OPISTHOBRANCHIATE MOLLUSCA FROM GHANA: DENDRODORIDIDAE AND CORAMBIDAE

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Abstract *Three species of Dendrodoridídae and one of Corambidae are described from Ghana, West Africa.* Dendrodoris guineana *Valdés and Ortea, 1996 is only known from this region but may be part of a cline round the west African coast, currently divided into several species. Another specimen of* Dendrodoris *was not fully mature and could not be definitively assigned to one of these species. Further material of* Doriopsilla albolineata *Edmunds, 1968 is described but is here recognised as forming part of a cline from Europe to West Africa. It is therefore considered to be a subspecies,* albolineata *Edmunds, 1968, of* Doriopsilla areolata *Bergh, 1880. It is proposed that West Atlantic and Indo-Pacific material which have been considered to be conspecific with* D. areolata *should be recognised as distinct species,* Doriopsilla nigrolineata *Meyer, 1977 and* Doriopsilla davisi *(Allan, 1933) respectively.* Corambe testudinaria *Fischer, 1889, reported here for the first time from West Africa, occurs on both sides of the Atlantic and may travel widely either on Sargassum or on the hulls of boats. The genera and valid species of the Corambidae are reviewed.*

Key words *Atlantic nudibranchs,* Corambe, Dendrodoris, Doriopsilla

INTRODUCTION

The opisthobranchiate molluscan fauna of West Africa is very poorly known yet is of interest because of possible relationships with the better known faunas of the Mediterranean, South Africa and the tropical West Atlantic. Early records of some of the larger opisthobranchs from Ghana are given by Buchanan (1954), Buchanan & Anderson (1956), Eales (1957) and Bassindale (1961). Between 1963 and 1973 I collected opisthobranch molluscs from the Accra-Tema region of Ghana. A series of papers on this material has been published dealing with taxonomy (Edmunds, 1966, 1968a, b, 1981; Edmunds & Marcus, 1977; Cervera, Cattaneo-Vietti & Edmunds, 1996), speciation (Edmunds, 1982), ecology (Edmunds & Edmunds, 1973; Edmunds, 1977) and behaviour (Edmunds, 1975), but there are still many species in this material that have not been identified. This paper describes the species in this collection from two families of Doridoidea, the Dendrodoridídae and the Corambidae.

MATERIAL AND METHODS

Unless otherwise stated, all of the material described here was collected in Ghana from the shore at low tide by the author, or by SCUBA diving or dredging by Mr Walter Pople. Rocks and detritus obtained by diving or dredging were kept in aquaria for a few days to encourage the smaller animals to crawl out. Most of the animals were first described alive, then narcotised with magnesium chloride and fixed, usually in Bouin's fluid, before storage in 70% ethanol. Some of the larger animals were dissected and the male duct removed and mounted for microscopical examination. Most of the material is deposited in the Natural History Museum, London.

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SYSTEMATIC DESCRIPTIONS

Family DENDRODORIDIDAE O'Donoghue, 1924
Genus *Dendrodoris* Ehrenberg, 1831

Type species *Dendrodoris lugubris* Ehrenberg, 1831 by subsequent designation by Gray, 1847

Dendrodoris guineana Valdés and Ortea, 1996
Figs 1A, 2

Dendrodoris guineana Valdés and Ortea, 1996, in Valdés, Ortea, Ávila, & Ballesteros, 1996: 23.

Material examined 1 sp 6 mm long alive, dredged from 9.5 m depth in Kpone Bay, 7 January 1968; 1 sp 13 mm alive dredged from 10 m depth in Kpone Bay, 11 March 1971.

External features Body of 6 mm living animal broadly oval (Fig. 1A), that of 13 mm animal elongate-oval, pink with the back overlying

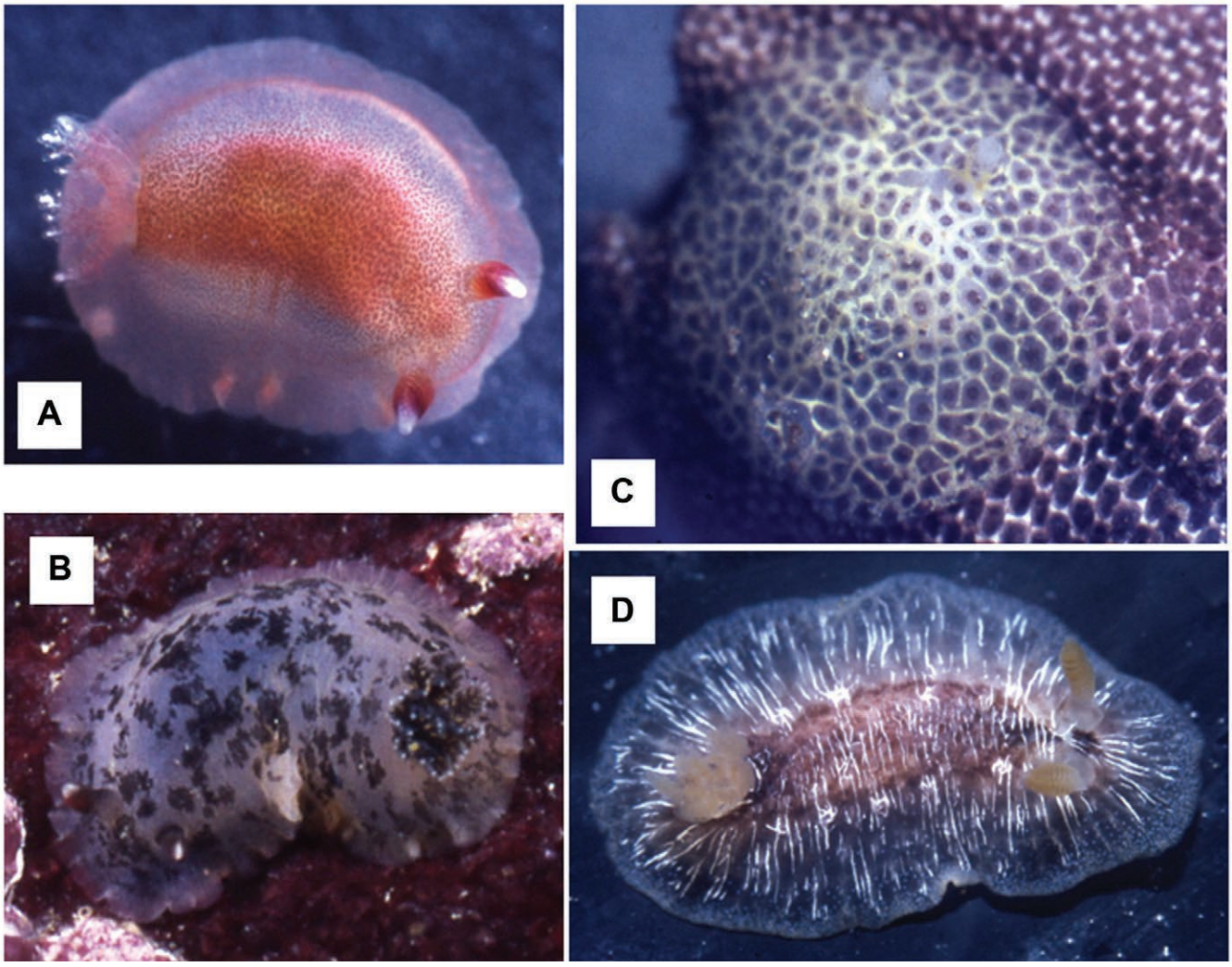

Fig. 1 **A** *Dendrodoris guineana*, 6 mm long, January 1968. **B** *Dendrodoris* sp., 28 mm long, November 1971. **C** *Corambe testudinaria*, 6 mm long, March 1968, on *Membranipora tuberculata* (Bosc). **D** *Doriopsilla areolata albolineata*, 14 mm long, January 1970.

the viscera darker red; at higher magnification mantle orange with minute brick-red chromatophores all over, densest centrally and smaller and sparser towards the edge. Eight bipinnate orange-red gills with white tips in larger animal, six irregularly bipinnate transparent gills with white tips and some orange pigment on the rhaches in smaller animal. Rhinophores of larger animal transparent with 13 rings, reddish orange merging to yellowish orange distally with conspicuous white tip, the colour residing in minute chromatophores as on mantle. Rhinophores of smaller animal with paler orange stalk, orange club merging to red distally, and white tip. Foot orange, with anterior edge and typical dendrodorid oral ridges bright yellow. Orange of underlying viscera shows through the pale foot in the smaller animal.

Internal morphology The 13 mm animal was dissected but found to be very immature. Digestive tract similar to those of Atlantic *Dendrodoris* spp. illustrated by Valdés *et al*. (1996) but with very small blood gland and slender intestine just in front of heart (Fig. 2A,B). Reproductive system with undifferentiated prostate and female glands, and looped vas deferens (Fig. 2C). The genital atrium was mounted for microscopical examination but no hooks were found in the cirrus: the animal may have been too immature.

Geographical range Known only from the Gulf of Guinea (Equatorial Guinea to Ghana).

Remarks Atlantic species of *Dendrodoris* have been described and reviewed by Valdés *et al*. (1996). The species are difficult to distinguish

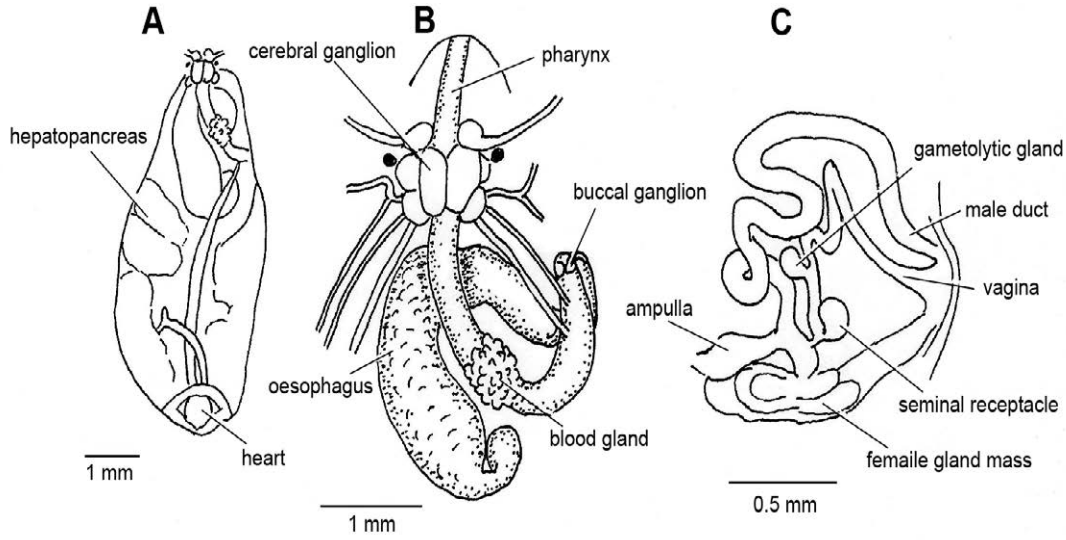

Fig. 2 *Dendrodoris guineana*. **A** Dorsal view of animal with mantle removed. **B** Dorsal view of pharyngeal region. **C** Reproductive system.

alive because of wide intraspecific variation in colour, and when preserved there is no radula which in other dorids is often diagnostic. Instead Valdés *et al.* rely on relative dimensions of parts of the reproductive system of adult animals, the shape of hooks along the length of the cirrus, and characteristics of the egg mass. They report three species from West Africa, *Dendrodoris senegalensis* Bouchet, 1975, from Senegal and the Cape Verde Islands, *D. guineana* Valdés & Ortea, 1996, from Equatorial Guinea and Takoradi, Ghana, and *D. angolensis* Valdés & Ortea, 1996, from Angola. Previously described specimens were all sexually mature and larger than my material; the largest specimen (from Ghana) was grey while the two smaller ones (from Equatorial Guinea) were red suggesting that, as with *D. senegalensis*, animals change from red to grey as they grow larger. My dissected animal has a looped vas deferens, as in both *D. senegalensis* and *D. guineana*, and a small blood gland, as in *D. guineana* but contrary to *D. senegalensis* and to all other species from the West Atlantic. With some hesitation I therefore consider that my Ghanaian material belongs to *Dendrodoris guineana*.

Since Valdés *et al*. (1996) show *D. senegalensis*, *D. guineana* and *D. angolensis* as having disjunct distributions, and since there are rather few well marked differences between them, the question arises as to whether they should be considered a single clinal species (to which could perhaps be added *D. grandiflora* (Rapp, 1827) and/or *D. herytra* Valdés & Ortea, 1996, from the Mediterranean, North Africa and some of the Atlantic Islands). However, Valdés (pers. comm.) dissected several *D. senegalensis* which he found were consistently different from *D. angolensis*. *D. guineana* was based on only three specimens which are very similar to *D. senegalensis*, but they differ in having a small blood gland. These three West African species probably evolved from an ancestral clinal species which adapted to local conditions along the coast such that today there may be little or no gene flow between neighbouring populations. Only further material from this region can resolve this question, but for the present, I maintain these three species as distinct.

Dendrodoris sp.
Figs 1B, 3)

Material examined 1 sp 28 mm long alive, from near Tema at low tide, 18 November 1971; 1 sp 15 mm long preserved (probably 20-25 mm alive), dredged off Tema by Ralph Isaacs, 20 December 1972.

External features Body of 28 mm live animal broadly elongate (Fig. 1B). Ground colour of mantle greyish yellow to buff, with patches of dark grey all over except at edge, and of variable size and shape; with additional small spots of red and greyish red all over; mantle wrinkled at edge as in *Dendrodoris nigra* and *D. rubra*, and

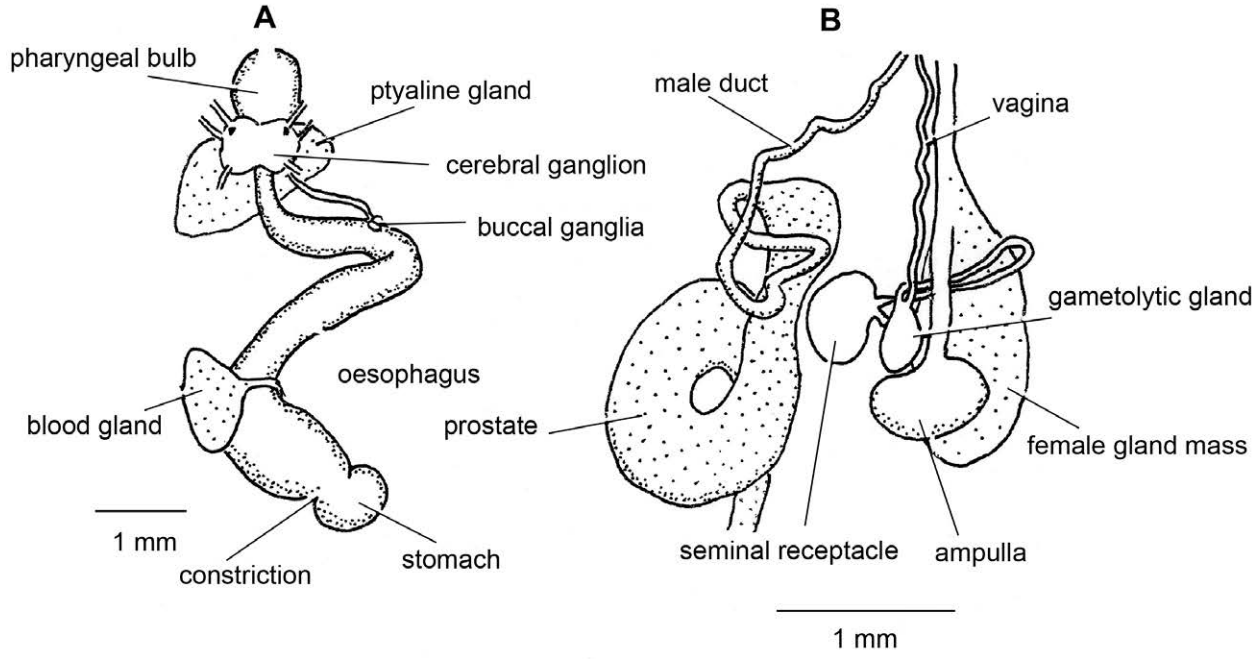

Fig. 3 *Dendrodoris* sp. **A** Dorsal view of anterior digestive tract. **B** Reproductive system.

tinged with red in front of rhinophores. Eight bi- to tripinnate transparent gills with black rhaches and white tips; white glands present proximally on outer sides of rhaches and main branches. Rhinophores with short stalk and about 20 annulae, buffish grey with dense grey-brown stippling so they appear grey-brown, tip white especially posteriorly, front of club below tip tinged with red. Mantle ventrally greyish yellow with many grey spots and some red pigment from dorsal side showing through. Foot yellow with grey patches concentrated at front and rear. The second large animal, collected by Ralph Isaacs, was only seen freshly preserved: mantle over the viscera pale grey with irregular darker mottling, greyish white laterally and edge bright pink. Foot greyish white with pink edge.

Internal morphology The 28 mm animal was dissected. Bulbous pharynx leading to looped oesophagus, swollen posteriorly, with constriction (possibly a sphincter) before spherical stomach (Fig. 3A). Large ptyaline gland ventrally and small triangular blood gland dorsally. Reproductive system well developed apart from small female gland mass, so animal may not have been fully sexually mature (Fig. 3B). Prostate forms a single coil; male duct loops before running to genital opening. Male duct mounted for microscopical examination but no trace of hooks was seen either in an aqueous or an oil-based medium (Aquamount and Histamount). Gametolytic gland smaller than seminal receptacle, lying underneath a larger oval structure labelled ampulla in Fig. 3B. Ampullae are usually thick and looped or coiled ducts rather than oval sacks in *Dendrodoris*, so this structure has the appearance of an accessory gland but these do not occur in other species of the genus. I was unable to confirm its relationship with either the oviduct or the prostate, so my identification of this structure as the ampulla is tentative.

Remarks This animal is similar in colour and size to illustrations of sexually mature *D. senegalensis* and *D. guineana* in Valdés *et al*. (1996), but it was not fully mature. Several other species of Atlantic *Dendrodoris* have similar colour markings and grow to much larger size. It differs from other species of the genus in the small size of the gametolytic gland, the oval ampulla (if this has been correctly identified), and the small triangular blood gland. However, there is considerable variation in details of the reproductive system within some species, e.g. *D. grandiflora* (Valdés *et al*., 1996), so it is difficult to evaluate the importance of these differences in a single specimen. I therefore

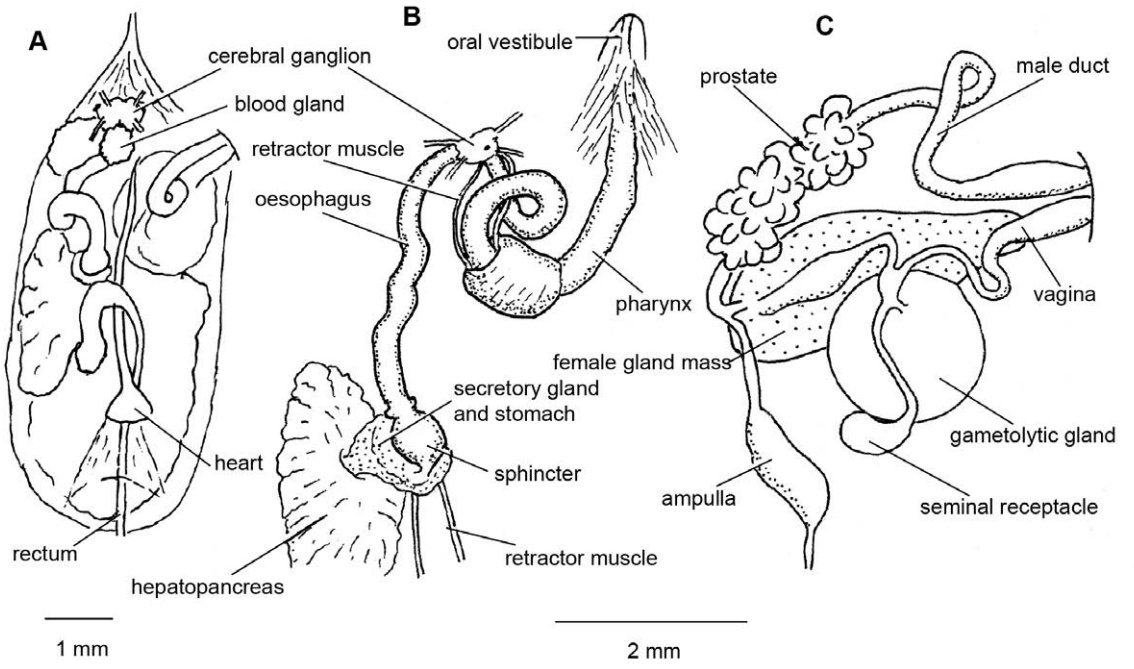

Fig. 4 *Doriopsilla areolata albolineata*. **A** Dorsal view of animal with mantle removed. **B** Pharyngeal region dissected out. **C** Reproductive system.

identify this specimen simply as *Dendrodoris* sp., and positive identification must await richer material from the Gulf of Guinea. The second specimen collected by Mr Isaacs was not dissected and could belong to the same or to a different species.

Genus *Doriopsilla* Bergh, 1880

Type species *Doriopsilla areolata* Bergh, 1880

Doriopsilla areolata albolineata Edmunds, 1968
Figs 1D, 4

Doriopsilla albolineata Edmunds, 1968: 93, Fig. 9
Doriopsilla areolata albolineata Edmunds, 1968 (Valdés & Ortea, 1997)

Material examined A total of 36 animals were found in the Accra-Tema area, almost all under rocks, as follows: Tema: 1 sp 9 January 1965, 3 at low tide 8 January 1970, 4 at low tide 15 February 1973; West Tema rocks: 6 at low tide (3 not collected) 31 December 1970; Tema breakwater: 1 at low tide 25 November 1970; Teshie: 1 at low tide 28 December 1970, 2 at low tide 30 December 1970; Kpone Bay at 10-12 m depth by dredging: 1 sp 12 January 1965, 3 on 22 January 1965, 1 on 14 January 1968, 2 on 4 February 1968, 1 on 8 October 1969, 1 on 30 November 1969, 3 on 8 March 1970, 1 on 11 March 1970; Tema Bay: 1 sp dredged from 35 m 27 March 1968, 2 dredged from 20-23 m 13 February 1970; off shore at Tema: 2 sp dredged by Ralph Isaacs 20 December 1972.

External features Living animals elongate-oval, from 2.5 to 19 mm long with minute low papillae dorsally, each containing several spicules. Mantle pale pearl-grey, sometimes tinged with yellow or pale orange; with irregular blotches or spots of brick-red, maroon or occasionally dark brown in central area, sometimes extending to mantle edge, rarely absent; with a variable number of mostly transverse irregular white lines (Fig. 1D; see also Fig. 9A in Edmunds, 1968), but lines almost randomly orientated in two specimens; with small creamy white glands all over mantle but most abundant near edge. Mantle ventrally with spicules near edge arranged in radiating lines (see Fig. 9B in Edmunds, 1968). Up to five irregularly bipinnate yellow gills, with one sometimes arising from the stalk of its neighbour, fully retractile into smooth gill socket. Rhinophores with up to 16 lamellae sloping back from anterior ridge to posterior groove, stalk translucent grey, lamellae yellow or orange-yellow, tip white or cream. Rhinophore

sheath a low rim. Oral ridges present (as in other dendrodorids), foot bilabiate and notched.

Internal morphology Mouth opens into thin-walled vestibule which is separated from thicker-walled pharynx by mass of muscle fibres which probably protract and retract pharynx (Fig. 4 A,B). Innermost distal part of pharynx with even thicker walls, and from it two (presumably) retractor muscles run through nerve ring, but their precise destination was not traced. Buccal ganglia just below and adherent to the nerve ring (Fig. 9C in Edmunds, 1968b). Oesophagus runs through nerve ring to a spherical sphincter which opens into circular stomach above digestive gland. A secretory gland partly overlies stomach (and is not clearly distinguished from it in my dissection and in Fig. 4B). Oesophagus with pair of minute projections just proximal to sphincter. Intestine emerges posteriorly from digestive gland, loops forwards and then runs back to rectum. Circular blood gland with serrated outline lies just behind the similar sized cerebro-pleural ganglia.

Reproductive system (Fig. 4C) with hermaphrodite duct from ampulla running for about 0.5 mm before branching. Male duct runs through lobular prostate then loops before entering male atrium. This region was mounted for microscopical examination but no spines or hooks were seen. Oviduct swells after leaving hermaphrodite duct (possibly this is a fertilization chamber), then receives short duct from large circular gametolytic gland and long duct from much smaller seminal receptacle before looping to vagina.

The larger specimens were sexually mature and laying eggs at 12-14 mm length. The egg ribbon underneath rocks was white and comprised a simple coil of 3 turns about 1 cm in diameter.

Geographical range Ghana, São Tomé, Angola (Edmunds, 1968; Valdés & Ortea, 1997).

Remarks The above description and illustration of the gut differ in four ways from those of Edmunds (1968): the muscles behind the vestibule form a sheath rather than discrete tracts; the posterior thick-walled part of the pharynx is relatively much shorter; the relationship of the oesophageal sphincter to the stomach is more clearly defined; and minute oesophageal swellings were seen in front of the sphincter. The relative length of the thick-walled part of the pharynx probably depends on the degree of contraction of this organ at time of death: Marcus & Marcus (1962) show no swollen region at all in their otherwise similar illustration of a *Doriopsilla* identified as *areolata* from the Caribbean, but instead they show the pharynx projecting into the vestibule. The Marcuses studied the parts of the gut histologically and it is by following their work that I have identified the distal swelling of the oesophagus as a sphincter. However, because it is a swelling rather than a constriction, I doubt if it really is a sphincter regulating movement of gut contents from oesophagus to stomach. Certainly it is muscular, and I suggest it is more likely to be a gizzard which crushes material before it passes to the stomach for digestion. The Marcuses follow Bergh in regarding the buccal ganglia as the boundary between pharynx and oesophagus. In both of the animals which I dissected the gut in front of and behind the buccal ganglia appears to be similar and it is possible that it can be slid forwards and backwards through the nerve ring, unlike in *Dendrodoris* where the buccal ganglia are attached to a specific part of the gut. I have therefore labelled this narrow region of the gut as the oesophagus. Observation of live animals feeding could resolve the precise way in which the pharynx operates.

Valdés & Ortea (1997) have reviewed the Atlantic species of *Doriopsilla* and recognise three species, *D. areolata* Bergh, 1880, *D. pelseneeri* d'Oliveira, 1895 and *D. pharpa* Marcus, 1961. Within *D. areolata* they recognise three subspecies with different colour patterns and different geographical ranges: *D. areolata areolata* Bergh 1880 from the Mediterranean to the Cape Verde Islands is yellow to pale brown with white rings or lines forming a frayed network and the centre of the dorsum pale brown; *D. areolata albolineata* Edmunds 1968 from Ghana to Angola is pearl grey to yellow with mostly transverse white lines dorsally and brown radial lines on the mantle margin; and *D. areolata nigrolineata* Meyer 1977 from the Caribbean region is light to dark orange with white rings round the tubercles and with black lines dorsally forming a frayed network. They consider that, without supporting anatomical differences, these colour patterns are not sufficient to justify recognition of three distinct species, so they treat the three forms as subspecies. I have followed their decision in recognising the subspecies *D. areolata areolata* and *D.*

areolata albolineata, but my material of the latter did not have the brown radial lines on the mantle margin. The colour of the body (grey to yellow or orange) probably depends on the colour of the sponges on which the animals have been feeding so may not be of systematic importance.

The principal difference between *D. areolata areolata* and *D. areolata albolineata* is therefore the arrangement of the white epidermal markings on the mantle which are only visible in the living animal. In all but two of the *D. areolata albolineata* from Ghana most of these white lines run transversely whereas in European *D. areolata areolata* they form an intricate network (Ballesteros & Ortea, 1980 Fig. 4; Ortea, 1975 colour photo; Valdés & Ortea, 1997). Of two paintings of animals from Morocco published by Pruvot-Fol (1953), Fig. 32 (as *Doriopsilla fedalae*) is similar to other European animals though with fewer white lines while Fig. 33 is more similar to *D. areolata albolineata*. The disposition of white lines in material from Senegal, Mauritania and offshore Côte d'Ivoire is not known because the animals were not described live (White, 1955; Marcus & Marcus, 1966), and this is also true for many West Atlantic animals. My failure to find cuticular hooks in the penis which were seen by the Marcuses in their West African material is probably not of systematic relevance: their specimen was considerably larger (22 mm preserved) than any of my animals, so it is possible that these hooks only develop in larger animals.

It seems, therefore, that there is a cline in *D. areolata sensu lato* running round the coast of West Africa to Europe, and there can be little exchange of genes between European populations and those from Ghana or Angola. There is probably even less gene exchange between West and East Atlantic populations since it appears unlikely that the planktonic larvae can survive transatlantic travel or that settled juveniles on boat bottoms will have suitable (sponge) food to sustain them on such a journey. It is therefore probable that Caribbean animals are genetically isolated from those in western Europe and Africa and so should be recognised as a distinct species. However, there is probably no discontinuity between the ranges of *D. areolata sensu stricto* from Europe and north-west Africa and populations attributed to *D. areolata albolineata* in West Africa. For the present it is important that separate names are used (as proposed by Valdés & Ortea, 1997) so that future workers will not simply record animals as *Doriopsilla areolata* and then not bother to give any description of the key features that currently distinguish the different subspecies. Then, as material and field notes of specimens from the entire West African coast accumulate, it will be possible to make an informed decision on whether the currently recognised subspecies should be retained, or raised to specific rank, or abandoned altogether.

A species of *Doriopsilla* from the Indo-Pacific resembling *D. areolata* in its pattern of branching white lines on the mantle and lobulate prostate has been identified by Baba (1949), Thompson (1975) and Gosliner (1987) as *Doriopsilla miniata* (Alder & Hancock, 1864). However, as pointed out by Valdés & Ortea (1997), Alder & Hancock make no mention of white lines on the dorsum of *D. miniata*, so Indo-Pacific *Doriopsilla* with white lines should probably be identified as *Doriopsilla davisi* (Allan, 1933) which was originally described from Australia. Burn (1969) has suggested that *D. davisi* (which he calls *D. miniata*) and *D. areolata* are Indo-Pacific and Atlantic forms of a circumtropical species. However, unless it can travel round the world on boat hulls there can be little or no genetic interchange between populations from these two areas, so I consider it more probable that Atlantic and Indo-Pacific populations belong to different species. A scanning of colour photos on Internet sites for *Doriopsilla areolata* and *D. miniata* confirms that there is considerable variation in colour and reinforces my view that Indo-Pacific animals should be considered distinct from *D. areolata*. I therefore suggest recognition of the following species of the *Doriopsilla areolata* complex with the request that future studies on this group should aim to give full descriptions of the colour pattern as well as the internal anatomy so that the relationships between the various forms can be better understood:

Doriopsilla areolata areolata Bergh, 1880 (Europe to Cape Verde Islands)

D. areolata albolineata Edmunds, 1968 (Ghana to Angola)

Doriopsilla nigrolineata Meyer 1977 (Caribbean to Brazil)

Doriopsilla davisi (Allan, 1933) (Australia and Indo-Pacific)

Table 1 Genera and species of Corambidae according to Martynov (1994), Swennen & Dekker (1995) and Valdés & Bouchet (1998), with type species in these columns in bold. Final column shows probable synonyms with eight recognised species (in bold) assigned to three genera.

Original name	Martynov	Swennen & Dekker	Valdés & Bouchet	Present paper
***Corambe sargassicola* Bergh, 1871**	*Corambe sargassicola* Bergh, 1871	*Corambe sargassicola* Bergh, 1871	*Corambe sargassicola* Bergh, 1871	= *Corambe obscura* (Verrill, 1870)
***Doridella obscura* Verrill, 1870**	*Corambe obscura* (Verrill, 1870)	*Corambe obscura* (Verrill, 1870)	*Corambe obscura* (Verrill, 1870)	***Corambe obscura* (Verrill, 1870)**
Corambe batava Kerbert, 1886	*Corambe batava* Kerbert, 1886	*Corambe batava* Kerbert, 1886		= *Corambe obscura* (Verrill, 1870)
***Corambella depressa* Balch, 1899**	*Corambe depressa* (Balch, 1899)	*Corambe depressa* (Balch, 1899)	*Corambe depressa* (Balch, 1899)	= *Corambe obscura* (Verrill, 1870)
Corambella baratariae Harry, 1953	*Corambe baratariae* (Harry, 1953)	*Corambe baratariae* (Harry, 1953)		= *Corambe obscura* (Verrill, 1870)
Corambella carambola Marcus, 1955	*Corambe carambola* (Marcus, 1955)	*Corambe carambola* (Marcus, 1955)		= *Corambe obscura* (Verrill, 1870)
Doridella burchi Marcus & Marcus, 1967	*Corambe burchi* (Marcus & Marcus, 1967)	*Corambe burchi* (Marcus & Marcus, 1967)		= *Corambe obscura* (Verrill, 1870)
Corambe testudinaria Fischer, 1889	***Quasicorambe testudinaria* (Fischer, 1889)**	***Neocorambe testudinaria* (Fischer, 1889)**	*Corambe testudinaria* Fischer, 1889	***Corambe testudinaria* Fischer, 1889**
Corambe evelinae Marcus, 1958	*Quasicorambe evelinae* (Marcus, 1958)	*Neocorambe evelinae* (Marcus, 1958)		= *Corambe testudinaria* Fischer, 1889
Corambe pacifica MacFarland & O'Donoghue, 1929	*Quasicorambe pacifica* (MacFarland & O'Donoghue, 1929)	*Neocorambe pacifica* (MacFarland & O'Donoghue, 1929)	*Corambe pacifica* MacFarland & O'Donoghue, 1929	***Corambe pacifica* MacFarland & O'Donoghue, 1929**
Corambe lucea Marcus, 1959	*Quasicorambe lucea* (Marcus, 1959)	*Neocorambe lucea* (Marcus, 1959)		= *Corambe pacifica* MacFarland & O'Donoghue, 1929
Corambella steinbergae Lance, 1962	*Corambe steinbergae* (Lance, 1962)	***Paracorambe steinbergae* (Lance, 1962)**	*Corambe steinbergae* (Lance, 1962)	***Corambe steinbergae* (Lance, 1962)**
Corambella bolini MacFarland, 1966		*Paracorambe bolini* (MacFarland, 1966)		= *Corambe steinbergae* (Lance, 1962)
***Loy meyeni* Martynov, 1994**	***Loy meyeni* Martynov, 1994**		*Loy meyeni* Martynov, 1994	***Loy meyeni* Martynov, 1994**
***Proloy millenae* Martynov, 1994**	***Proloy millenae* Martynov, 1994**		*Loy millenae* (Martynov, 1994)	***Loy millenae* (Martynov, 1994)**
Corambe thompsoni Millen & Nybakken, 1991	***Psammodoris thompsoni* (Millen & Nybakken, 1991)**		*Loy thompsoni* (Millen & Nybakken, 1991)	***Loy thompsoni* (Millen & Nybakken, 1991)**
***Echinocorambe brattegardi* Valdés & Bouchet, 1998**			***Echinocorambe brattegardi* Valdés & Bouchet, 1998**	***Echinocorambe brattegardi* Valdés & Bouchet, 1998**

Family CORAMBIDAE Bergh, 1871
Genus *Corambe* Bergh, 1869
Type species *Corambe sargassicola* Bergh, 1871

Corambe testudinaria Fischer, 1889
Fig. 1C

Corambe testudinaria Fischer, 1889: 379
Corambe evelinae Marcus, 1958: 53
Quasicorambe testudinaria—Martynov, 1994a: 6
Neocorambe testudinaria—Swennen & Dekker, 1995: 104-105

Material examined 1 sp dredged off Tema, 13 June 1964; 1 dredged from 9.5 m depth in Kpone Bay, 31 December 1967; 1 on a buoy off Tema, 10 March 1968; 2 dredged from 30 m in Tema Bay, 12 June 1970; 1 dredged from 25 m in Tema Bay, 18 June 1970.

External features Although six specimens were found, several were very small and probably immature. Two of these were lost, one almost certainly eaten by a hermit crab, so the descriptions which follow are mainly based on two of the larger specimens.

Body of 6 mm live specimen oval, with posterior notch in mantle (Fig. 1C). Ground colour semi-transparent grey with cream viscera medially between rhinophores and gills. Cream lines form a meshwork of polygons dorsally which peter out towards mantle edge. Most polygons contain a circular maroon spot, smaller towards edge. Cream and maroon colours lost after fixation and storage in ethanol. Mantle surface of preserved specimen more or less smooth with no obvious tubercles or papillae.

Body of 3 mm live 1967 specimen circular, semi-transparent grey with brownish viscera medially behind rhinophores, tinge of crimson in front of and just behind rhinophores, and tinge of orange in front of posterior notch. White lines form a meshwork of polygons each with one circular blackish purple spot (occasionally two). Some of these spots are dark, others pale, and some peripheral polygons lack spots. Mantle more or less evenly covered with small conical tubercles, more conspicuous preserved than in life.

Oral tentacles in all specimens short, digitiform in life, but blunt when preserved. Foot notched anteriorly. Rhinophores short, with narrow posterior ridge and two vertical wings on each side which curve backwards (identical with the drawings by Fischer, 1891 plate IX Fig. 4 and by Garcia, Urgorri & González, 1990 Fig. 2), colourless but with sheath edged white. Largest, posterior gills visible through posterior notch or from ventral postero-lateral view, but smaller anterior gills difficult to see in both live and preserved animals; most easily seen in living but narcotised animal. 12 pairs of gills in 6 mm animal, extending from anus to half way along flank, 6 pairs in a 4 mm specimen, 4 pairs in 3 mm specimen. Posterior pair of gills with 3-4 pinnae, next pair with 2 pinnae, other gills are U-shaped ridges, progressively smaller towards the front. Cilia on the gills draw water into the mantle cavity postero-laterally and drive it out dorsally close to the anus through the mantle notch.

Ecology The 6 mm specimen was found on the bryozoan *Membranipora tuberculata* (Bosc) on a floating buoy (all bryozoans determined by P. Cook). Two more (2.5 and 4 mm long) on 12.6.70 were found on a *Turritella* shell occupied by a hermit crab (*Paguristes* sp.), much of the shell being covered by encrusting *Membranipora commensale* Kirkpatrick & Metzelaar on which they were feeding. After 3 days in captivity there were white eggs on three *Turritella* shells covered with *Membranipora*, but there were no eggs on shells encrusted with either *Lithothamnion* or *Hippoporidra littoralis* Cook. The largest egg mass was 3 mm in diameter covering 45 cells of *Membranipora*. Each egg was approximately 0.1 mm diameter with a total of 1050 eggs in the cluster. A young hermit crab was picking eggs off one of the egg masses one at a time and eating them. Another hermit crab picked up the larger *Corambe* from the bryozoan with its chela, and then dropped it. Three hours later the smaller *Corambe* had disappeared, presumably eaten. After 6 days the first batch of eggs hatched into veligers with a Type 1 shell (Thompson, 1961).

Another 3 mm long specimen was observed on 18 June 1970 laying eggs over a period of 3 days on *Membranipora commensale* growing

on a *Turritella* shell occupied by a *Paguristes* sp. hermit crab. This specimen only laid eggs on *Membranipora*, never on *Steganoporella buskii* Harmer which was also present. During this time it moulted the entire dorsal mantle cuticle as a thin transparent sheet with two holes for the rhinophores.

Geographical range Atlantic coast of Europe from Bay of Biscay (Arcachon) to Gulf of Cadiz (Huelva), Ghana, Brazil (Fischer, 1889; Garcia *et al*., 1990; Marcus, 1958).

Remarks The original description of this species (Fischer, 1889, 1891) gives much precise morphological detail and includes a description of the colouration of the live animal, but does not mention the fine white reticulation on the notum which is both described and illustrated by Garcia *et al*. (1990). *Corambe evelinae* Marcus from Brazil is very similar but differs in having up to seven gills on each side compared with only four in *C. testudinaria* (Marcus, 1958). However, Garcia *et al*. (1990) describe between seven and ten gills on each side in their material which came from quite close to the type locality, so I consider that *Corambe evelinae* is a junior synonym of *Corambe testudinaria*. The Ghanaian specimens described here agree closely with European animals but the largest has more gills (12 on each side instead of up to ten). Gill number clearly increases with body size but the more anterior ones are minute ridges, difficult to see unless the lighting is exactly right to show them. Gosliner (1987) illustrates a similar species from South Africa with darker yellow reticulation on the mantle and a "distinct arrangement of gill leaflets", but until this arrangement is described it is impossible to decide if this material is conspecific with *C. testudinaria*.

Small bryozoan feeding dorids including species of the Corambidae are able to travel considerable distances on seaweed and on boat hulls (Swennen & Dekker, 1995), but it is not easy to discover if they have been established at any one site for a long time or if they are recent colonists.

The Corambidae are small flattened dorids which are rarely found in abundance. Many of the species in the family are similar in external appearance and are described from only a small number of specimens. It is important to make detailed notes on the living animals because shape and number of gills and the shape of the rhinophores are often difficult to observe in preserved material when these structures have shrunk. Until 1994 three genera had been described, *Corambe*, *Doridella* and *Corambella*, but the precise number of species in the family was unclear. Two papers reviewing the family were then published by Martynov (1994a) and Swennen & Dekker (1995), both of which concluded that *Corambe* Bergh 1869, *Doridella* Verrill 1870 and *Corambella* Balch 1899 are synonyms. *Corambe* was defined in 1869, two years before the description and naming of its type species, but it still has priority over *Doridella*.

The Corambidae are doridaceans with a flattened, oval body, smooth or finely granulate notum; head small with short oral tentacles; rhinophores retractile into a sheath; anus and renal pore typically medial between mantle and foot; gills between mantle and foot posteriorly with branchial glands at their bases; genital apertures on right side anteriorly; no jaws; pharyngeal bulb lined with cuticle; crop large; radula lacking a central plate, lateral plates with strongly curved hook and small denticles, 3-7 marginal plates with simple cusp decreasing in size laterally. The Corambidae appear to be a very isolated family within the Doridoidea with unusual characteristics of the mantle, gills, rhinophores and radula, and it has been suggested that they may have evolved from the Onchidoridiidae by neoteny (Martynov, 1994b).

Martynov (1994a) described two new species of Corambidae which did not fit into the existing genera. He established two subfamilies, the Corambinae with two genera and the Loyinae with three genera (two of which were based on his new species), as outlined in Table 1. (He also described two subgenera for both *Corambe* and *Quasicorambe* which I have not repeated here.)

At the same time that Martynov was preparing his revision, Swennen and Dekker were examining *Corambe batava* Kerbert, 1886, from the Netherlands and comparing it with corambids collected elsewhere. They also re-examined Bergh's type material of *Corambe sargassicola*. They found that although *C. batava* is very similar to the well-known *Doridella obscura* Verrill, 1870 (and clearly belongs to the same genus), they were reluctant to conclude that the two are conspecific. By utilising three morphological

characters they were able to define three genera to the family. They were not aware of Martynov's new species, nor of *Corambe thompsoni* (Millen & Nybakken, 1991), all of which differ considerably from previously described corambids. If one accepts all of the genera proposed by Martynov and by Swennen & Dekker then there are five genera in the family for seven or possibly nine species, and one has to question the wisdom of proposing so many monospecific genera in a single small family.

Meanwhile in 1975 another strange corambid was found in the Norwegian abyss which was eventually described and placed in yet another new genus, *Echinocorambe*, by Valdés & Bouchet (1998). Fortunately they were able to reevaluate the systematics of the family by means of a phylogenetic analysis of the types of all of the proposed genera using ten characters. This led to their recognition of just three genera: *Corambe* Bergh, 1869, *Loy* Martynov, 1994 and *Echinocorambe* Valdés & Bouchet, 1998 (see Table 1). The 17 nominal species in the genera include many that are synonyms and the final column of Table 1 summarises the synonymies proposed by various authors (notably Swennen & Dekker, 1995).

DISCUSSION

This paper reports one species of the Corambidae and two (together with a possible third) species of the Dendrodorididae from Ghana. These records, together with those in Valdés *et al*. (1996), are also the only records I can trace of these two families in the entire Gulf of Guinea. It is probably because nudibranch molluscs are of little importance to fishery interests that they have been so neglected in this part of the world. Until much more material is available from this region it is likely that some of the taxonomic uncertainties outlined in this paper will remain unresolved.

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