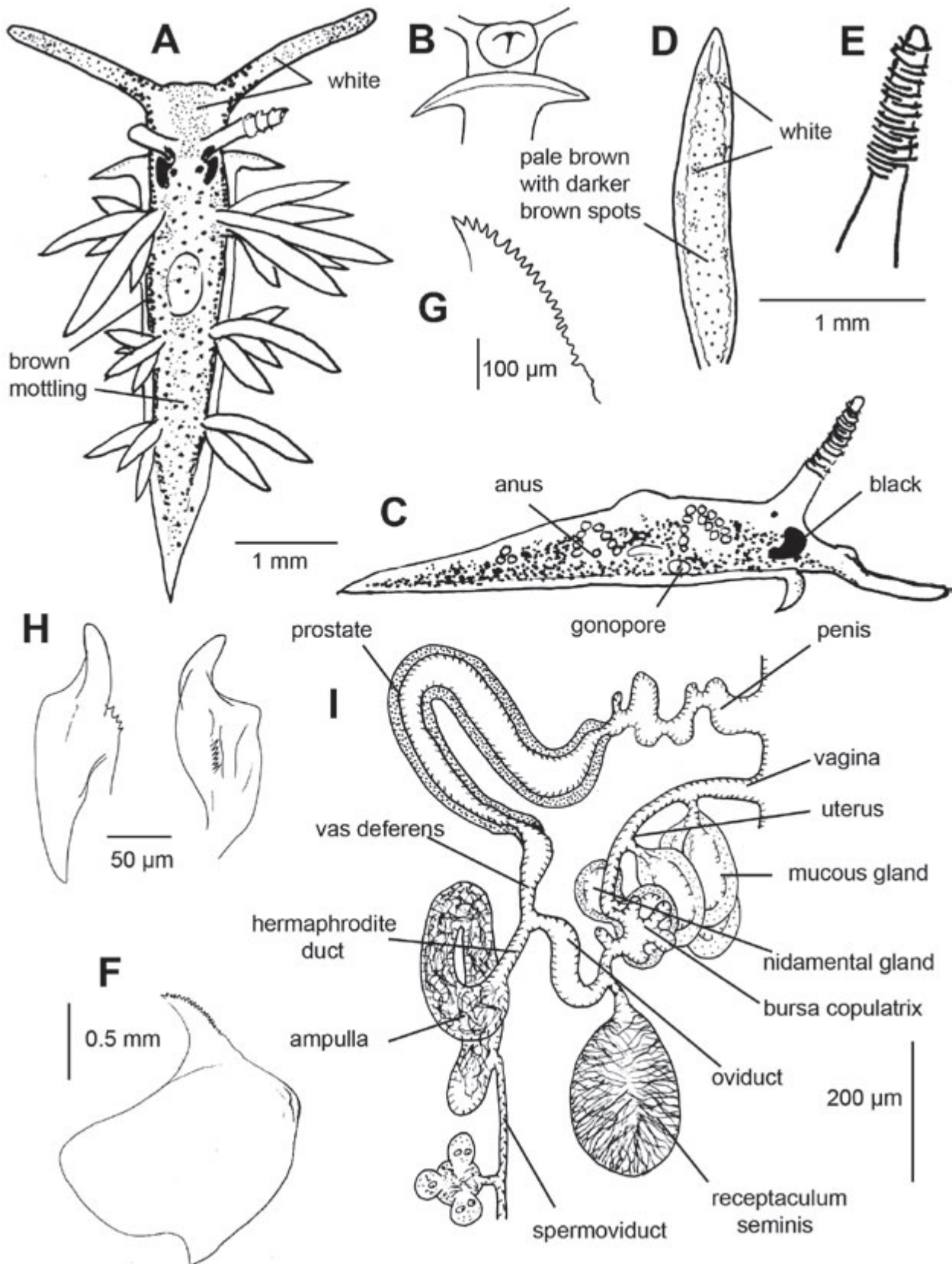
Internal morphology The buccal mass of the 5mm specimen was removed for examination of jaws and radula and the rest of it was then serial sectioned. The large jaws have an indentation and the cutting edge has 15 denticles plus a few worn ones (Figs 17F, G). I was unable to flatten the radula in spite of remounting it three times so Fig. 17H shows two teeth in lateral view. There are 23 teeth, each tooth with 4 to 6 small denticles on either side of the base of the large cusp.

In spite of its small size the specimen appeared to be sexually mature with autosperm in the ampulla and allosperm in the receptaculum. The vas deferens passes through a long glandular

prostate (Fig. 17I). The prostate opens into a large chamber with folds in the walls which may be a penis, but its structure suggests that rather than being a protrusible penis it is an eversible cirrus. After leaving the hermaphrodite duct the oviduct swells before narrowing again. The receptaculum seminis with sperm attached to the wall by their heads opens into the narrow oviduct which swells again into a chamber with folded walls at the junction of the nidamental gland. This chamber may be the bursa copulatrix although it did not contain any residue of partly digested sperm.

Geographical range Known only from Ghana (this paper).

Etymology The species is named after its predominantly brown colouration.



Figures 17A–I *Godiva brunnea* n. sp. 5mm long, December 1968: **A** dorsal view; **B** ventral view of head; **C** side view, semi-diagrammatic to show arrangement of cerata; **D** ceras; **E** rhinophore; **F** jaw and **G** denticles on cutting edge; **H** 16th radular tooth (on left) and 4th radular tooth; **I** semi-diagrammatic reconstruction of reproductive system from serial sections.

Remarks The genera of the Facelinidae with cerata in arches and at least the first group with two rows of cerata in the arch include *Facalana* Bergh, 1888, *Godiva* Macnae, 1954, *Dondice* Marcus, 1958, *Austraeolis* Burn, 1962 and *Echinopsole* Macnae, 1954 (Marcus, 1958). *Facalana* has jaws similar to those of *Glaucus*, the penis of *Echinopsole* has many small spines, that of *Austraeolis* has fleshy filaments and *Dondice* has an unarmed penis with both a penial gland and a pouch-like prostate, so all of these differ from the present species. *Godiva* was originally defined as species with a penial hook, no penial gland, and the prostate forming a swollen part of the vas deferens, but Edmunds (1964) modified this to include species with unarmed penis and he restricted *Dondice* to species with both a penial gland and a pouch-like prostate. The present species has the vas deferens swelling to form a prostate gland as in *Godiva*, but it also has black epithelium covering the jaws like *Dondice occidentalis*. On balance I have allocated it to the genus *Godiva*, but this is

a temporary solution until the many genera and species of the Facelinidae are subjected to a thorough phylogenetic analysis.

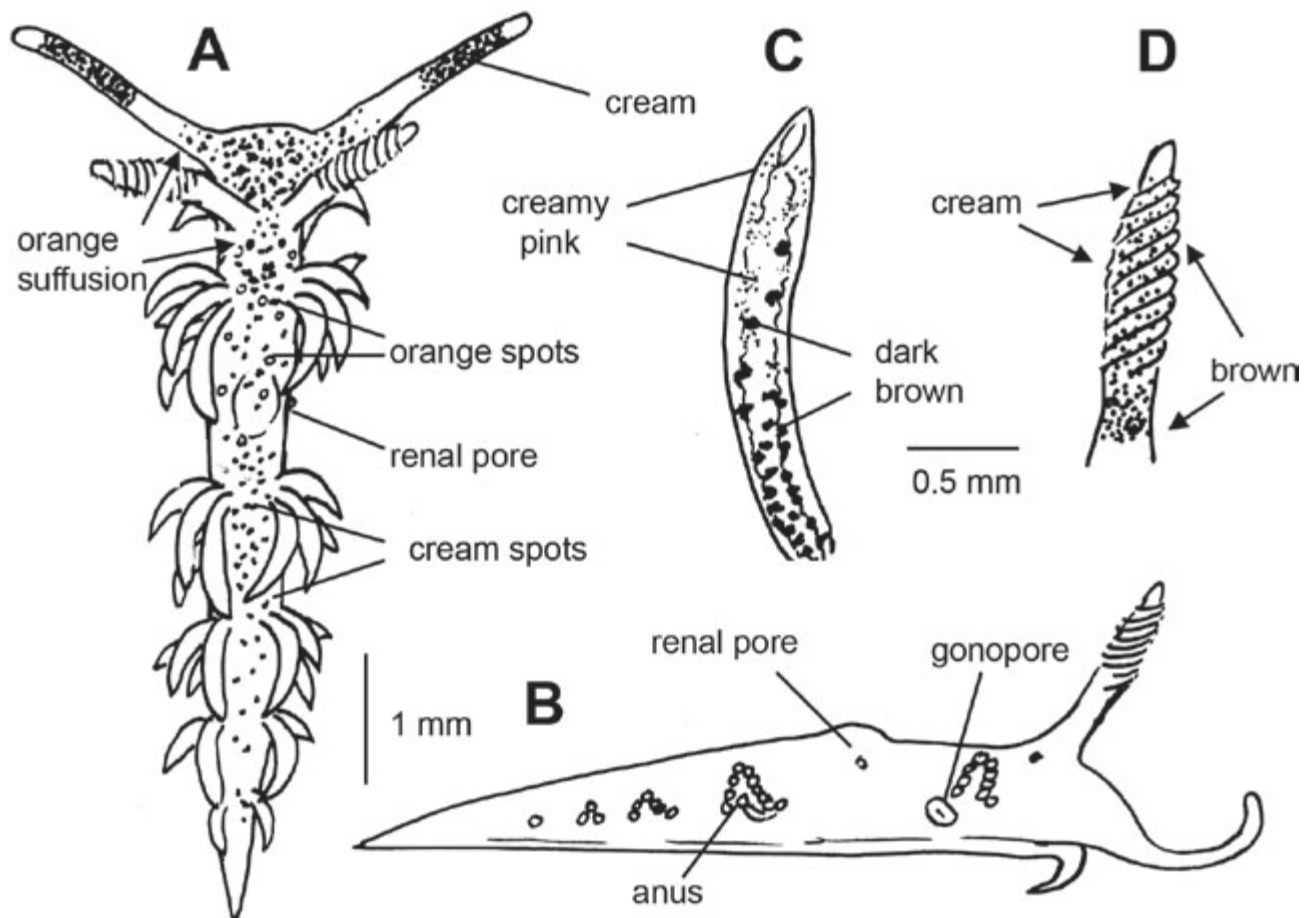
Facelinidae species A

Figs 16C; 18

Material examined Dredged from 37m depth Tema Bay, 1 sp 6mm long 23 July 1969 Reg. no. NHMUK 20150394.

External features Body with a short tail, foot as broad as body with slender pointed but not tentaculiform corners (Figs 16C, 18A); oral tentacles long; rhinophores long with 9 perfoliations from smooth anterior surface to posterior groove; cerata in arches with two rows of cerata in anterior arm of first arch, more noticeable on left side of body than on the right which has several cerata missing (Fig. 18B). The numbers of cerata in each group are:

Left: 12; 9, 5, 3, 1; Right: 9; 10, 6, 3, 1.



Figures 18A–D Facelinidae species A: **A** dorsal view; **B** side view, semi-diagrammatic to show arrangement of cerata; **C** ceras; **D** right side of rhinophore.

Cerata slender, tapering to a pointed tip. Anus below first arch of postcardiac cerata; gonopore below posterior arm of first arch.

Colouration Body pale grey, dorsal surface with faint orange-pink suffusion from bases of oral tentacles back to eyes and a touch more in inter-hepatic space, brighter above buccal mass, the colour residing in minute dots (Figs 16C, 18A); a few circular orange-pink spots between eyes and rear of pericardium; circular cream spots from bases of oral tentacles and head back to the last cerata, appearing slightly pink where the skin has pink suffusion, sparse groups of spots on sides and just a few on foot corners; oral tentacles with cream distal two-thirds; rhinophores with brown spots, dense just above base, becoming more sparse distally, tip clear grey, with cream perfoliations in distal half (Fig. 18D); digestive gland in cerata pale brown with darker tubercles especially at base and some cream tubercles

distally, epithelium with cream spots and patches especially just below cnidosac, sometimes tinged orange-pink (Fig. 18C).

Internal morphology Not examined.

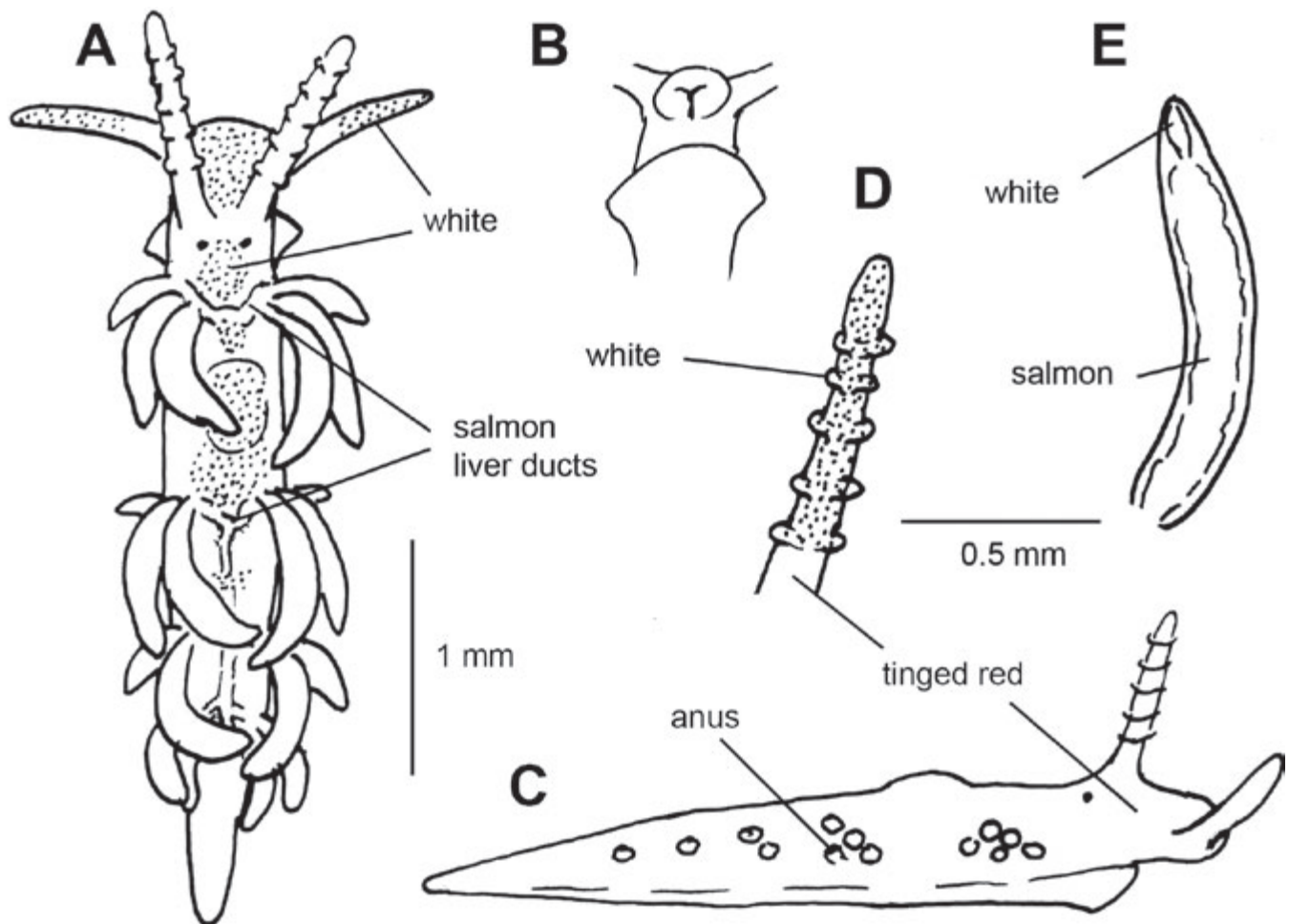
Geographical range Known only from Ghana (this paper).

Remarks This species resembles *Godiva brunnea* in its arrangement of cerata but the brown markings are very different. It is either a juvenile of a known species or a currently undescribed species, but without further specimens and details of its radula it must remain unnamed.

Facelinidae species B

Figs 16D; 19

Material examined Tema breakwater 1 spec. 3.5mm long 18 December 1970 Reg. no. NHMUK 20150401.



Figures 19A–E Facelinidae species B: **A** dorsal view; **B** ventral view of head; **C** side view, semi-diagrammatic to show arrangement of cerata; **D** posterior view of rhinophore; **E** cerata.

External features Body slender, tapering to a blunt tail (possibly damaged), foot semicircular at front with blunt corners (Figs 19A, B); oral tentacles 0.75mm long, rhinophores 1mm long with 5 inconspicuous rings (each ring only slightly raised above the rhachis with no deep groove between the rings); cerata in short rows (Fig. 19C), but because of the small size of the animal and because there are few cerata, these rows could develop into arches as it grows:

Left & Right: 5; 3, 2, 1, 1.

Cerata up to 1mm, tapering to blunt tip; anus just behind lowest cerata of first row of posterior digestive gland, genital opening not yet developed so the animal was very immature (Fig. 19C).

Colouration Body greyish white with patches of white on head, just behind eyes and over heart, faint tinge of red on sides of head, salmon-coloured digestive gland ducts visible through dorsal body wall (Figs 16D, 19A); oral tentacles transparent basal quarter, then white; rhinophores faintly tinged red basally, then white (Fig. 19D); in lateral view salmon-coloured gonads are visible behind heart; digestive gland in cerata pale salmon, cnidosac white (Fig. 19E).

Internal morphology Not examined.

Geographical range Known only from this single specimen from Ghana.

Remarks This appears to be a very immature specimen of an undescribed species of facelinid.

Facelinidae species C

Figs 16E; 20

Material examined 10m reef Kpone Bay 1 spec. 4.5mm long 22 February 1971.

External features Body broad, tapering to a slender pointed tail, foot with pointed corners (Figs 16E, 20A); oral tentacles short, 0.5mm long; rhinophores 0.75mm long, flat anteriorly with 6 diagonal rings meeting at rear and two partial rings (Fig. 20B); three tubercles on each side laterally in front of rhinophores (which may be minute cerata lacking cnidosacs, Fig. 20A); cerata in rows with first two (precardiac) close together and five postcardiac rows, almost all with three cerata in each row; cerata up to 0.75mm, slender, tapering to rounded tip; anus and gonopore were not checked before the animal died.

Colouration Body greyish with circular patch of creamy pink on head and continuous broad band of bluish white dorsally from this pink patch to the base of the tail, broader between the ceratal insertions (Figs 16E, 20A); tail and oral tentacles with cream spots; rhinophores grey at base, annular region dark purple, tip grey with a few cream spots (Fig. 20B); dark crimson jaws show through epidermis laterally; digestive gland in cerata pale brown or colourless with a few red-brown blotches, but hidden by a broad bluish white band in middle third of cerata followed by a narrower creamy pink band, and tip including cnidosac colourless (Fig. 20C).

Internal morphology The buccal mass was removed for examination. The jaws have a slightly rough cutting edge with no denticles (Fig. 20E). There are 9 teeth in the radula each with from 7 to 10 pointed denticles on each side of the prominent cusp (Fig. 20D).

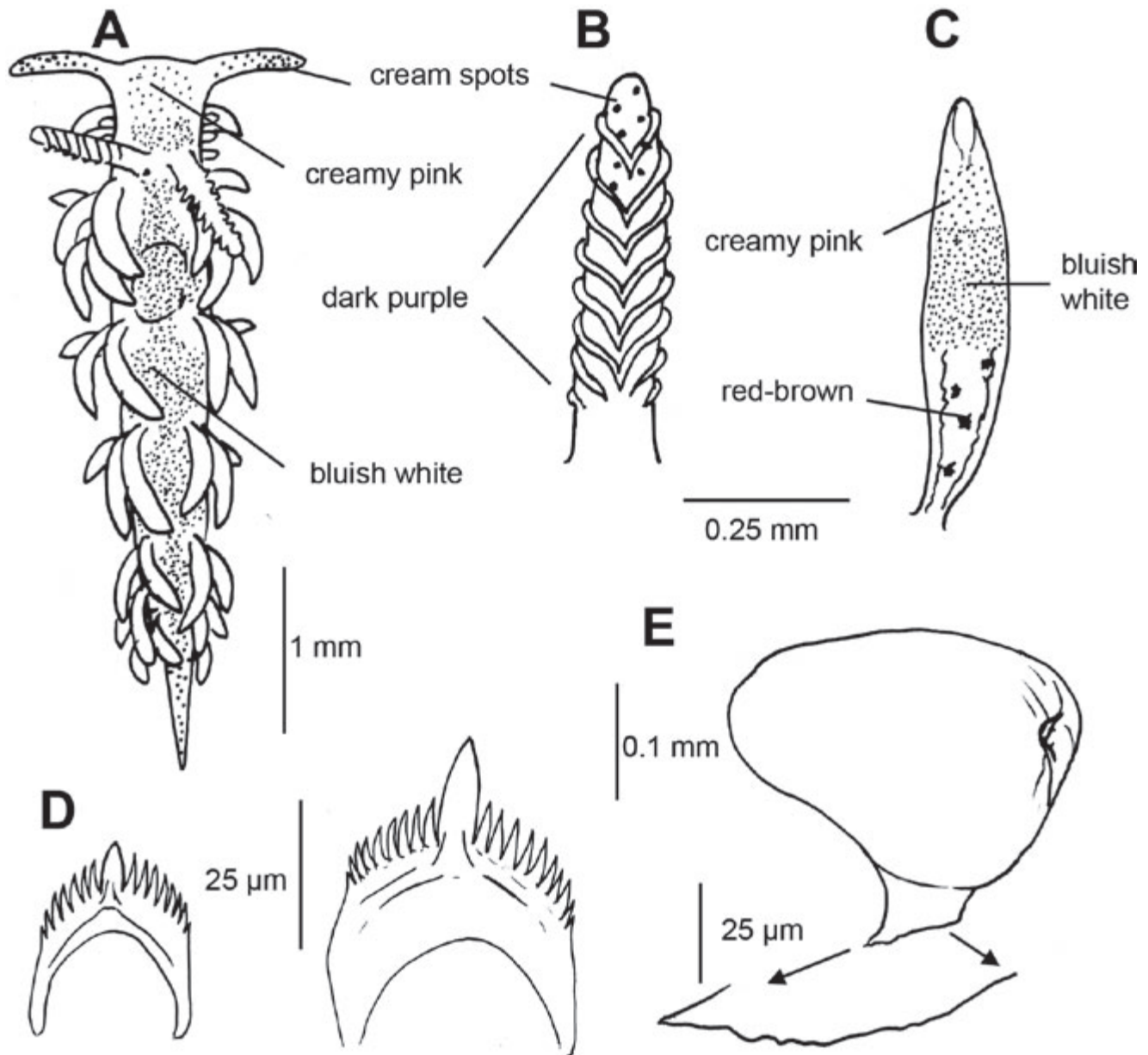
Geographical range Known only from the single specimen from Ghana.

Remarks The specimen was left overnight after initial notes and sketches had been made, but by morning it had died and partially decayed so it was not possible to complete the description. Nevertheless its colouration was so unusual and striking that it should be easy to recognise when found again. It appears to be an undescribed species of facelinid.

DISCUSSION

The histology of the prostate of *Godiva brunnea* n. sp is quite different from that of many other aeolids (e.g. species of Cuthonidae, personal observation), indeed the term 'prostate' refers to both swollen parts of the vas deferens (as in the Cuthonidae) and to discrete glands opening into the vas deferens (as in *Dondice*). Clearly when a phylogenetic analysis is carried out on aeolids care is needed to ensure that the different types of prostate are distinguished from one another.

This paper describes twelve species of aeolid from Ghana belonging to the family Facelinidae. Two of the species are new, *Cratena tema* and *Godiva brunnea*, while three more are probably undescribed species which are too poorly known to justify naming them: Facelina species A, B and C. Four of these are currently only known from



Figures 20A–E Facelinidae species C: **A** dorsal view; **B** posterior view of rhinophore; **C** ceras; **D** first and ninth radular teeth; **E** jaw with inset of cutting edge.

Ghana, but there are possible records of *C. tema* from Portugal, islands in the Gulf of Guinea and South Africa. Five of the twelve species were found in Tema harbour on boats or buoys so could be capable of travelling considerable distances on boat hulls: these are *Phidiana lynceus*, *Facelina coenda*, *Godiva quadricolor*, *Favorinus ghanensis* and *Cratena tema* n. sp. *Phidiana lynceus* and *Facelina coenda*, together with *Learchis poica* Marcus & Marcus, 1960 and *Learchis evelinae* Edmunds & Just, 1983, are amphiatlantic in their occurrence, and because most records of these species are from the West Atlantic it is probable

that they all originated in the West Atlantic and have only colonised the East Atlantic in recent years. Although *Learchis evelinae* was collected from 'natural' habitats, they were only a few kilometres from Tema harbour, so they could very easily have crossed the Atlantic by boat. *Learchis poica* was also found in 'natural' habitats near Tema harbour, but with the record of this species from St Helena (see above) this species could either be a recent colonist by boat or be an occasional oceanic traveller by veliger or on floating *Sargassum*. There is good evidence that *Godiva quadricolor* has travelled on boat hulls

round the Indian Ocean and the East Atlantic including the Mediterranean (Willan, 2004), so a similar route may well have been followed by these other widely distributed species. The remaining two species, *Pruvotfolia pselliotes* and *Favorinus ghanensis*, have also been recorded from the Mediterranean and the East Atlantic Islands, the latter species specialising in feeding on the bryozoan *Zoobotryon verticillatum* in the fouling community.

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